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Inflation Dynamics in Post-Soviet Economies: Evidence from Linear and Nonlinear Time-Series Models

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Abstract: *This study examines the dynamics of inflation in 13 post-Soviet economies over the period 1992–2024 using annual consumer price index data. Linear and nonlinear econometric approaches—including ARMA, GARCH-type, and threshold autoregressive (TAR) models—are employed to capture both persistence and regime-dependent behavior in inflation processes. The results reveal significant cross-country heterogeneity. Inflation in Estonia and Lithuania exhibits rapid mean reversion under low-inflation regimes, reflecting strong institutional credibility, whereas Belarus and Tajikistan display prolonged persistence driven by fiscal imbalances. Evidence of asymmetric volatility in Armenia and Kazakhstan highlights the vulnerability of commodity-dependent economies to exchange-rate and external shocks. Overall, the findings emphasize that institutional quality and policy coherence are essential for achieving durable price stability. Strengthening central bank independence, enhancing fiscal discipline, and adopting credible inflation-targeting regimes are vital for sustaining macroeconomic stability in the post-Soviet region. The study also demonstrates the analytical value of nonlinear models in capturing the complex and asymmetric nature of inflation adjustment in transition economies.*

Keywords: Inflation persistence, Post-Soviet economies, nonlinear stationarity, ARMA-GARCH Models, TAR estimation

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1. Introduction

Inflation remains a central issue in macroeconomic analysis, reflecting the interaction between structural characteristics, expectations, and policy credibility. Economic theory links inflation persistence to nominal rigidities and imperfect information, as articulated in the New Keynesian Phillips Curve (Clarida et al., 1999). Complementary frameworks—such as policy-credibility models (Barro & Gordon, 1983) and state-dependent pricing theories (Ball & Mankiw, 1994)—emphasize that asymmetric adjustment arises when firms and households respond differently to shocks of varying magnitude. These perspectives jointly explain why inflation in transition economies often displays persistence, asymmetry, and regime dependence, amplified by structural rigidities and credibility gaps. Building on this theoretical foundation, Kutan and Yigit (2004) highlight that transition economies exhibit heterogeneous convergence patterns once regime switches and threshold effects are considered, underscoring the need for nonlinear approaches when examining inflation dynamics.

The post-Soviet region provides a distinctive and policy-relevant setting for analyzing these mechanisms. Following the dissolution of the Soviet Union in 1991, the newly independent republics experienced profound macroeconomic disruptions during their transition from centrally planned to market-

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based systems. The early transition period was marked by hyperinflation, output collapse, and institutional instability. The abrupt liberalization of administered prices, the breakdown of inter-republic trade links, and the monetization of fiscal deficits generated intense inflationary pressures (Fischer et al., 1996). The disintegration of the ruble zone further amplified monetary instability, producing triple- and quadruple-digit inflation across the region. According to IMF (2024) and World Bank (2024) data, annual inflation peaked at approximately 2,300% in Russia (1992), 1,800% in Armenia (1993), and 1,200% in Ukraine (1993), with several Central Asian economies also experiencing rates exceeding 500%. These episodes reflected a combination of abrupt policy shocks, the absence of credible nominal anchors, and weaknesses in monetary and fiscal institutions, all of which constrained the effectiveness of early stabilization efforts.

By the mid-1990s, most post-Soviet economies embarked on stabilization programs that emphasized fiscal consolidation, exchange-rate anchoring, and initial steps toward central bank independence. As a result, inflation declined sharply across the region: by 1999, annual inflation had fallen to 28% in Russia, 18% in Kazakhstan, and 14% in Armenia (IMF, 2021; World Bank, 2024). This period marked a turning point in macroeconomic governance, as the introduction of national currencies, nascent financial-sector reforms, and improved fiscal discipline strengthened policy credibility and monetary transmission. However, cross-country heterogeneity became more pronounced. While the Baltic states implemented currency boards and achieved rapid disinflation, several Central Asian and Caucasus economies continued to face persistent fiscal pressures, institutional weaknesses, and vulnerability to external shocks.

From the 2000s onward, many post-Soviet economies achieved relative price stability supported by more robust monetary frameworks, including the adoption of inflation-targeting regimes in countries such as Armenia, Georgia, and the Baltic republics. Nevertheless, inflation in the region has remained highly sensitive to external disturbances. The 2008–2009 global financial crisis, the 2014 oil price collapse, and the Russia–Ukraine conflict of 2022 periodically reintroduced inflationary pressures through commodity prices, exchange-rate volatility, and financial spillovers. These recurrent shocks underscore the structural vulnerabilities of post-Soviet economies, particularly their dependence on energy exports, exposure to global price cycles, and relatively high exchange-rate pass-through. The interaction between commodity price cycles, exchange-rate regimes, and shifting geopolitical alliances has reinforced asymmetric adjustment patterns across countries, making the region a particularly relevant setting for examining inflation within a broader institutional and geoeconomic framework.

These characteristics motivate a renewed empirical assessment of inflation behavior in the post-Soviet region using frameworks capable of capturing regime-dependent and asymmetric adjustment processes. While existing studies have examined inflation persistence, convergence, and the impact of external shocks, the literature has not systematically applied nonlinear time-series models—particularly threshold-based approaches—to post-Soviet economies as a group. Given the region's history of structural transformation, repeated external shocks, and evolving monetary institutions, identifying potential threshold effects and asymmetric responses is crucial for understanding the inflation process and for designing effective stabilization policies.

Against this backdrop, the present study examines inflation dynamics in 13 post-Soviet economies from 1992 to 2024 using annual CPI data. By integrating ARMA, GARCH-type, and threshold autoregressive (TAR) models within a unified empirical framework, the analysis captures both persistence in the mean process and regime-dependent adjustment in volatility. This approach provides a systematic and region-wide nonlinear assessment of inflation behavior across post-Soviet economies. The study contributes to the literature by: (i) documenting heterogeneous threshold and asymmetric dynamics across countries; (ii) assessing whether mean reversion occurs only beyond economically meaningful deviations; and (iii) extending prior work on inflation persistence and convergence (Cuestas & Mourelle, 2011; Franta et al., 2010) through the application of advanced nonlinear techniques (Caner & Hansen, 2001; Enders & Granger, 1998), thereby linking institutional transition processes with nonlinear inflation adjustment. In doing so, the study not only advances nonlinear inflation modeling but also provides additional economic insight into how geoeconomic exposure and institutional heterogeneity jointly shape inflation dynamics in post-Soviet economies.

The remainder of the paper is organized as follows. Section 2 reviews the existing literature on inflation in transition economies. Section 3 presents the methodology and data. Section 4 reports the empirical results, followed by discussion and policy implications and concluding remarks.

2. Existing Literature on Inflation in Transition Economies

The empirical literature on inflation has extensively explored the macroeconomic, structural, and institutional determinants of price dynamics, employing diverse methodological approaches across countries and time periods. This body of research is particularly rich in the context of transition economies, where the collapse of centrally planned systems triggered profound changes in monetary regimes, fiscal structures, and price-setting mechanisms.

Among the earliest empirical contributions, Fischer et al. (1996) underscored the importance of initial conditions, policy choices, and institutional development in shaping disinflation trajectories during the early transition phase. Similarly, Loungani and Sheets (1997) examined the relationship between central bank independence and macroeconomic performance in post-communist economies, finding that greater autonomy was associated with lower inflation and improved macroeconomic stability. Building on these institutional insights, Cottarelli et al. (1998) conducted a panel analysis of 28 transition economies, identifying fiscal imbalances, structural reforms, and exchange-rate regimes as key inflationary drivers beyond purely monetary factors.

Expanding the analytical scope, Kutan and Yigit (2004) employed threshold and regime-switching models to assess inflation and nominal convergence in Central and Eastern Europe. Their findings revealed limited evidence of monetary convergence once heterogeneous adjustment speeds were accounted for, implying that flexible exchange-rate arrangements may be required to absorb asymmetric shocks. Furthering the institutional perspective, Papadopoulos et al. (2005) investigated the role of central bank independence (CBI) in reducing inflation persistence. They concluded that the effectiveness of CBI depends critically on complementary structural reforms—particularly price liberalization—and that CBI alone is insufficient where price controls persist.

Subsequent research deepened the understanding of nonlinear inflation dynamics. Franta et al. (2010) estimated inflation persistence in new EU member states using time-varying parameter models and nonlinearity diagnostics. While basic measures indicated high persistence, more advanced models produced estimates closer to those in the euro area. Nonetheless, countries such as the Czech Republic and Hungary displayed more backward-looking inflation dynamics and greater deviations from targets, highlighting the importance of expectation anchoring and policy credibility, particularly during euro adoption. In a similar nonlinear framework, Akdoğan (2015) explored asymmetric inflation behavior around target levels in inflation-targeting emerging markets using the AESTAR model. The study found that central banks respond more strongly to inflation overshoots than undershoots, with persistence itself exhibiting asymmetry. The model demonstrated superior long-term forecasting performance, reinforcing the relevance of nonlinear methods in inflation modeling and policy formulation.

Extending the scope to the inflation–growth nexus, Baharumshah et al. (2016) applied a three-regime threshold model to assess the effects of inflation and inflation uncertainty on economic growth in emerging and developing economies. Their results indicate that inflation negatively affects growth only beyond specific thresholds, while moderate inflation can yield mild positive effects. Moreover, inflation uncertainty exerts a nonlinear influence—dampening growth at low inflation levels but potentially supporting it at higher levels through precautionary savings. These findings highlight the need for threshold-sensitive inflation targeting, suggesting that moderate rather than zero inflation may be optimal for sustainable growth.

More recent empirical studies focusing specifically on post-Soviet economies have emphasized the growing importance of external shocks, exchange-rate pass-through, and structural rigidities in shaping inflation outcomes. Early evidence from Baranov and Somova (2015) indicates that inflation dynamics in post-Soviet Russia have increasingly reflected structural rather than purely monetary factors, particularly in the context of rising exchange-rate flexibility and evolving monetary policy frameworks. Subsequent evidence by

Poghosyan (2022) shows that exchange-rate pass-through remains incomplete yet sizable across the Caucasus and Central Asia, with depreciation episodes contributing disproportionately to headline inflation due to high import dependence and persistent dollarization. Further insights are provided by Inogamov and Leon-Gonzalez (2024), who document weak but non-negligible inflation co-movement across CIS countries, driven predominantly by global commodity price cycles rather than synchronized regional demand dynamics. The most recent contributions by Atamanchuk et al. (2025) demonstrate that global food and energy prices constitute the dominant drivers of inflation in the region, whereas domestic monetary conditions and inflation expectations exert meaningful but secondary effects. Similarly, Davlatov and Sagi (2025) find that in Uzbekistan, the transition to market-based pricing and exchange-rate liberalization has heightened the influence of monetary aggregates and producer prices on inflation dynamics. Collectively, this evolving body of literature indicates that inflation in CIS and post-Soviet economies is increasingly shaped by global shocks, exchange-rate volatility, and the credibility of evolving monetary policy frameworks, making the region a distinctive yet policy-relevant setting for studying nonlinear and regime-dependent inflation behavior.

While this extensive literature has significantly advanced understanding of inflation dynamics in emerging and developing economies, empirical findings remain sensitive to differences in country groupings, sample periods, and methodologies. Despite this progress, the post-Soviet economies remain relatively underexplored, even though they share a post-communist legacy and have undergone substantial institutional and structural transformation since the early 1990s. Investigating inflation in these economies is particularly relevant given their unique transitional challenges, including the shift to market-based systems, the establishment of autonomous monetary institutions, and exposure to persistent structural shocks.

Despite these advances, a systematic nonlinear assessment of inflation dynamics across post-Soviet economies as a group remains limited, particularly in terms of threshold-based and regime-dependent modeling. A deeper understanding of inflation behavior in the CIS region is therefore essential for assessing the effectiveness of monetary policy, refining inflation-targeting frameworks, and ensuring macroeconomic stability in the post-transition era.

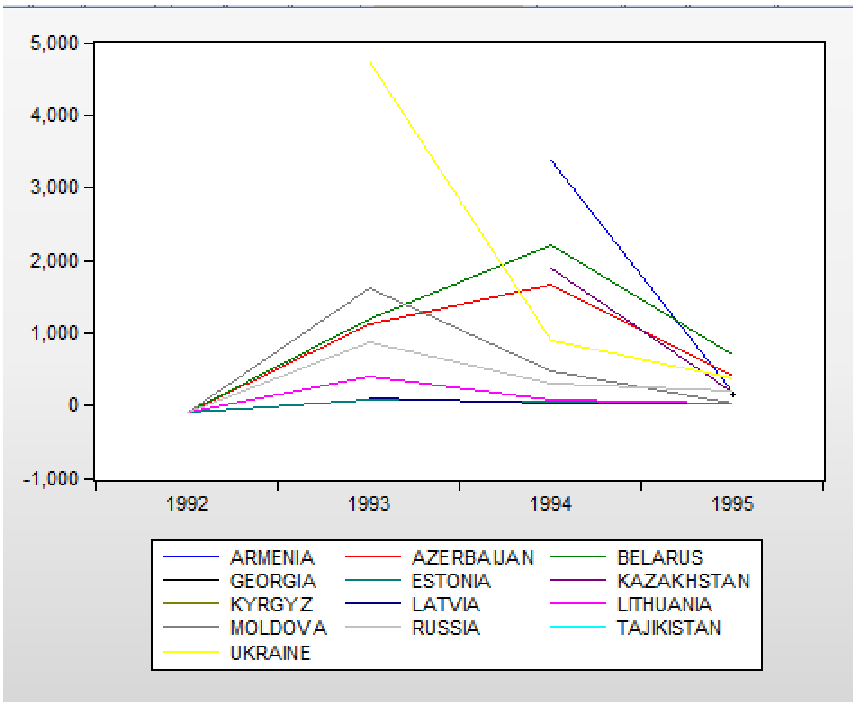
3. Data and Methodology

3.1. Data

This study examines the inflation dynamics of 13 former Soviet republics—Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, the Kyrgyz Republic, Latvia, Lithuania, Moldova, the Russian Federation, Tajikistan, and Ukraine—using annual consumer price index (CPI) data for the period 1992–2024 obtained from the World Bank. The selected sample period reflects the longest span for which harmonized and internationally comparable CPI data are consistently available for all countries in the sample. Earlier transition years are characterized by significant structural breaks and measurement inconsistencies that would undermine cross-country comparability and econometric reliability. For comparability and clearer economic interpretation, the CPI series were converted into annual inflation rates.

To provide an initial overview of historical developments, the inflation series for each country were plotted. Graph 1, covering 1992–1995, highlights the severe macroeconomic instability of the early transition period. Most post-Soviet economies experienced triple- or quadruple-digit inflation as a result of abrupt price liberalization, monetized fiscal deficits, and the collapse of inter-republic trade networks. The magnitude of inflationary spikes varies across countries—most notably in Armenia, Kazakhstan, and Ukraine—reflecting differences in stabilization sequencing and institutional readiness. By 1994–1995, however, inflation begins to decline sharply, indicating the initial effects of currency reforms and early monetary tightening.

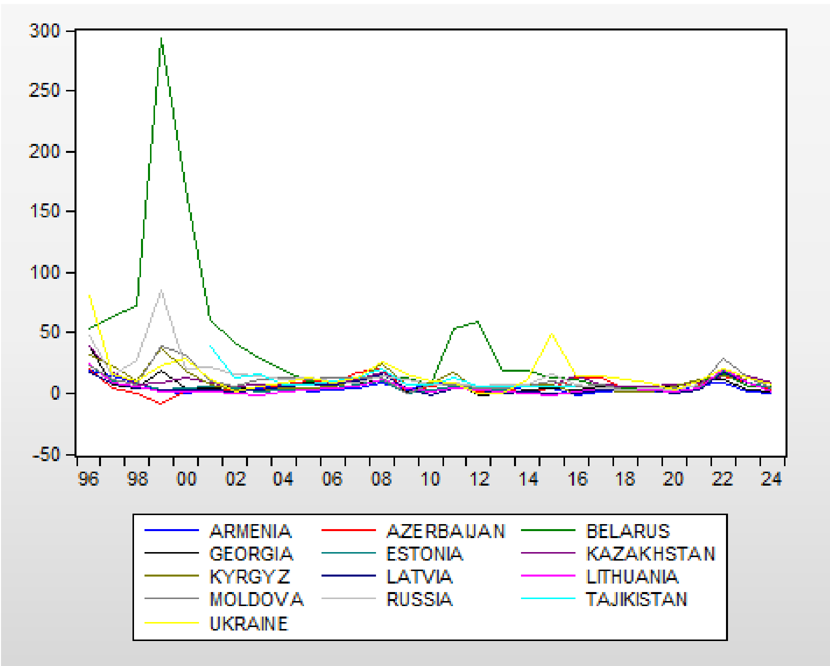
Graph 1. Inflation Dynamics in Post-Soviet Economies (1992–1995)



Source: World Bank, World Development Indicators (annual CPI); authors' transformation to inflation rates.

Graph 2, covering 1996–2024, shows a marked shift toward macroeconomic stabilization. Inflation rates converge downward across countries, consistent with strengthened fiscal discipline, improved monetary frameworks, and enhanced institutional credibility. Although occasional spikes persist—particularly in Belarus, Moldova, and Kazakhstan—the general trend is toward lower, less volatile, and more homogeneous inflation.

Graph 2. Inflation Dynamics in Post-Soviet Economies (1996–2024)



Source: World Bank, World Development Indicators (annual CPI); authors' transformation to inflation rates.

These patterns reveal persistence and volatility clustering in several series, motivating the use of ARMA and GARCH-type models, while the presence of regime-dependent behavior supports the subsequent application of nonlinear threshold approaches.

3.2. Methodology

3.2.1. AR and ARMA Mean Equations

Autoregressive moving-average (ARMA) specifications were first estimated. These models capture persistence and short-term dependence and serve as the mean equation for later GARCH-type estimations.

The general autoregressive process of order p defined as:

$$y_t = \mu + \sum_{i=1}^{\mathrm{p}} \phi_i y_{t-1} + \varepsilon_t \qquad (1)$$

Here, y_t denotes the inflation rate, μ is the constant term, ϕ_i are autoregressive parameters, and ε_t is a white-noise error term.

When a pure AR process proved insufficient, moving-average terms were introduced, yielding the general ARMA(p,q) specification shown in Equation (2):

$$y_t = \mu + \sum_{i=1}^{\mathrm{p}} \phi_i y_{t-1} + \sum_{j=1}^{\mathrm{q}} \theta_j \varepsilon_{t-j} + \varepsilon_t \qquad (2)$$

In equation (2), , θ_j capture short-term corrections to past shocks. The optimal lag length (p, q) were selected using the Akaike information criterion (AIC). These mean-equation estimates formed the baseline for the conditional-variance models described below.

3.2.2. GARCH-Type Models

Following the AR/ARMA estimation, GARCH-type models were applied to capture both mean and variance dynamics. The general ARMA(p,q)–GARCH(1,1) process is specified as:

$$y_t = \mu + \sum_{i=1}^{\mathrm{p}} \phi_i y_{t-1} + \sum_{j=1}^{\mathrm{q}} \theta_j \varepsilon_{t-j} + \varepsilon_t, \quad \varepsilon_t | \Omega_{t-1} \sim \mathrm{N}(0, \mathrm{h}_t) \qquad (3)$$

$$\mathrm{h}_t = w + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1} \qquad (4)$$

In equation (4), h_t denotes the conditional variance and α,β measure the short-term impact and persistence of volatility, respectively.

Because the standard GARCH model assumes symmetric shock effects, the Exponential GARCH (EGARCH) model of Nelson (1991), presented below, was also estimated to capture potential asymmetry:

$$\ln(\mathrm{h}_t) = w + \alpha \left| \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} \right| + \gamma \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} + \beta \ln(h_{t-1}) \qquad (5)$$

Here, γ captures the leverage (asymmetric) effect: when γ ≠ 0, positive and negative shocks affect volatility unequally.

All models were estimated by conditional maximum likelihood, and adequacy was assessed using Ljung–Box Q-statistics and ARCH-LM tests.

While GARCH models effectively describe volatility clustering, they remain linear in the mean equation. This motivates the adoption of nonlinear threshold frameworks discussed below.

3.2.3. Threshold Autoregressive (TAR) Framework

Tong (1978; 1983) and adapted for unit-root testing by Enders and Granger (1998), extends linear autoregression by incorporating regime-dependent dynamics. Unlike linear models that impose symmetric mean reversion, the TAR framework allows different autoregressive processes depending on whether the lagged value of the series lies above or below a threshold—making it particularly suitable for identifying asymmetric behavior and structural breaks in inflation.

Building on the Dickey–Fuller principle, the Enders–Granger specification is expressed as:

$$\Delta y_t = I_t \rho_1 [y_{t-1} - \alpha_0] + (1 - I_t)\rho_2 [y_{t-1} - \alpha_0] + \varepsilon_t \tag{6}$$

In this formulation, I_t is the Heaviside indicator function

$$I_t = \begin{cases} 1 \text{ if } y_{t-1} \geq 0, \\ 0 \text{ if } y_{t-1} < 0, \end{cases} \tag{7}$$

and ε_t is an i.i.d. error term. The coefficients ρ_1 and ρ_2 represent regime-specific adjustment speeds.

The hypotheses for nonlinear stationarity are defined as follows:

$H_0 : \rho_1 = \rho_2 = 0$ (nonstationarity in both regimes),

$H_1 : \rho_1 < 0 \; or \; \rho_2 < 0$ (stationarity in at least one regime).

The corresponding ϕ-statistic is compared to non-standard critical values from Enders and Granger (1998). Rejection of H_0 implies nonlinear stationarity.

After confirming nonlinear stationarity through the KSS and Enders–Granger tests, the TAR(1) model was estimated as follows:

$$y_t = \begin{cases} \mu_1 + \phi_L y_{t-1} + \varepsilon_t & \text{if } y_{t-1} \leq \tau \\ \mu_2 + \phi_H y_{t-1} + \varepsilon_t & \text{if } y_{t-1} > \tau \end{cases} \tag{8}$$

Here, y_t is the inflation rate, τ is the estimated threshold, and ϕ_L, ϕ_H denote the autoregressive coefficients in the low- and high-inflation regimes, respectively. The threshold is estimated endogenously, typically as the median of the lagged inflation series.

For empirical estimation, the regime structure can equivalently be represented using dummy variables as expressed below:

$$D_1 = 1(y_{t-1} \leq \tau), D_2 = 1(y_{t-1} > \tau) \tag{9}$$

This formulation yields the regression form:

$$y_t = \mu + \phi_L D_1 y_{t-1} + \phi_H D_2 y_{t-1} + \varepsilon_t \tag{10}$$

Nonlinearity is formally tested using the Wald test of H_0: $\phi_L = \phi_H$; rejection of the null confirms the presence of statistically distinct regimes. Model adequacy is evaluated via Ljung–Box Q-statistics to ensure the absence of serial correlation.

This framework explicitly models asymmetric and discontinuous inflation dynamics, capturing how inflation in transition economies adjusts differently across low- and high-inflation regimes, and complements the volatility insights derived from GARCH-type models.

4. Estimation Results

Since ARMA estimation requires stationarity and correct identification of the integration order, standard unit-root procedures were first applied. Prior to model estimation, a sequence of linear and nonlinear unit-root tests was implemented to determine the stochastic properties of inflation in each country. Under the assumption of linear adjustment, the analysis began with conventional unit-root tests—Augmented Dickey–Fuller (ADF), Phillips–Perron (PP) (Phillips & Perron, 1988), and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) (Kwiatkowski et al., 1992)—to establish the order of integration. Results from the Augmented Dickey–Fuller (ADF) test, reported in Table 1, provide strong evidence that most inflation series are stationary. Specifically, Armenia, Georgia, Kazakhstan, Ukraine, Estonia, and Latvia reject the null hypothesis of a unit root at the 1% significance level under all model specifications. This finding indicates that inflation in these economies is mean-reverting—that is, while temporary shocks may cause fluctuations, inflation ultimately converges to a long-run equilibrium level.

Table 1. Augmented Dickey-Fuller Unit Test Results

	t-Statistic at Level			t-Statistic at First Level		
	With intercept	*With intercept and trend*	*Without intercept and trend*	*With intercept*	*With intercept and trend*	*Without intercept and trend*
Armenia	-870.50***	-843.66***	-602.76***	-748.19***	-693.20***	-773.59***
Azerbaijan	-2.99**	-3.52*	-2.86***	-10.58***	-12.48***	-10.13***
Belarus	-2.96**	-3.68**	-21.50***	-5.67***	-5.58***	-5.74***
Estonia	-9.84***	-11.79***	-7.95***	-5.16***	-5.16**	-5.17***
Georgia	-28.41***	-26.07***	-21.72***	-8.16***	-7.94***	-8.33***
Kazakhstan	-383.69***	-360.31***	-179.27***	-324.70***	-305.41***	-334.87***
Kyrgyz Republic	-3.81**	-3.79*	-2.70**	-6.27***	-6.29***	-6.41***
Latvia	-16.11***	-14.64***	-3.64***	-4.51**	-4.30	-4.53***
Lithuania	-6.26***	-40.68***	-5.89***	-22.61***	-19.64***	-23.64***
Moldova	-4.62***	-5.25***	-4.43***	-15.31***	-4.28**	-14.98***
Russian Federation	-21.41***	-17.25***	-1.37	-19.18***	-22.48***	-18.30***
Tajikistan	-6.10***	-6.39***	-3.60**	-3.12*	-2.97	-3.19**
Ukraine	-101.07***	-95.22***	-97.63***	-74.26***	-70.96***	-76.17***

Note: *, **, and *** denote rejection of the null hypothesis at 10%, 5%, and 1% significance levels respectively and appropriate lag length based on SIC.

By contrast, Azerbaijan, the Kyrgyz Republic, Belarus, Moldova, Lithuania, and Tajikistan exhibit weaker yet statistically significant rejections of the unit-root null hypothesis, suggesting that inflation in these economies is stationary, though it may display higher persistence or structural shifts over time. For the Russian Federation, stationarity is observed only when deterministic components (intercept and trend) are included, indicating a trend-stationary process influenced by institutional reforms and commodity price fluctuations.

To address potential limitations of the ADF test, particularly its sensitivity to lag-length selection and serial correlation, the Phillips–Perron (PP) test was applied as a robustness check. The PP procedure, being more robust to heteroskedasticity and autocorrelation, serves as a valuable complement and enhances the reliability of the unit-root testing results.

Table 2. Phillips–Perron (PP) Unit Root Test Results

	t-Statistic at Level			t-Statistic at First Level		
	With intercept	*With intercept and trend*	*Without intercept and trend*	*With intercept*	*With intercept and trend*	*Without intercept and trend*
Armenia	-742.49***	-724.24***	-347.48***	-1711.63	-1631.67***	-1542.63***
Azerbaijan	-3.04**	-3.78**	-2.80**	-6.74***	-7.43***	-6.61***
Belarus	-2.99**	-3.90**	-2.70***	-7.08***	-10.39***	-6.74***
Estonia	-7.87***	-8.89***	-7.03***	-24.38***	-30.90***	-23.54***
Georgia	-29.87***	-27.59***	-14.48***	-15.13***	-17.88***	-15.82***
Kazakhstan	-356.36***	-332.08***	-93.32***	-443.55***	-480.25***	-453.81***
Kyrgyz Republic	-3.80*	-3.77**	-2.67***	-9.58***	-18.06***	-8.96***
Latvia	-15.99***	-14.27***	-11.83***	-15.55***	-15.48***	-16.27***
Lithuania	-6.21***	-6.88***	-5.90***	-16.33***	-18.56***	-15.90***
Moldova	-4.62***	-5.31***	-4.43***	-12.11***	-13.28***	-11.87***
Russian Federation	-4.49**	-5.54***	-4.09***	-13.26***	-16.10***	-12.67***
Tajikistan	-6.29***	-12.44***	-3.63**	-17.36***	-16.89***	-10.95***
Ukraine	-125.41***	-118.84***	-101.60***	-81.04***	-79.45***	-83.22***

Note: *, **, and *** denote rejection of the null hypothesis at 10%, 5%, and 1% significance levels respectively and appropriate lag length based on SIC.

The results presented in Table 2 broadly corroborate the findings of the ADF test. Armenia, Georgia, Kazakhstan, Ukraine, Estonia, and Latvia strongly reject the null hypothesis of a unit root, reinforcing the conclusion that inflation in these economies is stationary and mean-reverting. Meanwhile, Azerbaijan, Belarus, the Kyrgyz Republic, Moldova, Lithuania, Tajikistan, and the Russian Federation also reject the null, though their test statistics lie closer to the critical thresholds in some model specifications. These outcomes suggest that inflation in these economies exhibits persistence and remains sensitive to external shocks, including fluctuations in energy prices and episodes of institutional fragility.

Overall, the combined results of the ADF and PP tests indicate that inflation across most former Soviet republics is stationary, albeit with heterogeneous speeds of mean reversion. As an additional robustness check, the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test was applied, which differs from the preceding tests by taking stationarity as the null hypothesis.

Table 3. KPSS Unit Root Test Results

	t-Statistic at Level		t-Statistic at First Level	
	With intercept	*With intercept and trend*	*With intercept*	*With intercept and trend*
Armenia	0.36***	0.14***	0.35***	- 0.14***
Azerbaijan	0.35***	0.18***	0.50***	0.50
Belarus	0.44***	0.12***	0.50***	0.50
Estonia	0.15***	0.12***	0.23***	0.11***
Georgia	0.42***	0.18***	0.44***	0.14***
Kazakhstan	0.36***	0.15***	0.35***	0.15***
Kyrgyz Republic	0.34***	0.108467***	0.50***	0.32
Latvia	0.40***	0.14***	0.41***	0.16***
Lithuania	0.27***	0.10***	0.34***	0.22
Moldova	0.36***	0.12***	0.50***	0.50
Russian Federation	0.42***	0.13***	0.50***	0.36
Tajikistan	0.50***	0.08	0.25***	0.12**
Ukraine	0.38***	0.16***	0.37***	0.15***

Note: *, **, and *** denote rejection of the null hypothesis at 10%, 5%, and 1% significance levels respectively and appropriate lag length based on SIC.

The results presented in Table 3 largely reinforce the earlier findings. For Estonia, Latvia, Lithuania, Kazakhstan, Moldova, Ukraine, and the Russian Federation (with a trend included), the null hypothesis of stationarity cannot be rejected, confirming that inflation in these economies is mean-reverting. In contrast, Armenia, Georgia, Belarus, the Kyrgyz Republic, and Tajikistan reject the null under certain model specifications, indicating episodes of persistence or structural breaks that weaken evidence of full stationarity. These mixed outcomes suggest that, while inflation in most cases returns to equilibrium, adjustment speeds differ, and shocks may persist longer in economies characterized by institutional fragility or structural rigidities.

Although the ADF, PP, and KPSS tests collectively support linear stationarity, they do not account for potential nonlinear adjustment mechanisms. To address this, the Kapetanios, Shin, and Snell (KSS, 2003) test was applied to assess nonlinear mean reversion, enabling a comparison between linear ARMA-based representations and nonlinear specifications such as the Threshold Autoregressive (TAR) model. This step provides a more robust evaluation of whether inflation dynamics in post-Soviet economies exhibit asymmetric or regime-dependent adjustment behavior.

Table 4. KSS Test Results

	t-Statistic
Armenia	1.28
Azerbaijan	1.87
Belarus	3.11
Estonia	-5.04
Georgia	2.91
Kazakhstan	1.89
Kyrgyz Republic	3.29
Latvia	1.09
Lithuania	-35.34
Moldova	-30.58
Russian Federation	-11.18
Tajikistan	1.44
Ukraine	8.31

Notes: Asymptotic critical values for the KSS test statistics at 1%, 5%, and 10% significance levels are −2.82, −2.22, and −1.92 for the test with the raw data, −3.48, −2.93, and −2.66 for the test with the demeaned data, and −3.93, −3.40, and −3.13 for the test with the demeaned and de-trended data, respectively (Kapetanios et al., 2003).

The results in Table 4 provide strong evidence of nonlinear mean reversion for Lithuania, Moldova, the Russian Federation, and Estonia, as their test statistics fall well below the 1% critical value. This indicates that although inflation in these economies is stationary, the adjustment process is regime-dependent: inflation converges more rapidly toward equilibrium during high-inflation episodes than under stable conditions. In contrast, Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, the Kyrgyz Republic, Latvia, Tajikistan, and Ukraine do not reject the null of a unit root in the KSS test, suggesting that their inflation dynamics are better described by linear stationarity, consistent with the ADF and PP results.

Accordingly, the unit root analysis supports the use of ARMA specifications for Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, the Kyrgyz Republic, Latvia, Tajikistan, and Ukraine, as linear models adequately capture persistence and short-run dynamics. Conversely, for Lithuania, Moldova, Estonia, and the Russian Federation—where the KSS test indicates nonlinear mean reversion—nonlinear frameworks such as threshold autoregressive (TAR) model is more appropriate for representing the regime-dependent nature of inflation adjustment.

Table 5. ARMA Estimation Results and Diagnostic Outcomes

	Sellected Model	AR(1)	AR(2)	MA(1)	Constant	Residual Var.(σ^2)	Ljung–Box Q-Statistic	ARCH LM	Results
Armenia	ARMA (1,1)	0.61***		-0.64***	0.44	31,395	29.85***	13.67***	ARMA–GARCH
Azerbaijan	AR(2)	0.99***	-0.74***		67.03	52,578	8.55	2.84	AR(2)
Belarus	AR(2)	0.90***	-0.59***		125.81	94,559	7.53	26.91***	AR–GARCH
Georgia	ARMA (1,1)	0.88***		0.55**	46.34	486	20.20*	0.29	TAR
Kazakhstan	ARMA (1,1)	0.77***		0.74***	359.53	85,002	36.91***	4.19**	ARMA–GARCH
Kyrgyz Republic	ARMA (1,1)	0.74***		–0.33	11.61**	66.1	14.54	0.003	ARMA (1,1)
Latvia	AR (1)	0.94***			32.20	198.0	1.85	0.46	AR (1)
Tajikistan	AR (1)	0.37			11.96*	64.8	7.24	8.52	AR–GARCH
Ukraine	ARMA (1,1)	0.88***		0.71***	1336.36	418,633	32.37***	1.23	TAR

Notes: **, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. The most appropriate lag length was determined by the Akaike Information Criterion (AIC). Residual variance (σ^2) is reported for model diagnostics. The diagnostics column reports the Ljung–Box Q (12) test and the ARCH LM test (p-values), both of which should ideally exceed 0.05 to support model adequacy.*

The ARMA estimations presented in Table 5 indicate that relatively low-order models are sufficient to capture the principal dynamics of inflation across the sample. Strong and statistically significant autoregressive components, particularly in Azerbaijan, Belarus, and Latvia, highlight the persistence of inflationary shocks, whereas ARMA (1,1) specifications provide a good fit for Armenia, Georgia, Kazakhstan, the Kyrgyz Republic, and Ukraine.

Diagnostic tests based on the Ljung–Box Q (12) and ARCH–LM statistics reveal notable cross-country differences. For Azerbaijan, the Kyrgyz Republic, and Latvia, the baseline ARMA models appear statistically adequate. By contrast, Armenia, Belarus, Kazakhstan, and Tajikistan exhibit evidence of conditional heteroscedasticity, suggesting that ARMA–GARCH extensions provide a more appropriate representation. Meanwhile, Georgia and Ukraine show signs of residual autocorrelation but no conditional heteroscedasticity, indicating the presence of nonlinear adjustment mechanisms that may be better captured by Threshold (TAR) or Smooth Transition (STAR) models.

Overall, these results highlight considerable heterogeneity in the persistence and volatility of inflation dynamics across post-Soviet economies, reinforcing the necessity of country-specific model extensions beyond standard linear formulations.

Table 6. GARCH-Type Model Results for Selected Former Soviet Economies

	Mean Eq. (AR, MA)	AR(1)	AR(1)	MA(1)	Variance Eq. (ω, α, γ, β)	Results
Armenia	ARMA(1,1)–EGARCH(1,1)	0.99***		0.049*	ω=2.716***α=1.769 *** γ=1.680***β=0.073	Strong persistence; asymmetric volatility; positive shocks dominate
Belarus	AR(2)–GARCH(1,1)	0.573**	-0.108		Var const=75.41 ARCH=0.328 GARCH=0.331	Significant AR(1) and GARCH(1); persistent inflation and volatility
Kazakhstan	ARMA(1,1)–EGARCH(1,1)	0.99***		0.083***	ω=2.745*** α=2.125*** γ=1.824*** β=–0.047	Strong persistence; volatility shock-driven and asymmetric; positive shocks dominate; little persistence
Tajikistan	AR(1)–GARCH(1,1)	–0.053			Var const=2.72 ARCH=–0.148***, GARCH=0.883***	Strong AR persistence; GARCH models invalid/unstable (short sample, 16 obs.)

Note: *, **, and *** denote significance at 10%, 5%, and 1% significance levels respectively.

The GARCH-type estimations reported in Table 6 reveal substantial cross-country heterogeneity in both the magnitude and nature of inflation volatility. For Armenia and Kazakhstan, the EGARCH (1,1) specification provides the best fit, with statistically significant asymmetry coefficients (γ) indicating that volatility responds differently to positive and negative shocks. In Belarus, the AR (2)–GARCH (1,1) model produces significant AR (1) and GARCH (1) parameters, confirming the presence of both mean persistence and volatility clustering. For Tajikistan, however, neither the AR (1)–GARCH (1,1) nor the EGARCH (1,1) model yields stable variance dynamics, largely due to the short sample period, leaving strong AR (1) persistence as the only robust result. This limitation reflects data constraints rather than model misspecification.

Building on these findings, the next analytical step involves estimating nonlinear models, specifically the Threshold Autoregressive (TAR) specification, for economies in which GARCH-type models prove inadequate or where the KSS test indicates nonlinear mean adjustment. In particular, Estonia, Georgia, Lithuania, Moldova, the Russian Federation, and Ukraine require TAR estimation to capture regime-dependent dynamics in the mean process. By contrast, Armenia and Kazakhstan are more appropriately modelled using EGARCH-type frameworks, given their pronounced asymmetric volatility effects.

Table 7. TAR Unit Root Results

	Threshold (τ)	**Low regime *φ_L***	**High regime *φ_H***	**Intercept**	**Wald Test (ϕ_L=ϕ_H)**	**Ljung–Box *Q(8)***	**Results**
Estonia	3.976	0.869***	0.485***	3.667***	506.70***	5.08	Significant threshold effect; inflation mean-reverts below τ, persistent above
Georgia	5.587	0.562	0.212***	3.612**	0.69	5.26	No significant regime difference; linear adjustment adequate
Lithuania	2.89	–4.14***	0.171***	5.825***	3147.58***	12.69	Strong nonlinearity; rapid mean reversion in low regime, persistent inflation in high regime
Moldova	9.72	–15.17***	0.241***	50.097***	742.99***	7.20	Pronounced nonlinearity; sharp regime switch, strong mean reversion below τ, persistence above
Russian Federation	11.27	–8.09***	0.307***	39.441***	565.98***	6.03	Strong threshold nonlinearity; rapid mean reversion in low regime, inflation persistence in high regime
Ukraine	12.84	–0.088	0.192***	16.270*	0.04	1.50	No evidence of regime shift; inflation dynamics are linear and persistent

Note: *, **, and *** denote significance at 10%, 5%, and 1% significance levels respectively.

The results of the Threshold Autoregressive (TAR) estimations presented in Table 7 provide compelling evidence of regime-dependent inflation dynamics across most of the examined transition economies. For Estonia, Lithuania, Moldova, and the Russian Federation, the Wald tests strongly reject the null hypothesis of equal autoregressive coefficients across regimes, confirming statistically significant nonlinear adjustment. In these economies, the low-inflation regimes (ϕ_L < 0) exhibit rapid mean reversion, whereas the high-inflation regimes (ϕ_H > 0) display persistence, indicating that inflation responds asymmetrically to deviations from equilibrium. The Ljung–Box Q-statistics further confirm the absence of serial correlation in residuals, supporting the adequacy and stability of the estimated models.

In contrast, the TAR estimations for Georgia and Ukraine fail to reject the null of linearity ($p > 0.10$), implying no statistically significant difference between the low- and high-inflation regimes. For these economies, inflation follows a predominantly linear and persistent process, consistent with the earlier ARMA results.

Taken together, the TAR results demonstrate that nonlinear mean reversion constitutes a defining feature of inflation adjustment in many post-Soviet economies—particularly those that experienced severe price shocks during the early transition period (Estonia, Lithuania, Moldova, and Russia). Given the strong statistical evidence of regime-dependent dynamics and the robust diagnostic performance of the models, further smooth transition analysis (e.g., STAR models) was deemed unnecessary. Overall, the findings provide internally consistent and econometrically robust evidence of asymmetric inflation behavior in selected former Soviet economies, reflecting structural differences in policy responses and institutional resilience.

5. Discussion and Conclusion

This study investigated the inflation dynamics of post-Soviet economies from 1992 to 2024 using linear and nonlinear econometric approaches, including ARMA, GARCH-type, and Threshold Autoregressive (TAR) models. The results reveal that inflation across these economies remains shaped by structural legacies, institutional capacity, and exposure to external shocks, producing heterogeneous and often nonlinear adjustment patterns. The ARMA estimates indicate that inflation in most countries exhibits short-run persistence and autoregressive dependence, reflecting adaptive price-setting behavior typical of transitional systems. However, residual autocorrelation in several cases suggests that linear models capture only part of the adjustment process, indicating the presence of underlying nonlinear mechanisms. GARCH-type results further confirm pronounced volatility clustering in countries such as Armenia, Belarus, and Kazakhstan, while EGARCH estimates for Armenia and Kazakhstan reveal asymmetric volatility—particularly the stronger inflationary effects of negative shocks such as currency depreciations. These dynamics underscore the vulnerability of commodity-dependent and financially shallow economies to external disturbances, geoeconomic fragmentation, and exchange-rate fluctuations.

The nonlinear TAR estimates provide additional evidence of regime-dependent adjustment. Estonia, Lithuania, Moldova, and the Russian Federation exhibit rapid mean reversion in low-inflation regimes but more persistent inflation at higher levels. This asymmetry reflects differences in policy credibility and expectations formation. By contrast, Georgia and Ukraine show more linear and persistent inflation dynamics, consistent with relatively stable monetary environments and smoother disinflation processes.

These results align with earlier empirical evidence on transition-economy inflation dynamics. However, the present findings also allow for a broader institutional interpretation. The persistence identified in the ARMA estimates is consistent with Cuestas and Mourelle (2011), who document similarly sluggish mean reversion in post-communist economies. The asymmetric volatility patterns observed in the EGARCH models reflect the findings of Poghosyan (2022), who shows that depreciations exert disproportionately large inflationary effects in the Caucasus and Central Asia. Furthermore, the threshold behavior revealed by the TAR estimations corresponds to Kutan and Yigit (2004), who identify regime-dependent adjustment mechanisms in transition economies.

Beyond these empirical parallels, the results suggest that inflation dynamics in post-Soviet economies cannot be adequately explained by conventional monetary transmission mechanisms alone. While earlier studies emphasize persistence and exchange-rate pass-through, the present results indicate that credibility formation, fiscal dominance, and the sequencing of institutional reforms shape both the speed and asymmetry of adjustment. The cross-country heterogeneity observed here therefore points to differentiated paths of institutional consolidation rather than a uniform transition toward macroeconomic stabilization. In this respect, the evidence refines existing transition-economy literature by highlighting the interaction between nonlinear inflation behavior and incomplete institutional convergence.

Taken together, the empirical findings highlight the central role of institutional strength, fiscal discipline, and policy coherence in achieving durable price stability. Countries with transparent governance, independent central banks, and credible policy frameworks—such as Estonia and Lithuania—benefit from faster stabilization and lower volatility. In contrast, economies where fiscal dominance and limited policy autonomy persist, notably Belarus and Tajikistan, continue to experience prolonged inflation persistence and heightened vulnerability to shocks.

The empirical results carry several important policy implications. Strengthening central bank independence, enhancing policy transparency, and improving coordination between fiscal and monetary authorities are essential for consolidating macroeconomic credibility. Flexible exchange-rate arrangements, supported by credible inflation-targeting frameworks, can mitigate asymmetric responses to external shocks and help anchor inflation expectations. Furthermore, deeper capital markets and strengthened macro-prudential regulation would enhance financial resilience and reduce vulnerability to global commodity and exchange-rate volatility.

Methodologically, the findings demonstrate that linear models alone cannot adequately capture the inflation dynamics of post-Soviet economies. Nonlinear frameworks—particularly TAR and EGARCH models—offer richer insight into how structural shocks, expectations, and credibility constraints interact, and therefore provide a stronger foundation for monetary policy design. Future research could benefit from higher-frequency data, structural-break analysis, panel-based approaches, and explicit modeling of external spillovers to better account for the increasing integration of these economies into global commodity and financial markets.

Despite its contributions, the study is limited by the use of annual data and the exclusion of structural breaks and cross-country spillover effects. Addressing these limitations would require more granular datasets and multivariate, spillover-sensitive frameworks capable of capturing regional and global transmission channels.

In conclusion, the results underscore that durable price stability in post-Soviet economies depends less on short-term disinflation and more on sustained institutional reform, credible monetary governance, and enhanced resilience to external shocks. The combination of linear and nonlinear evidence presented here offers a comprehensive understanding of inflation behavior in the region and provides a solid foundation for future empirical research and policy design.

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