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Anchoring Firms’ Inflation Expectations in Ukraine: Assessing Shock and Level Anchoring with a VAR Approach

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EDITOR'S NOTE

The editors wish to acknowledge the extraordinary circumstances under which this research was completed. After presenting the results of this study at the 2024 Annual Conference for Students and Young Researchers of the National Bank of Ukraine and submitting the initial version of this paper, the lead author, Vitaliy Kramar, voluntarily joined the National Guard of Ukraine to defend his country.

Despite the demanding conditions of active military service, he continued to contribute to the revisions and finalization of the manuscript, demonstrating a profound commitment to Ukraine – both through his military service and through the advancement of knowledge that is essential now and for the future. The results of this study were incorporated into the NBU's *Inflation Report* and informed the NBU's policy-making process.

We express our deepest respect and gratitude to Vitaliy for his exceptional dedication on both fronts: safeguarding Ukraine and enriching the field of economic research whose insights support critical policy decisions.

ANCHORING FIRMS' INFLATION EXPECTATIONS IN UKRAINE: ASSESSING SHOCK AND LEVEL ANCHORING WITH A VAR APPROACH

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Abstract

This paper investigates the degree of anchoring of firms' inflation expectations in Ukraine over 2006-2025. Using a VAR model, we decompose inflation anchoring into two components: shock anchoring, which captures the sensitivity of inflation expectations to temporary shocks to inflation and expectations, and level anchoring, which reflects the perceived long-term inflation target. We extend the model to a time-varying framework with stochastic volatility to assess the stability of the estimated coefficients and track the evolution of anchoring over time. Our findings reveal that while firms' inflation expectations are moderately responsive to temporary shocks, the long-term perceived inflation anchor remains substantially higher than the central bank's target. Time-varying analysis shows that shock anchoring has remained relatively stable throughout the estimation period. However, the long-term inflation anchor experienced a considerable decline following the adoption of inflation targeting and disinflation, with a further increase triggered by the COVID-19 pandemic and russia's full-scale invasion of Ukraine. These dynamics highlight the challenges facing monetary policy in maintaining inflation expectations and the growing risk of de-anchoring if the gap between the perceived long-term anchor and the central bank's target continues to widen.

JEL Codes D84, E31, E37, E52

Keywords inflation expectations, Ukraine, anchoring, Bayesian VAR, stochastic volatility

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1. INTRODUCTION

Inflation expectations play a critical role in shaping monetary policy aimed at ensuring price stability. These expectations influence price and wage setting, as well as decisions related to consumption, investment, borrowing, and saving through their impact on perceived real interest rates. When agents anticipate higher inflation, they adjust their behavior accordingly, potentially increasing the persistence of inflation and its sensitivity to shocks. Anchoring inflation expectations to the central bank's target enhances the stability of both nominal and real economic conditions. In such scenarios, monetary policy can adopt a more expansionary stance during recessionary demand shocks and a less restrictive stance during inflationary supply shocks (Bernanke, 2022). In contrast, when inflation expectations are unanchored, central banks must preemptively tighten policy to reassure economic agents of their commitment to maintaining price stability. Well-anchored inflation expectations thus serve as automatic stabilizers and improve the effectiveness of monetary policy transmission.

In Ukraine, the period prior to 2015 was characterized by a de facto fixed exchange rate regime, which led to persistent inflation volatility and limited tools for managing inflation expectations. This regime constrained the National Bank of Ukraine’s (NBU) ability to respond to inflationary shocks effectively and undermined public confidence in monetary policy. To address these challenges, the NBU adopted an Inflation Targeting (IT) regime in August 2015, with the goal of anchoring inflation expectations at low and stable levels through an explicitly declared quantitative target. This shift was crucial in building up the central bank’s credibility and the overall anchoring of inflation expectations (Savolchuk and Yukhymenko, 2023).

However, the full-scale russian invasion in February 2022 introduced unprecedented economic uncertainty, disrupted supply chains, and weakened the effectiveness of the IT regime. The NBU was forced to temporarily suspend IT, and implement a fixed USD/UAH exchange rate to stabilize the currency and prevent financial panic. Despite these challenges, inflation expectations continued to play a central role in monetary policy decisions. In 2023, the NBU transitioned to a managed flexibility exchange rate regime, and in 2024, it adopted a flexible inflation targeting framework with a quantified target of 5% (NBU, 2024). This flexible IT regime allows for a longer policy horizon and the use of multiple policy instruments to swiftly respond to shocks while maintaining a focus on long-term stability.

While the NBU has successfully maintained macroeconomic and financial stability during this turbulent period, the Ukrainian economy remains vulnerable to stagflationary supply shocks and elevated uncertainty. These conditions pose a significant risk of de-anchoring inflation expectations, complicating the central bank’s efforts to achieve price stability. Understanding how temporary inflationary shocks influence expectations and assessing the perceived long-term inflation target is thus crucial for effective monetary policy.

This paper investigates whether inflation expectations in Ukraine are sensitive to temporary shocks and whether they remain anchored to the central bank's long-term target. First, we employ a time-invariant VAR model to analyze firm-level inflation expectations data from 2006 to 2025. This approach allows us to decompose inflation expectations into two components: shock anchoring (the sensitivity to temporary shocks) and level anchoring (the stability of the long-term perceived target). Second, to capture potential changes over time, we extend our analysis with a time-varying coefficient model with stochastic volatility. This dual approach helps us understand the dynamics of expectations in both stable and crisis periods.

Our findings from our time-invariant model indicate that inflation expectations in Ukraine exhibit moderate sensitivity to temporary shocks. The estimated adaptability parameter is about 22%, suggesting that firms’ expectations are relatively anchored to a long-term perceived level. However, this perceived level is approximately 13%, significantly higher than the NBU's target of 5%. The time-varying analysis reveals that after the IT regime was implemented, the degree of adaptability fell from 35% to 25%, and only gradually rose to 28% after the COVID-19 and full-scale invasion shocks. Although the change in the degree of adaptability is not statistically significant over the entire analysis period, these dynamics indicate a relative anchoring of firms’ expectations around a certain long-term level, even in extreme conditions. The long-term perceived target, in contrast, showed a more pronounced declining trend after the adoption of inflation targeting in 2015. Unfortunately, this trend reversed following the COVID-19 pandemic and the full-scale invasion, with the perceived target averaging around 11.5%. These results suggest that while IT improved the anchoring of expectations, external shocks and crises have hindered further progress.

Our study contributes to the growing literature on inflation expectations in Ukraine, which examines the factors influencing these expectations (e.g., Coibion and Gorodnichenko, 2015; Yukhymenko, 2022; Yukhymenko and Sorochan, 2024), the role of central bank credibility (e.g., Savolchuk and Yukhymenko, 2023), and the impact of financial literacy (e.g., Tsapin and Faryna, 2024). By focusing on both shock- and level-anchoring, we provide new insights into the stability of expectations and the effectiveness of monetary policy in a volatile environment. Our findings also underscore the importance of central bank credibility and the need for continued policy adjustments to maintain well-anchored expectations.

The remainder of this paper is structured as follows. Section 2 reviews the existing literature on inflation expectations in Ukraine and previews the data. Section 3 introduces the analytical framework, drawing on the expectations-augmented Phillips curve and the methodology of Bomfim and Rudebusch (2000). Section 4 presents the results of our time-invariant and time-varying models, including impulse responses and parameters for shock and level anchoring. Section 5 concludes with key findings and policy implications.

2. INFLATION EXPECTATIONS IN UKRAINE

The concept of anchoring inflation expectations lacks a universally accepted definition or measurement methodology, leading to diverse approaches shaped by specific definitions and data choices. In this section, we discuss the evolution of monetary policy in Ukraine, systematize the growing research on inflation expectations, and provide an overview of the data used in this study.

Since August 2015, the NBU has implemented an IT regime, transitioning from a de facto fixed USD/UAH exchange rate. The primary goal of this shift was to anchor inflation expectations at low and stable levels through explicitly declared quantitative targets. Initially, the NBU set inflation targets of 12% ±3 percentage points in December 2016, before settling on a consistent 5% ±1 percentage point medium-term target since December 2019. The monetary policy decisions under this regime aimed to achieve the inflation target within a 9-18 month horizon, specifically addressing one-year-ahead inflation expectations. To enhance transparency and aid economic agents in forming expectations, the NBU began publishing inflation forecasts.

However, the full-scale russian invasion in 2022 introduced extreme uncertainty, significantly undermining the effectiveness of market-based monetary instruments. In response, the NBU temporarily suspended the IT regime and adopted a fixed USD/UAH exchange rate to maintain macroeconomic stability. Despite this temporary shift, the NBU expressed a commitment to returning to a floating exchange rate and resuming the IT regime once conditions stabilize.

In the interim, the NBU introduced a managed exchange rate flexibility approach combined with flexible inflation targeting. Under this approach, the central bank continues to target a medium-term inflation rate of 5%, but the monetary policy horizon extends up to three years. This extended horizon allows the NBU to react swiftly to shocks while maintaining macroeconomic and financial stability. To enhance policy transmission, the NBU utilizes multiple instruments, including conventional interest rate adjustments, foreign exchange market interventions, and capital controls. This flexible framework accommodates temporary deviations from the inflation target, provided they do not threaten to de-anchor expectations. Consequently, managing inflation expectations through transparent communication, independence, and credibility-building measures remains central to the NBU’s strategy.

Inflation expectations in Ukraine have been extensively studied, with researchers examining various dimensions to understand how these expectations are formed and evolve. Several factors influence expectations, including exchange rate movements, media narratives, and central bank credibility. Both firms and households take into account past and expected inflation, but their expectations remain weakly anchored. Trust in financial institutions and financial literacy also play significant roles, with more informed individuals exhibiting lower and more stable expectations.

Notable contributions to the literature have highlighted these dynamics. Coibion and Gorodnichenko (2015) found a strong link between inflation and exchange rate expectations, showing how exchange rates signal broader price trends. Zholud et al. (2019) observed that firms’ and households’ expectations are shaped by both historical and forward-looking inflation, yet remain weakly anchored to the NBU’s target. Grui et al. (2023) documented an improvement in inflation expectations, though biases persist, with exchange rate shocks influencing firms’ expectations. Yukhymenko (2022) emphasized the media's role in shaping expectations, while Yukhymenko and Sorochan (2024) demonstrated that monetary policy announcements could moderate expert expectations. Savolchuk and Yukhymenko (2023) underscored the importance of central bank credibility in stabilizing firms’ expectations and reducing sensitivity to past inflation deviations. Additionally, Tsapin and Faryna (2024) identified a relationship between financial literacy and lower household inflation expectations, particularly among those with unanchored expectations.

The concept of anchoring inflation expectations is often associated with the behavior of longer-term expectations, as these play a crucial role in signaling a central bank's credibility and facilitating effective monetary policy implementation. However, recent studies by Werning (2022) and Hajdini (2023) suggest that long-term expectations may have a limited impact on current inflation. Similarly, Mehrotra and Yetman (2018) show that the time it takes for inflation forecasts to converge to their steady-state levels varies across economies, indicating that the length of the medium-term horizon can be state-dependent. In other words, the selection of a particular horizon by the central bank does not guarantee that inflation expectations are anchored in the short run.

Shorter-term expectations can provide early warning signals about potential risks of de-anchoring long-term expectations. Domit et al. (2015) argue that short-term expectations reflect how quickly agents expect inflation to return to the target following a shock. If agents foresee a slower-than-anticipated convergence, this may indicate emerging risks to the anchoring of longer-term expectations. Łyziak and Paloviita (2018) add that when short-term inflation expectations resemble the central bank's forecasts, it may indicate either that the central bank effectively manages these expectations, or that private agents simply process available information similarly to the central bank. In either case, short-term expectations aligned with the central bank's expected inflation trajectory suggest that agents' views are consistent with monetary authorities' objectives.

Measuring inflation expectations poses a challenge because they are not directly observable. This study relies on survey data collected by the NBU since February 2006, focusing on the expectations of non-financial firms. The quarterly survey, which targets approximately 700 firms, is conducted in the second month of each quarter, with selections based on quotas representing the economic structure. The survey measures one-year-ahead annual CPI inflation expectations, with respondents choosing from predefined intervals. The mean response is used to construct the expectations series. This dataset is particularly valuable due to its relevance to economic decision-making, as firms' expectations directly influence pricing, wage-setting, employment, and investment decisions. Furthermore, the NBU's firm-level survey provides the longest available time series for inflation expectations compared to other respondent groups.

The dataset spans from the first quarter of 2006 to the first quarter of 2025, covering several significant periods of economic disruption (see Figure 1). These include the Global Financial Crisis of 2008-2009, the initial russian invasion in 2014, and the full-scale invasion in 2022. Inflation expectations spiked during each of these crises. Despite improvements following the adoption of IT from 2016 to 2020, firms' expectations consistently exceeded the NBU's targets.

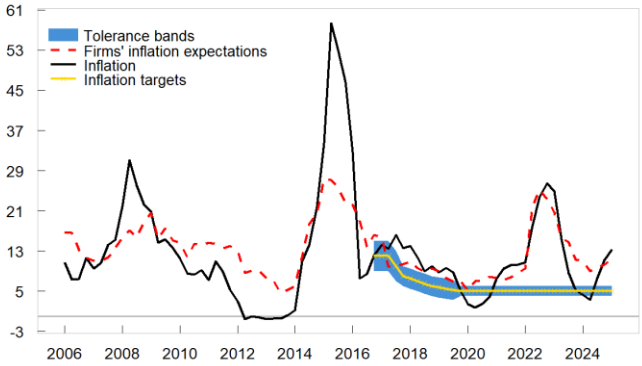


Figure 1. Actual Inflation and Firms' Inflation Expectations in Ukraine, %

Source: State Statistics Service of Ukraine, NBU.

Descriptive statistics reveal important trends across the data. Firms' inflation expectations have shown greater stability compared to actual inflation, but remain persistently above the NBU's target (see Table 1). Over the first two sub-samples, both inflation and expectations exhibited a declining trend and reduced volatility. However, in the final sub-sample, corresponding to the full-scale invasion, both the levels and volatility of inflation and expectations increased notably.

Table 1. Descriptive Statistics

Sample	06q1-25q1		06q1-13q4		16q2-22q1		22q2-25q1	
	π	π^e	π	π^e	π	π^e	π	π^e
Min.	-0.5	4.7	-0.5	4.7	1.7	5.1	3.3	9
1st Qu.	7.3	9.0	4.7	11.1	7.5	7.6	6.9	10.8
Median	10.3	11.8	9.4	13.8	9.6	9.0	12.3	13.2
Mean	12.7	13.2	10.1	13.0	9.2	9.7	13.5	15.4
3rd Qu.	14.7	15.8	14.3	15.5	11.8	10.1	19.5	21.0
Max.	58.4	27.3	31.1	20.6	16.2	18.9	26.5	25.2

This analysis underscores the importance of understanding the anchoring of inflation expectations, particularly in an environment of ongoing economic shocks and monetary policy adjustments. Our preliminary assessment of the data reveals that addressing anchoring from different angles is crucial. Specifically, it is essential to explore whether the volatility in inflation expectations stems from sensitivity to current shocks, as well as the extent to which the long-term perceived inflation rate aligns with the central bank's target. This multifaceted approach can provide deeper insights into the effectiveness of monetary policy and the factors influencing the stability of inflation expectations in Ukraine.

3. ANALYTICAL FRAMEWORK

This section outlines the theoretical and empirical underpinnings for assessing the anchoring of inflation expectations in Ukraine. It provides a conceptual framework for distinguishing between different dimensions of anchoring, explains how these concepts are integrated into a structural economic model, and describes the empirical methods used to estimate time-varying parameters. This section sets the stage for the subsequent empirical analysis of shock and level anchoring, their evolution over time, and their relationship with monetary policy regimes.

Assessing the anchoring of inflation expectations requires considering both their alignment with the central bank's target and their sensitivity to short-term shocks. Ball and Mazumder (2011) distinguish between two core aspects: shock anchoring, which refers to the stability of expectations despite temporary disturbances, and level anchoring, which reflects how closely expectations align with the central bank's target over time. Kumar et al. (2015) propose metrics that emphasize how closely expectations track the target, the extent of dispersion among agents, the confidence in forecasts, the magnitude of forecast revisions, and the co-movement between short- and long-term expectations. Similarly, the ECB (2021) categorizes research findings into two main approaches: one based on the proximity of expectations to the central bank's target and another on their sensitivity to short-term developments.

The anchoring condition influences whether the output gap affects the level of inflation or changes in inflation. The expectations-augmented Phillips curve illustrates this relationship:

$$\pi_t = \pi_t^e + \alpha \hat{y}_t + \beta s_t + \varepsilon_t, \tag{1}$$

where π_t is the inflation rate; π_t^e represents inflation expectations; $\hat{y}_t$ is the output gap; s_t captures relative price changes (such as oil prices or exchange rates); and ε_t is a cost-push shock.

The formation of inflation expectations is often modeled using the framework proposed by Bomfim and Rudebusch (2000):

$$\pi_t^e = \lambda \pi^* + (1-\lambda)\pi_{t-1}, \tag{2}$$

where $\lambda \in [0,1]$ measures the weight that agents place on an implicit long-term inflation anchor π^*. When $\lambda = 0$, expectations rely entirely on past inflation π_{t-1}, making the output gap influence the change in inflation rather than the inflation level. This scenario increases inflation persistence. As λ approaches 1, expectations become firmly anchored to π^* and are less responsive to temporary shocks, allowing the Phillips curve to represent a stable relationship between the output gap and the inflation level.

However, even if expectations are not influenced by past inflation, they are not truly anchored if π^* deviates from the central bank's target π^T. A persistent difference between π^* and π^T exerts ongoing pressure on inflation. Full anchoring thus requires both $\lambda = 1$ and $\pi^* = \pi^T$. Equation (2) therefore captures two related but distinct concepts: the responsiveness of expectations to inflation spikes (shock anchoring) and the alignment of the long-term perceived rate with the target (level anchoring).

To empirically assess these theoretical constructs and quantify their interplay, we employ a bivariate VAR(p) model that links inflation and inflation expectations through their lagged values. We follow the method introduced by Demertzis et al. (2012):

$$\pi_t = a_0 + a(L)\pi_{t-1} + b(L)\pi_{t-1}^e + e_{1t}, \tag{3}$$

$$\pi_t^e = c_0 + c(L)\pi_{t-1} + d(L)\pi_{t-1}^e + e_{2t}, \tag{4}$$

In the long-run equilibrium, we can derive λ_t and π^*:

$$\lambda = 1 - \frac{c(L)}{1-d(L)}, \tag{5}$$

$$\pi^* = \frac{c_0}{(1-d(L))\lambda}, \quad (6)$$

The parameter λ may exceed one if $c(L) < 0$, implying a negative relationship between inflation and expectations, though such cases generally lack straightforward economic interpretation. The degree of adaptability, or the sensitivity of expectations to inflation spikes, is given by $(1-\lambda) \times 100$. If expectations are fully anchored, a shock in actual inflation would have no effect on them, implying that the impulse response functions (IRFs) of expectations to such shocks are zero.

Since the anchoring of inflation expectations may change over time due to shifts in policy frameworks or evolving economic conditions, it is essential to allow for time variation in the parameters. A Bayesian VAR model with time-varying parameters and stochastic volatility (TVP-VAR-SV) can capture gradual changes in both the conditional mean parameters (reflecting policy changes) and the error covariance matrix (reflecting time-varying shocks).

This modeling strategy is particularly pertinent to Ukraine's monetary landscape. The country's transition from a de facto fixed exchange rate to an IT framework, combined with recent geopolitical and economic shocks, is likely to have influenced the stability of inflation expectations. A time-varying model is well-suited to capturing such dynamics, as it can identify periods when expectations were better anchored and times when they may have become more sensitive to inflationary pressures.

Several studies support the relevance of adopting a TVP-VAR-SV framework. Mehrotra and Yetman (2018) find a decline in anchors over time for most economies, while Yetman (2020) also reports an increase in the number of economies with anchored expectations over time, particularly under inflation targeting regimes. Moessner and Takáts (2020) highlight that persistent deviations from inflation targets, especially on the high side, can loosen long-term anchoring. Kose et al. (2019) link improved anchoring in Emerging Market and Developing Economies (EMDEs) to the adoption of IT and enhanced central bank transparency, although expectations in EMDEs remain less anchored than in Advanced Economies (AEs). Bems et al. (2021) document a significant improvement in the anchoring of inflation expectations worldwide, while noting weaker anchoring in emerging economies, influenced by factors such as central bank independence, fiscal rules, and policy transparency.

This study employs a TVP-VAR-SV framework following Primiceri (2005) and Del Negro and Primiceri (2015). The model assumes gradual changes in VAR coefficients and the error covariance matrix, thereby capturing shock heteroscedasticity and nonlinearities in simultaneous relationships. We assume a two-lag model based on marginal likelihood criteria and parametrize it using a grid search process to balance model complexity and fit. The inference is performed using a Markov Chain Monte Carlo (MCMC) sampler developed by Del Negro and Primiceri (2015). A detailed description of the TVP-VAR-SV model and parametrization is presented in the Appendix.

In summary, this analytical framework allows for a comprehensive examination of both shock and level anchoring in inflation expectations, using state-of-the-art econometric methods that account for time-varying relationships and stochastic volatility. Such a framework provides nuanced insights into how and when inflation expectations become more or less anchored, and how monetary policy regimes and economic conditions influence the stability of these expectations.

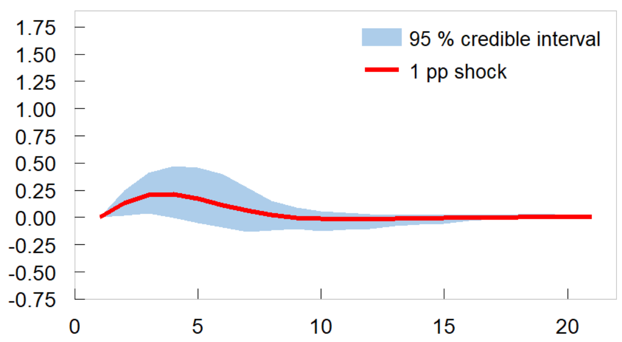
4. RESULTS

This section presents the empirical findings and analyzes them in the context of Ukraine's evolving monetary policy environment. We begin by examining a time-invariant VAR(2) model (equations 3 and 4) to establish baseline relationships between inflation and inflation expectations, and then proceed to a time-varying parameter VAR model with stochastic volatility. This approach allows us to understand how these relationships evolve under changing policy regimes and economic conditions, including the introduction of IT, the COVID-19 pandemic, and the full-scale russian invasion.

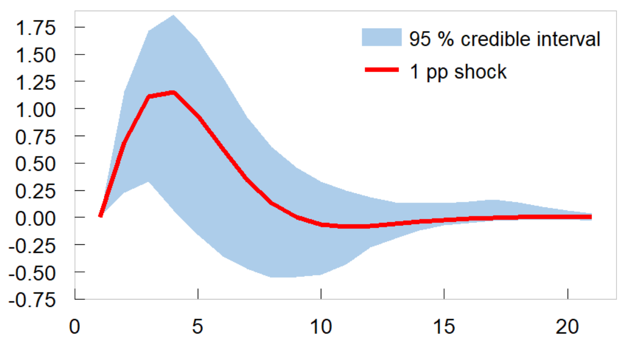
Our initial analysis uses a VAR(2) model to measure how shocks to one variable influence the other, using impulse responses to a 1% orthogonal shock (IRFs). Figure 2 shows that while inflation shocks affect inflation expectations, the influence is moderate compared to the effect of shocks to expectations on the expectations variable itself. Expectations also exert a significant influence on future inflation, comparable to inflation's own persistence. These findings suggest that the expectations channel is strong, but that inflation expectations are only moderately responsive to current inflation shocks. The response of inflation to its own shock appears somewhat large, as the inflation sample contains outliers due to the crisis of 2014-2015. However, we did not remove these outliers, as we are studying the impact of an expectations shock on inflation and it is important to account for such crisis-related structural changes in the economy.

Applying equations (5) and (6), we find that the degree of adaptability of expectations to past inflation $(1-\lambda)$ is 22.18%, which is relatively moderate, and the perceived anchor level π^* stands at 13.06%. This suggests that while expectations are moderately stable in the face of inflation and expectations shocks (considerable shock anchoring), they do not align closely with the central bank's inflation target (low level anchoring). In other words, expectations remain insulated from short-term fluctuations in inflation, but they hover considerably above the target, indicating incomplete anchoring at the desired level.

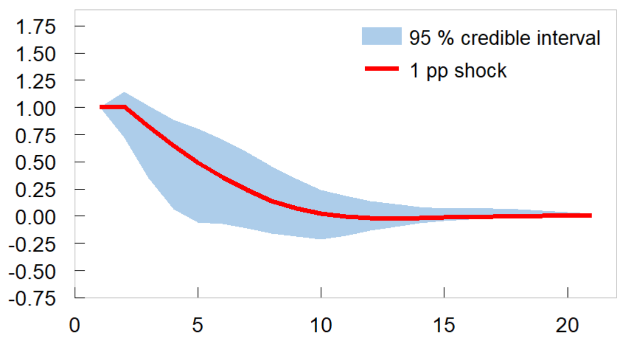
To investigate whether this relationship holds over time and under changing policy regimes, we turn to a time-varying parameters VAR model with stochastic volatility. By allowing parameters to evolve, we can better capture shifts associated with the introduction of IT and other structural changes in Ukraine's economy, such as the COVID-19 pandemic and the full-scale russian invasion.



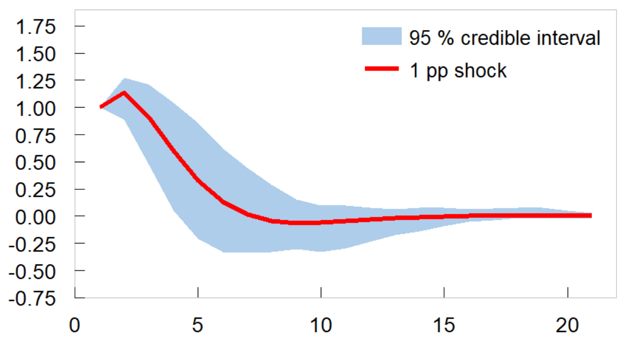
a) Response of expectations to inflation



b) Response of inflation to expectations



c) Response of expectations to expectations



d) Response of inflation to inflation

Figure 2. Impulse responses of inflation and inflation expectations to a 1 pp shocks in inflation and expectations

Notes: Horizon in quarters.

Source: Author's calculations.

Table 2 shows that the model with time-varying parameters in both equations offers a slightly higher marginal likelihood than the constant-parameter model (standard deviation in parentheses). Although the evidence favoring time variation is modest, previous research (Mehrotra and Yetman, 2018; Yetman, 2020) suggests that the anchoring of expectations in Ukraine is unlikely to be static. We therefore proceed with the time-varying specification, which is particularly pertinent given Ukraine's transition from a de facto fixed exchange rate to IT, as well as the further structural changes and regime shifts that occurred after the COVID-19 pandemic and the full-scale russian invasion.

Table 2. Log Marginal Likelihood Estimates for Various Models

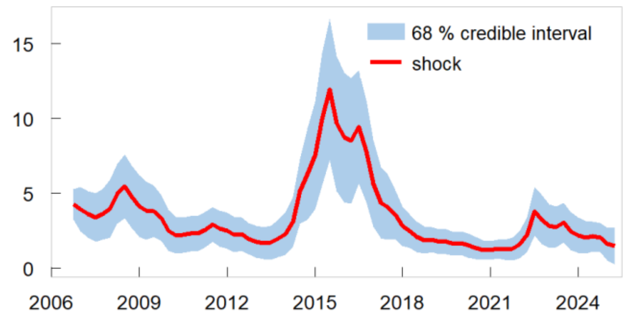
Model Specification	Log marginal likelihoods
Both equations are constant	-810.94 (17.94)
Both equations are time varying	-809.53 (38.30)

Examining the influence of shocks under the time-varying model, we find that changes in impulse responses often stem more from variations in shock magnitudes than from shifts in underlying coefficients. As illustrated in Figure 3, which plots the posterior median of the standard deviation of shocks to inflation and expectations, inflation shocks peak during the 2014-2015 hryvnia devaluation before declining, while expectations shocks surge following the full-scale russian invasion. These patterns suggest that while structural parameters may remain relatively stable, the intensity of shocks fluctuates over time, especially during periods of heightened uncertainty.

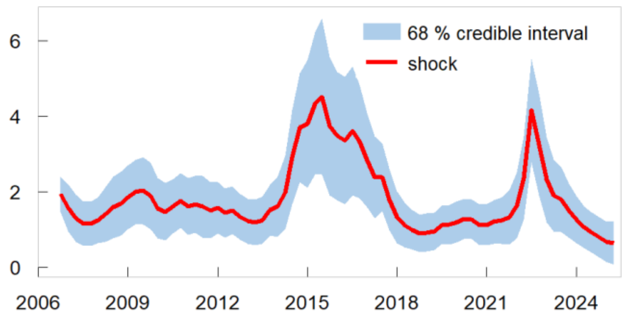
Conditioning on shock magnitude, the time-varying impulse responses show that the impact of inflation shocks on inflation expectations remains broadly consistent throughout the sample period, as does the impact of shocks to expectations on the expectations variable itself. This stability, shown in Figure 4, indicates that the degree of shock anchoring does not depend on shock magnitude, even in stagflationary conditions.

In contrast, Figure 5 reveals more pronounced nonlinearity in how inflation responds to expectations shocks over time. After the introduction of IT, inflation becomes more sensitive to expectations shocks, and while this link moderates slightly during the COVID-19 pandemic and the full-scale russian invasion, it remains stronger than in the pre-IT era. This pattern suggests that improved policy credibility and clearer communication may have enhanced the role of expectations in shaping inflation outcomes.

To further understand how adaptability and level anchoring evolve, we compute time-varying parameters for $(1-\lambda)$ and π^* according to equations (5) and (6) and compare them to time-invariant estimates.[1]



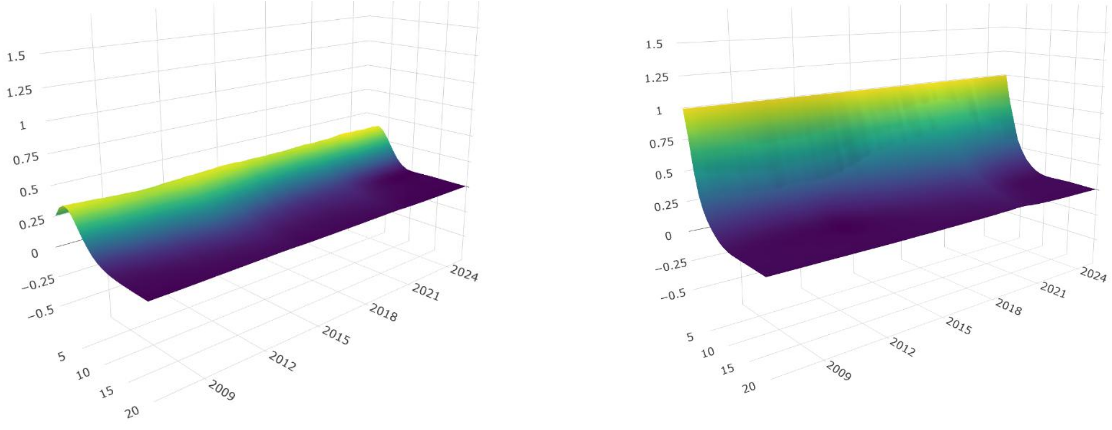
a) Inflation Shocks



b) Expectation Shocks

Figure 3. Posterior median of the standard deviation of shocks to inflation and inflation expectations (in pp)
Source: Author's calculations.

[1] The results for the degree of adaptability $(1-\lambda)$ and the expectations "anchor" π^* derived from both of the approaches used do not necessarily have to coincide. The standard linear approach may have biased estimates due to the inability to account for non-linearities. In contrast, the time-varying coefficient model also includes stochastic volatility, which affects the interaction and values of the variable coefficients. Accounting for these factors increases the accuracy of the reflection of real economic phenomena (Primiceri, 2005; Nakajima, 2011; Lubik and Matthes, 2015). Accordingly, the linear VAR model slightly overestimates the long-run anchor level for inflation and underestimates the degree of adaptability to shocks.



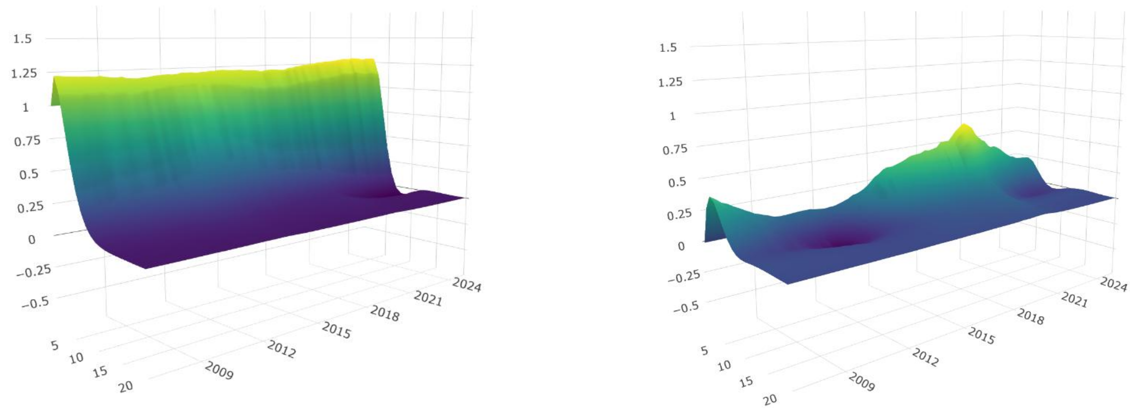
a) Shock to Inflation

b) Shock to Expectations

Figure 4. Time-varying impulse response of inflation expectations to 1 pp shocks to inflation and inflation expectations

Notes: Horizon in quarters and dates on horizontal axes.

Source: Author's calculations.



a) Shock to inflation

b) Shock to expectations

Figure 5. Time-varying impulse response of inflation to 1 pp shocks to inflation and inflation expectations

Notes: Horizon in quarters and dates on horizontal axes.

Source: Author's calculations.

Figure 6 shows a minor decline in adaptability over time, indicating slightly stronger shock anchoring, though not statistically pronounced. Some improvement coincides with IT adoption, a period when inflation became more responsive to expectations. Notably, neither the pandemic nor the invasion significantly worsened adaptability or caused de-anchoring effects. Figure 7 plots the time-varying perceived anchor. Initially anchored at about 13%, the perceived level began declining before the introduction of IT, reflecting the influence of earlier low-inflation episodes. Improved communication and a gradual reduction in announced targets aligned expectations closer to the NBU's goal. By 2019, with actual inflation even below target, the perceived anchor stood near 8.5%. Although it rose somewhat during the pandemic and after the full-scale russian invasion, it remained around 11.5% by 2025 – lower than at the start, but still above the target band.

In summary, the time-varying approach enriches our understanding compared to the time-invariant model. While shock anchoring remains consistently strong and adaptability does not markedly deteriorate, level anchoring – although improved – has not fully converged to the central bank's target. Policy changes, especially the shift to IT and better communication, appear to have supported more stable and credible expectations formation.

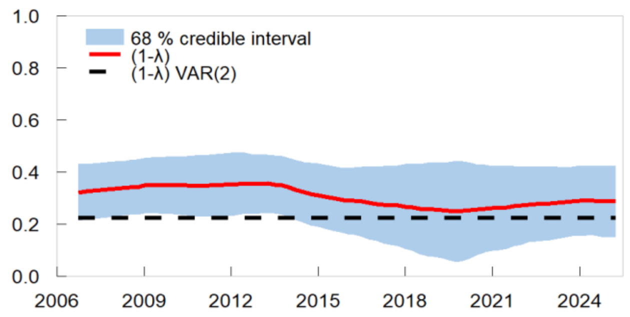


Figure 6. Time-varying degree of adaptability $(1-\lambda_t)$ versus the time-invariant VAR(2) model

Source: authors' estimates.

Note: $(1-\lambda_t)$ – degree of adaptability of the model with time-varying coefficients; $(1-\lambda_t)$ VAR(2) – degree of adaptability of the linear model.

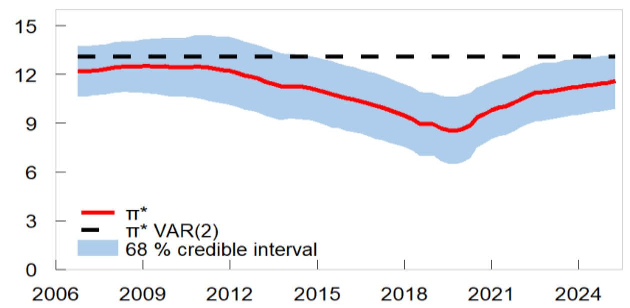


Figure 7. Time-varying level of anchoring (π_t^*) versus the time-invariant VAR(2) model

Source: authors' estimates.

Note: π_t^* – level of anchoring of the model with time-varying coefficients; π_t^* VAR(2) – level of anchoring of the linear model.

However, a lower anchor level after IT adoption also coincides with a greater response of inflation to inflation expectations shocks, which highlights the increased role of a sound expectations management policy. Hence, fully anchored expectations at the target level require sustained credibility, enhanced transparency, and the flexibility to adjust policy tools during turbulent periods.

At the same time, our findings underscore that anchoring conditions can be resilient even amid significant shocks. They also carry important implications for policymakers aiming to align expectations more closely with stated targets and minimize the destabilizing effects of large, uncertain shocks.

5. CONCLUSIONS

This study provides insights into the anchoring of firms' inflation expectations in Ukraine over a period marked by significant economic and geopolitical challenges. By decomposing inflation expectations into shock and level anchoring components and employing both time-invariant and time-varying VAR models with stochastic volatility, we offer a nuanced understanding of how monetary policy and external shocks influence the stability of expectations.

Our findings indicate that firms' inflation expectations in Ukraine have remained moderately sensitive to temporary shocks, suggesting that while short-term disturbances do not drastically alter expectations, they are not fully insulated either. More importantly, the perceived long-term inflation anchor has persistently exceeded the central bank's target. Although the shift to an IT regime initially improved the level anchoring of expectations – bringing the perceived anchor closer to the NBU's objective – subsequent shocks, including the COVID-19 pandemic and the full-scale russian invasion, reversed part of this progress. As a result, while the anchor level improved from its initial state, it never fully converged to the 5% target and more recently remained around 11.5%.

The stability of shock anchoring amidst shifting economic conditions suggests that the fundamental mechanism through which firms process short-term fluctuations has not weakened. However, the persistent gap between the perceived anchor and the target underscores the challenges the NBU faces in maintaining firmly anchored expectations. Policy credibility, transparent communication, and ongoing adaptation of monetary instruments remain critical. Enhanced credibility may not only mitigate the impact of crises on expectations but also help guide them closer to target levels in the long run.

In a broader context, these insights highlight that improvements in monetary policy regimes, such as moving toward IT, can bolster expectation anchoring, but sustained effort is required to preserve these gains through periods of uncertainty. Future research might consider incorporating other respondent groups (households, financial analysts), exploring cross-country comparisons, or examining additional structural factors that shape expectation formation. Such extensions could provide an even deeper understanding of how economic agents form, update, and anchor their inflation expectations in emerging markets subject to persistent shocks.

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APPENDIX A. TVP-VAR-SV MODEL

The TVP-VAR-SV model outlined in equations (3) and (4), can be represented by defining the $n \times 1$ vector of dependent variables as $\mathrm{y}_t = (\pi_t \; \pi_t^e)'$ to estimate:

$$\mathrm{y}_t = A_t^{-1}\mathrm{B}_t \mathrm{y}_{t-1} + \cdots + \mathrm{B}_{pt}\mathrm{y}_{t-p} + \varepsilon_t, \qquad \varepsilon_t \sim \mathcal{N}(0, \Sigma_t), \tag{7}$$

where B_t is the matrix of time-varying VAR coefficients; A_t is a matrix of short-term structural coefficients; ε_t is a vector of innovations (structural shocks) with time-varying covariance Σ_t; $\Sigma_t = \mathrm{diag}\left(\exp(\sigma_{t,1}^2), \cdots, \exp(\sigma_{t,n}^2)\right)$ is the diagonal matrix of stochastic volatility.

Time-varying VAR coefficients are modeled as a random walk process:

$$B_t = B_{t-1} + \nu_t, \qquad \nu_t \sim \mathcal{N}(0, Q), \tag{8}$$

where $Q \sim IW(k_Q^2 * \tau * V(B_{OLS}), \tau)$,

where IW – independent inverse-Wishart distribution, $V(B_{OLS})$ – covariance matrix of coefficients obtained by the least squares method (OLS). The number of periods (τ) that are included in the training sample is exactly *77*, that is, the entire sample fits simultaneously into the training and subsequently into the test sample. This approach will allow for more complete retention of the full information from the sample, and it can also simplify the process of calibrating hyperparameters. τ will be used in this multiplication if the parameter p_Q is not specified, otherwise it will be multiplied by the configured value p_Q.

The matrix A_t also changes over time:

$$A_t = A_{t-1} + \zeta_t, \qquad \zeta_t \sim \mathcal{N}(0, S), \tag{9}$$

where S is covariance matrix, which depends on the number of variables and is defined as

$$S_1 \sim IW(k_S^2 * p_{S1} * V(A_{1,OLS}), p_{S1})$$

$$S_2 \sim IW(k_S^2 * p_{S2} * V(A_{2,OLS}), p_{S2})$$

The logarithm of variable volatility is also modeled as a random walk process:

$$\sigma_t = \sigma_{t-1} + \eta_t, \qquad \eta_t \sim \mathcal{N}(0, W), \tag{10}$$

where $W \sim IW(k_W^2 * p_W * I_n, p_W)$.

Matrix V describes the complete structure of covariance between innovations $[\varepsilon_t, \quad \nu_t, \quad \zeta_t, \quad \eta_t]$, i.e.:

$$V = \mathrm{Var}\left(\begin{bmatrix}\varepsilon_t \\ \nu_t \\ \zeta_t \\ \eta_t\end{bmatrix}\right) = \begin{bmatrix} I_n & 0 & 0 & 0 \\ 0 & Q & 0 & 0 \\ 0 & 0 & S & 0 \\ 0 & 0 & 0 & W \end{bmatrix}$$

Where I_n is *n* dimensional identity matrix; Q is a matrix of variances for VAR coefficients; S is a matrix of variances for structural coefficients; W is the variance matrix for stochastic volatility.

The choice of prior distributions and parameters of the priors can have a substantial effect on the model. The lag length $p = 2$ was chosen to maximize the marginal likelihood for the model without TVP and SV. The value of k_W

was selected using a grid search to maximize the marginal likelihood for the model without TVP. Then, k_Q and, p_Q were selected through a grid search to maximize the marginal likelihood for the model with TVP and SV. Calculations were performed using R and the bvarsv library. Table 3 summarizes how the initial state of each of the above model parameters was adjusted.

Table 3. Prior Distributions of Parameters of the Model with Two Variables

Parameter	Description	Values
B_t	Structural parameter for initial level of VAR coefficients	$k_B = 5$
A_t	Scale parameter for the matrix A_t	$k_A = 4$
σ_t^2	Structural parameter for initial volatility dispersion	$k_{sig} = 0.25$
V	The general matrix of variations and covariances for all disturbances in the model	Depends on Q, S, W
Q	Scale parameter for matrix Q; degree of freedom for the prior distribution of Q	$k_Q = 0.175$; $p_Q = 10$
S	Scale parameter for matrix S; degree of freedom for matrix S depending on its size	$k_S = 0.1$; $p_S = (2,\ 3)$
W	Scale parameter for W matrix; degree of freedom for the prior distribution of W	$k_W = 0.75$; $p_W = 5$

Source: Author's calculations.

In order to estimate the model when both equations are constants, the parameter k_Q which accounts for the scale of expected changes in the coefficients must be equal to zero or close, and p_Q must be large (larger than the number of sample periods or close to infinity) so that the distribution of parameters is strongly concentrated around its mean value.

For the posterior inference, the study utilized the MCMC sampler developed by Del Negro and Primiceri (2015). We used 200,000 draws from the sampler with 50,000 draws as burn-in, and retained every 10th draw for posterior inference to limit the impact of the sampler's autocorrelation.