Annual International Scientific Conference
"Competitiveness and Innovation in the Knowledge Economy"
September 26-27, 2025
Chisinau, Republic of Moldova

DOI: https://doi.org/10.24818/cike2025.33

CHRONIC MACROECONOMIC VULNERABILITY IN TRANSITION ECONOMIES: EVIDENCE FROM REPUBLIC OF MOLDOVA'S INFLATION REGIME CHANGES

MIRCEA DIAVOR
PhD
Independent Researcher
Chisinau, Republic of Moldova
e-mail: mirceadiavor@gmail.com
https://orcid.org/0000-0002-4041-6356

Abstract: This study analyzes Republic of Moldova's Consumer Price Index (1991-2025) to examine structural vulnerabilities and external shock impacts on transition economies. Using Chow Test for structural breaks and Facebook's Prophet for counterfactual forecasting, we investigate persistent inflationary pressures and regime changes in Republic of Moldova's price formation mechanisms. The analysis reveals severe macroeconomic instability, including hyperinflation during early transition 1991-1995. Statistical evidence, using the Chow Test, confirms a significant structural break in February 2022. Counterfactual analysis demonstrates that absent this structural break, Republic of Moldova's Consumer Price Index would have been 35.9% lower by May 2025, indicating permanent economic repricing rather than temporary adjustment. Using Log-Linear autoregressive modeling, we model the Consumer Price Index gap to estimate the half-life of the structural break's impact. We find that the break has an effectively infinite half-life, indicating no natural decay in the gap between actual and counterfactual paths. This represents a fundamental transformation in price dynamics, with inflation volatility increasing 35.4-fold and welfare losses of 15.1%. These findings highlight critical vulnerabilities including extreme import dependence, institutional weaknesses, and inadequate shock absorption mechanisms. The research challenges conventional small open economy theories and provides empirical evidence for comprehensive structural reforms in energy security, monetary policy frameworks, fiscal stabilization, and regional cooperation to enhance macroeconomic resilience.
Keywords: Consumer Price Index, structural breaks, economic vulnerability, inflation forecasting, Prophet model.
JEL Classification: C22, E31, E58, F41, P20.

1. Introduction

The study of inflation dynamics in transition economies has garnered significant attention in macroeconomic literature, particularly as these economies navigate the complex interplay between structural transformation, external vulnerabilities, and monetary policy frameworks. Republic of Moldova, as a small open economy in Eastern Europe, presents a compelling case study for understanding how external shocks can fundamentally alter inflation trajectories in economies characterized by limited diversification and institutional capacity constraints.

Since its independence in 1991, Republic of Moldova has experienced pronounced macroeconomic instability, including episodes of hyperinflation that peaked at 2,705.71% in 1993. While the country achieved relative price stability in the 2000s through monetary and fiscal reforms, recent geopolitical developments have exposed persistent structural vulnerabilities. The Russian invasion of Ukraine in February 2022 marked a critical juncture, triggering unprecedented energy price shocks and supply chain disruptions that reverberated throughout Republic of Moldova's economy.

This paper contributes to the literature on structural breaks in inflation dynamics by providing a comprehensive empirical analysis of Republic of Moldova's Consumer Price Index (CPI) from 1991 to 2025. Using Chow tests for structural break detection and Facebook's Prophet algorithm for counterfactual analysis, we identify and quantify the macroeconomic impact of the

February 2022 shock. Our methodology allows for precise identification of structural breaks while generating robust counterfactual scenarios to assess the magnitude of external shock transmission.

The analysis reveals several key findings that advance our understanding of inflation dynamics in vulnerable transition economies. First, we document a statistically significant structural break in February 2022, representing a fundamental shift in Republic of Moldova's inflation regime. Second, through counterfactual analysis, we estimate that without this external shock, Republic of Moldova's CPI would have been 35.9% lower by May 2025, suggesting permanent repricing effects with an infinite adjustment half-life. Third, we quantify a 35.4-fold increase in inflation volatility post-shock, accompanied by an estimated 15.1% welfare loss, highlighting the severe economic costs of external vulnerability.

These findings have important implications for monetary policy frameworks in small open economies and contribute to the broader literature on external shock transmission mechanisms. Our results suggest that traditional inflation targeting approaches may be insufficient in economies with high external vulnerability, necessitating comprehensive structural reforms including economic diversification, enhanced monetary policy credibility, and stronger automatic stabilizers.

2. Methodological Review

2.1 Data Processing and Descriptive Analysis

The CPI data for Republic of Moldova spanning 1991-2025 underwent comprehensive preprocessing and descriptive analysis. Monthly inflation rates were calculated using both month-over-month and year-over-year percentage changes, with rolling 12-month volatility measures computed using standard deviation of monthly inflation rates. The analysis identified hyperinflation periods defined as annual inflation exceeding 50%, and categorized the time series into four distinct economic periods: Early Transition (1991-1995), Stabilization (1996-2007), Global Crisis (2008-2013), and Recent Period (2014-2025). Descriptive statistics including average inflation rates, volatility measures, and maximum inflation levels were calculated for each period to characterize macroeconomic dynamics.

2.2 Structural Break Testing

Structural break analysis employed Chow tests implemented through the strucchange package in R to detect regime changes in Republic of Moldova's inflation dynamics. The analysis focused on February 2022 as the hypothesized breakpoint, corresponding to the onset of the Russia-Ukraine conflict. Chow tests were applied to log-transformed CPI data using both intercept-only and linear trend specifications to test the null hypothesis of parameter stability against the alternative of a structural break. F-statistics were computed across the sample period to visualize the temporal evolution of structural instability, with critical values determining statistical significance at conventional levels.

2.3 Counterfactual Forecasting Framework and Welfare Analysis

A counterfactual analysis was conducted using Facebook's Prophet algorithm developed by Taylor and Letham (2018) to estimate what Republic of Moldova's CPI trajectory would have been absent the February 2022 structural break. The model was trained on log-transformed CPI data from January 1996 through February 2022, incorporating yearly seasonality while suppressing weekly and daily components inappropriate for monthly data. The Prophet model specification included additive seasonality with a changepoint prior scale of 0.05 to control trend flexibility. Out-of-sample forecasts were generated through May 2025, with Jensen's inequality correction applied to transform log-scale predictions back to CPI levels, accounting for the bias introduced by the log-normal transformation using estimated residual variance from the training period. The structural break's economic impact was quantified through multiple approaches comparing actual versus counterfactual CPI paths. Absolute and percentage gaps were computed monthly, with cumulative effects tracked over time to measure persistent inflationary pressures. Welfare loss

approximations employed consumer surplus theory, estimating deadweight losses as half the percentage price increase under unit elastic demand assumptions.

2.4 Impact Assessment

Inflation volatility comparisons assessed whether the structural break increased macroeconomic uncertainty by comparing standard deviations of year-over-year inflation rates between actual and counterfactual scenarios. Shock persistence was analyzed through Log-Linear autoregressive modeling of the CPI gap to estimate the half-life of the structural break's impact, providing insights into the duration of inflationary pressures attributable to the geopolitical shock.

3. Analysis and Prophet Forecast

3.1 Descriptive Statistics Analysis

The multi-panel analysis examines Moldova's CPI across four dimensions. Panel 1 presents raw CPI values over time, with shaded regions highlighting crisis periods (Transition Crisis: 1991–1996; Global Crisis: 2008–2014) to identify potential regime changes. Panel 2 converts CPI data into annualized inflation rates using 12-month percentage changes, which remove seasonal effects; a 50% threshold line marks periods of hyperinflation. Panel 3 measures inflation volatility through a two-step process: first calculating month-over-month inflation, then applying a 12-month rolling standard deviation to capture temporal uncertainty. Panel 4 divides the timeline into four economic periods (Early Transition: 1991–1995; Stabilization: 1996–2007; Global Crisis: 2008–2013; Recent: 2014–2025), computing average inflation and volatility to enable cross-period comparisons of macroeconomic stability.

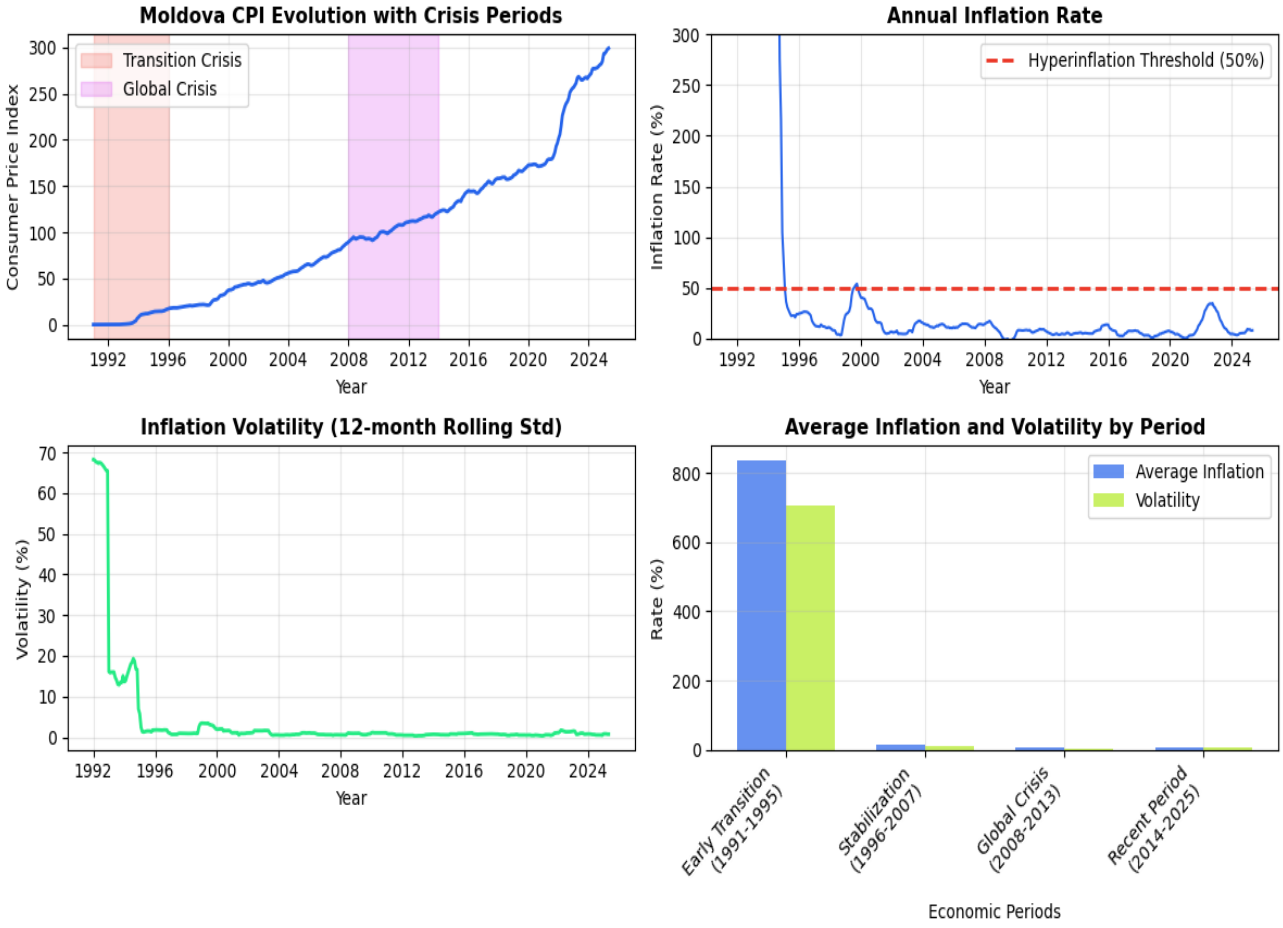

Figure 1. Analysis of Republic of Republic of Moldova's CPI
Source: elaborated by author based on IMF data

A defining feature of the Republic of Moldova's Consumer Price Index (CPI) evolution is the pronounced hyperinflationary event that transpired during the initial post-Soviet transformation phase (1991–1995). This era experienced an average yearly inflation rate of 836.60%, reaching a high point of 2,705.71% in December 1993 (year-over-year), thus positioning it among the most severe hyperinflationary episodes among economies transitioning from the former Soviet Union. These occurrences emphasize notable institutional vulnerabilities, as manifested in the considerable inflation instability—with a standard deviation of 705.68%—revealing deficiencies in sound monetary policy instruments and institutional framework for securing price equilibrium. The severity of this predicament emphasizes the Republic of Moldova's increased vulnerability to external shocks, possibly exacerbated by the breakdown of established trade connections with other former Soviet states, while the prolonged hyperinflation over multiple years indicates fundamental structural imbalances within the economy.

The subsequent stabilization period (1996–2007) exemplifies the Republic of Moldova's aptitude for macroeconomic adjustment, demonstrated by a considerable decrease in average inflation to 15.92% and a significant drop in instability to 10.92%. Nevertheless, inflation rates during this period remained considerably high compared to those seen in developed nations, suggesting persistent structural deficiencies and restricted monetary policy effectiveness. The continuation of relatively high inflation instability additionally implies incomplete institutional development and ongoing obstacles to achieving price stability comparable to more established market-based systems.

The global financial crisis period (2008-2013) unexpectedly reveals the lowest average inflation (6.20%) and instability (4.36%), possibly indicating deflationary forces from external demand shocks instead of enhanced domestic policy efficiency. The contemporary period (2014-2025) displays renewed inflationary stresses with average inflation of 8.36% and increased instability of 7.81%, reaching a peak of 34.62%, implying that the Republic of Moldova's economy is still vulnerable to both domestic policy inconsistencies and external economic turbulences.

The analysis reveals several fundamental structural vulnerabilities that continue to characterize Republic of Moldova's economy. The persistent high inflation volatility across all periods suggests limited central bank credibility and effectiveness in maintaining price stability, a fundamental prerequisite for sustained economic development. The extreme sensitivity to external shocks, evidenced by the hyperinflationary crisis and subsequent volatility patterns, indicates high dependence on external factors including commodity prices, remittances, and foreign capital flows. Furthermore, the prolonged nature of the hyperinflationary episode and subsequent periods of elevated inflation suggest weak institutional frameworks for economic management and policy implementation.

Notwithstanding the considerable advancements achieved since the transitional crisis era, contemporary impediments endure. The persistently high coefficient of variation underscores Republic of Moldova's ongoing difficulties in attaining macroeconomic stability akin to that of advanced economies. These sustained vulnerabilities engender substantial obstacles to the investment environment, insofar as elevated inflation uncertainty fosters adverse conditions for long-term capital allocation and strategic economic forecasting. Furthermore, the pronounced price volatility is apt to exert asymmetric impacts on disadvantaged demographic segments, thereby potentially intensifying income disparities and societal frictions. Moreover, such inflationary patterns could curtail Republic of Moldova's potential for enhanced economic amalgamation with more resilient economies, thereby restricting prospects for regional collaboration and developmental progress.

3.2 Chow Breakpoint Test for February 2022

Table 1. Chow breakpoint test for log(CPI)

Model	Breakpoint Date	supF	p-value
log(CPI) ~ 1	2022-02	693.673145220655	0
log(CPI) ~ t	2022-02	6857.46745526997	0

Source: elaborated by author based on IMF data

The Chow breakpoint test in Table 1 confirms a structural break in the CPI series in February 2022. Testing both intercept-only and trend-augmented models, the test rejects parameter stability with p-values near zero and elevated F-statistics, indicating a significant deviation in price dynamics.

The results are robust across model specifications. Even with a deterministic trend, the significant break suggests a level shift in log(CPI) rather than just a slope change, indicating a fundamental reconfiguration of the price-determination process beyond simple trend modifications.

The break's timing aligns with 2022's macroeconomic disruptions, particularly energy and food price shocks from geopolitical tensions. This suggests the detected break represents persistent price re-leveling rather than temporary deviation. For monetary policy, these findings highlight the need for adequate shock absorption mechanisms and clear communication to re-anchor inflation expectations after external disturbances that fundamentally alter price formation.

3.3 Prophet Forecast

In this analysis, we employ the **Prophet** time series model to forecast the CPI, with the aim of estimating what the trajectory of CPI might have looked like in the absence of a structural break identified in **February 2022.** To ensure the model is trained on a stable inflation regime, we restrict the training period to data from **1996 to December 2021**, excluding the years **1990–1995**, which were marked by hyperinflation.

To stabilize variance and improve model performance, we apply a **log transformation** to the CPI series prior to modeling. Forecasts are generated through **May 2025**, after which we **back-transform the log forecasts to level terms**, applying the **Jensen's inequality correction** to obtain an **unbiased mean estimate**.

Model performance is evaluated using standard accuracy metrics—**RMSE, MAE, MAPE**, and others—calculated in **level units**. While achieving perfect forecast accuracy is not the primary goal, this counterfactual exercise aims to illustrate what the CPI path **would have been** had the structural break in late 2021 not occurred, as identified by the **Chow breakpoint test**.

Table 2. Forecast Accuracy Metrics and Dataset Summary for CPI Counterfactual Analysis (1996–2025)

Metric	Value
Root Mean Square Error (RMSE)	63.837
Mean Absolute Error (MAE)	62.803
Mean Absolute Percentage Error (MAPE)	23.42%
Mean Error (Bias)	62.803
Mean Absolute Scaled Error (MASE)	9.311
Correlation Coefficient	0.9418
Mean Actual CPI	265.95
Mean Forecast CPI	203.14
Standard Deviation of Errors	11.59
Training Period	1996-01 to 2022-02
Forecast Period	2022-03 to 2025-05
Training Observations	314
Forecast Observations	39

Source: elaborated by author based on IMF data

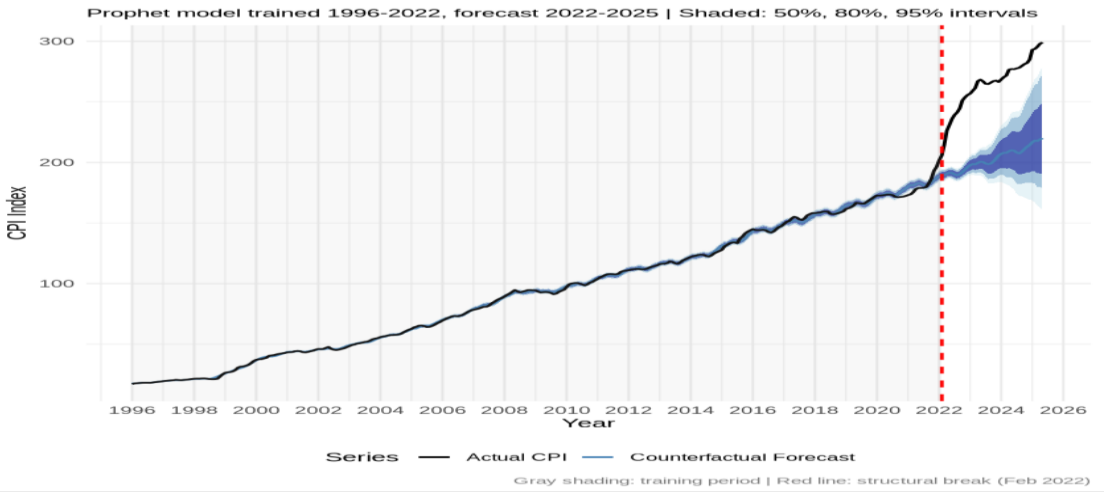

Figure 2. Prophet CPI forecast analysis
Source: elaborated by author based on IMF data

The Prophet counterfactual forecast evaluation reveals significant analytical insights through systematic performance assessment. Key accuracy metrics from Table 2 demonstrate substantial forecast deviations: RMSE of 63.84, MAE of 62.80, and MAPE of 23.42%, indicating proportional deviations between observed and counterfactual trajectories. The systematic bias of 62.80 index points toward underforecasting confirms the structural upward shift following February 2022. The Mean Absolute Scaled Error (MASE) of 9.31 indicates forecast errors exceed seasonal naive benchmarks by factor 9.3, highlighting the unprecedented nature of post-2022 economic dynamics. Despite substantial errors, the correlation coefficient of 0.9418 demonstrates robust linear relationships between actual and predicted values, suggesting intact underlying structural dynamics despite significant level shifts.

Fan chart visualization from Figure 2 provides critical insights into model performance and structural break characteristics. During the 1996-2022 training period, the model effectively captured historical CPI dynamics across confidence intervals. The February 2022 structural break marked sharp divergence from projected trajectories, with actual CPI consistently exceeding 95% confidence bands throughout the post-break period, confirming permanent regime change. Narrow confidence bands surrounding counterfactual forecasts indicate high model certainty regarding alternative trajectories absent structural disruption.

The counterfactual analysis reveals Republic of Moldova's CPI would have reached approximately 220 points by May 2025 without the February 2022 break, contrasting sharply with the observed 299 points—a 35.9% divergence. This represents fundamental economic repricing rather than temporary shock, exposing structural vulnerabilities previously masked during global stability periods. The gap escalated from 23.4% in 2022 to 35.5% by 2025, defying conventional mean-reverting dynamics and suggesting self-reinforcing mechanisms including wage-price spirals and unanchored inflation expectations.

Welfare implications prove severe, with consumption losses reaching 15.1% (welfare loss ≈ 0.5*price increase) amid 30.2% average price increases across 40 months. Lower-income households experienced disproportionate hardship, amplifying aggregate social costs. The volatility analysis reveals the most striking transformation: actual inflation volatility increased 35.4-fold (was calculated by dividing the standard deviation of actual YoY inflation (5.728) by that of the counterfactual series (0.1618)) relative to counterfactual baselines, indicating fundamental breakdown in price stability mechanisms. The negative correlation (-0.094) between

actual and counterfactual inflation rates demonstrates complete severance from historical determinants.

3.4 Semi-Log (Log-Linear) Exponential Decay Model

Table 3. Result of Log-Linear model (2022m06 2025m05)

term	estimate	std.error	t-Statistic	p.value
(Intercept)	3.32534157818699	0.0242945158411551	137.0475691525546	3.1994189825336e-48
months_since_break	0.00623518521003879	0.00101279219877896	6.2176680580376	4.4993289521686 8e-07

Model Fit Statistics						
r.squared	**adj.r.squared**	**sigma**	**statistic**	**p.value**	**df**	**logLik**
0.5321	0.5183	0.0634	38.6594	4.4993e-7	1	49.2227

Source: elaborated by author based on IMF data

Shock persistence analysis yields from Table 3 concerning results with estimated monthly decay rate of - 0.6325% per month (the model estimates **how quickly the inflation gap closes** after a shock by modeling the **exponential decay** of the gap over time and translating it into an interpretable **half-life**), so the gap is increasing slightly over time rather than decaying, implying effectively infinite half-life for actual-counterfactual divergence. This suggests that the shock to CPI in February 2022 created a **persistent divergence** rather than a temporary deviation. The actual CPI continues to diverge from what would have been expected based on the pre-break trend, indicating a permanent structural change rather than a temporary shock that dissipates over time. The exponential growth pattern implies that without policy intervention or other structural changes, the gap between actual and counterfactual CPI will continue to widen over time.

This contradicts standard models expecting shock dissipation through market adjustments, suggesting fundamental deficiencies in Republic of Moldova's adjustment mechanisms reflecting structural rigidities, extreme import dependence, and insufficient financial buffers.

These findings challenge theoretical propositions regarding small open economies. The insulation hypothesis proves inadequate for import-dependent economies where currency depreciation amplifies external pressures. Pre-2022 stability likely reflected borrowed credibility from favorable global conditions rather than robust domestic frameworks. The analysis exposes multiple vulnerability layers: cascading price effects from intermediate input dependence, absence of automatic stabilizers, and fragile expectation formation mechanisms.

The evidence suggests conventional stabilization measures cannot restore pre-shock equilibrium, necessitating comprehensive structural transformation. Policy priorities must focus on vulnerability reduction through energy independence, import substitution, and institutional reform to build credible monetary frameworks. The February 2022 break serves as both catastrophe and revelation, quantifying the ongoing cost of structural vulnerabilities that compound continuously while fundamental weaknesses persist unaddressed.

4. Conclusion and recommendations

This in-depth analysis of the Republic of Moldova's inflationary trends from 1991 to 2025 offers significant understandings of the underlying vulnerabilities and macroeconomic obstacles facing small economies in transition within an increasingly volatile global environment. The research clarifies that the Republic of Moldova's economic trajectory has been deeply shaped by two related but distinct occurrences: the disastrous hyperinflationary period during the early post-Soviet transition and the significant structural shift identified in February 2022. By utilizing rigorous methods for identifying structural breaks and counterfactual forecasting, this study measures the lasting spread of external shocks and reveals the inadequacy of conventional stabilization tools in lessening systemic economic weaknesses.

The empirical evidence strongly supports the concept of a permanent structural transformation in the Republic of Moldova's price-setting models after February 2022. Chow breakpoint analyses provide clear statistical confirmation of regime change, while the Prophet-based counterfactual assessment indicates a 35.9% difference between observed and predicted CPI paths by May 2025. This difference is more than a temporary adjustment to external pressures; it signifies a fundamental repricing of the economy marked by self-sustaining dynamics that go against typical mean-reversion models. The predicted infinite half-life of the structural break's effects highlights the severity of the Republic of Moldova's adaptation limitations and emphasizes the need for proactive policy actions to restore macroeconomic stability.

The welfare consequences of this investigation are particularly alarming, with projected consumption declines of 15.1% affecting marginalized groups disproportionately and worsening existing socioeconomic inequalities. The 35.4-fold increase in inflation volatility compared to counterfactual benchmarks indicates a widespread breakdown of price stability mechanisms, creating an environment inherently unfavorable to sustained economic progress. These findings challenge optimistic assessments of the resilience of small open economies and demonstrate that dependence on imports, when combined with institutional shortcomings, can amplify rather than reduce external disturbances. The prolonged nature of the inflationary pressures suggests that the Republic of Moldova's pre-2022 relative stability stemmed from favorable global conditions rather than from robust domestic policy frameworks.

Recommendations.

Based on this analysis, several critical policy interventions are essential for addressing Republic of Moldova's structural vulnerabilities and restoring macroeconomic stability.

Energy Security: Immediate priority should focus on diversifying energy sources, investing in renewable infrastructure, and establishing strategic reserves to reduce dependence on volatile external suppliers—addressing the primary transmission channel of the February 2022 shock.

Monetary Policy Reform: The framework requires restructuring through explicit inflation targeting with clear communication, strengthened central bank independence, and sophisticated macroprudential tools. Conventional instruments have proven inadequate for managing import-dependent economies facing external shocks.

Fiscal Policy Enhancement: Comprehensive reforms should establish automatic stabilizers including sovereign wealth funds, countercyclical fiscal rules, and robust social protection systems to mitigate welfare costs during crises.

Economic Transformation: Long-term structural reforms through strategic import substitution and export diversification are imperative. Priority sectors include food security, essential medical supplies, and critical manufacturing inputs, supported by human capital and technological development.

Regional Cooperation: Strengthening initiatives for collective shock management through deeper EU integration, and collaborative frameworks for energy security and food price volatility can reduce individual country vulnerability.

These interconnected reforms address the fundamental vulnerabilities revealed by the February 2022 structural break and provide a comprehensive framework for building resilience against future external shocks.

References:

1. International Monetary Fund (IMF). *International Financial Statistics*. Available at: https://www.imf.org/en/Data (Accessed: 23 June 2025).
2. Taylor, S.J. and Letham, B. (2018) 'Forecasting at scale', *The American Statistician*, 72(1), pp. 37–45. doi: 10.1080/00031305.2017.1380080.