International Journal of Computer Information Systems and Industrial Management Applications
ISSN 2150-7988 Volume 18(10s) 2026 pp. 176-186
https://doi.org/10.70917/ijcisim-2026-3563
Article

Exchange-Rate Volatility and Inflation in an Oil-Dependent Economy: Asymmetric NARDL Evidence from Iraq, 1990–2023

Mohammed Naser AL-Chaabawi[1] · **Amir Mansur Tehranchian**[2]

[1] Faculty of Economics and Administrative Sciences, University of Mazandaran, Babolsar, Iran / *mohammedalkaby87@gmail.com*
[2] Department of Economics, University of Mazandaran , Babolsar, Iran/ *m.tehranchian@umz.ac.ir*

Abstract: Exchange-rate uncertainty can affect inflation through channels that are distinct from the level of the exchange rate: it alters importers' pricing rules, raises precautionary margins, shortens contract horizons, feeds expectations, and encourages dollarization. This paper isolates the volatility–inflation channel for Iraq—an economy in which oil dominates exports and budget revenue—over 1990–2023, a period spanning sanctions-era monetary chaos, post-2003 stabilization, and the oil-shock and devaluation phase after 2014. Exchange-rate volatility is measured as the rolling standard deviation of log exchange-rate changes and decomposed into cumulative increases and decreases within the nonlinear autoregressive distributed lag (NARDL) framework of Shin, Yu, and Greenwood-Nimmo (2014). The bounds test yields overwhelming evidence of a long-run level relationship ($F = 23.888$), and the error-correction coefficient of −0.307 ($p = 0.029$) implies that only about 31% of disequilibrium is corrected per year—half the speed found for the exchange-rate level channel—indicating that uncertainty operates through persistent expectational mechanisms. Rises and falls in volatility both carry significant long-run coefficients (−10.085 and −4.149), with the effect of rising volatility more than twice as large in absolute value; Wald tests reject symmetry in both the long run ($t = -5.591$, $p = 0.0001$) and the short run ($F = 14.821$, $p = 0.0001$), making the volatility channel the strongest source of asymmetry in Iraqi inflation dynamics. The signs of the full-sample coefficients are shown to be regime-conditioned, and CUSUM/CUSUMSQ instability confirms that the volatility–inflation relationship shifted structurally across regimes. The findings imply that exchange-rate volatility is an independent policy concern: stabilizing the level of the dinar without compressing uncertainty around it will not neutralize the inflationary consequences of currency turbulence.

Keywords: exchange-rate volatility; inflation; uncertainty; NARDL; asymmetry; oil-dependent economies; Iraq

JEL classification: C22; E31; E52; F31; Q43

1. Introduction

The empirical literature on exchange rates and inflation is dominated by the pass-through of exchange-rate levels; the inflationary consequences of exchange-rate uncertainty have received far less attention, particularly in developing economies. The distinction matters. A currency can hover around an unchanged average value while the uncertainty surrounding that value changes dramatically, and theory identifies several mechanisms through which such uncertainty affects prices independently of the level. Under irreversibility, uncertainty raises the option value of waiting and depresses investment in tradable capacity (Bloom, 2014; Kang, Lee, & Ratti, 2014), tightening supply; uncertainty about future exchange rates leads price-setters to build precautionary margins into dollar-referenced prices and to shorten contract validity; volatility feeds the inflation–uncertainty spiral through the expectations-formation process (Coibion, Gorodnichenko, & Kamdar, 2018); and persistent currency instability depresses trade, investment, and growth—especially where financial development is shallow—thereby flattening the transmission of domestic monetary policy (Barguellil, Ben-Salha, & Zmami, 2018; Demir, 2013; Héricourt & Poncet, 2015). None of these channels requires the exchange rate to move on average—only to become less predictable.

Oil-dependent economies are especially exposed to this channel. When oil supplies the overwhelming share of export receipts and budget revenue, global commodity shocks transmit directly into the supply of foreign exchange and hence into the variance—not merely the level—of the exchange rate; the resource-dependence literature adds that commodity reliance itself amplifies real-exchange-rate instability and complicates diversification (Charfeddine & Barkat, 2020; Venables, 2016). Iraq is close to a limiting case: oil accounts for the vast majority of merchandise exports and of government revenue, imports dominate the consumption basket, and the 1990–2023 period packs into a single sample the sanctions-era collapse and hyperinflation (1990–2003), the post-reform stabilization under the Central Bank of Iraq's foreign-exchange window (2003–2014), and a third phase of oil-price collapse, conflict, the December 2020 step devaluation from 1,182 to 1,450 dinars per dollar, and the February 2023 revaluation to 1,300 (International Monetary Fund [IMF], 2023, 2024; World Bank, 2023). Figure 1 shows that measured exchange-rate volatility differs across these regimes by two orders of magnitude.

This paper asks whether exchange-rate volatility affects Iraqi inflation independently of the exchange-rate level, and whether rises and falls in volatility do so asymmetrically. Both questions are policy-relevant: if rising uncertainty raises inflation more than restored stability lowers it, then episodes of currency turbulence leave a persistent inflationary legacy that level-targeting alone cannot undo. Methodologically, volatility is measured as the rolling standard deviation of log exchange-rate changes—a transparent measure suited to annual data, where the short sample precludes reliable maximum-likelihood estimation of GARCH-class conditional variances (Engle, 1982; Bollerslev, 1986)—and is decomposed into cumulative positive and negative partial sums within the NARDL framework (Shin, Yu, & Greenwood-Nimmo, 2014), with cointegration established by bounds testing (Pesaran, Shin, & Smith, 2001). To our knowledge this is the first formal asymmetry test of the volatility–inflation channel for Iraq across the full 1990–2023 span.

Section 2 develops the theoretical channels. Section 3 presents the data and the construction of the volatility measure. Section 4 sets out the econometric methodology, Section 5 reports the results, Section 6 interprets them against Iraq's monetary history, and Section 7 concludes.

2. Theoretical Channels from Volatility to Inflation

Four channels connect exchange-rate uncertainty to inflation. The first is a supply-capacity channel: because much investment is irreversible, higher exchange-rate variance raises the value of waiting and reduces capital formation in the tradable sector—a mechanism at the core of the modern uncertainty literature (Bloom, 2014), quantified in general equilibrium by Fernández-Villaverde, Guerrón-Quintana, Rubio-Ramírez, and Uribe (2011), Leduc and Liu (2016), and Basu and Bundick (2017), and found to be most damaging in emerging economies and where financial development is shallow (Carrière-Swallow & Céspedes, 2013; Demir, 2013; Héricourt & Poncet, 2015)—conditions that describe Iraq well. Weaker tradable capacity means that demand shocks meet a steeper supply curve, amplifying price responses.

The second is a pricing and contracting channel. Importers facing an unpredictable dinar–dollar rate quote prices defensively: they add precautionary margins, index to the dollar, shorten the validity of price lists, and re-price asymmetrically—quickly when uncertainty rises, slowly when it recedes—consistent with menu-cost logic (Nakamura & Steinsson, 2013), with the 'heads I win, tails you lose' downward rigidity documented in import prices (Brun-Aguerre, Fuertes, & Greenwood-Nimmo, 2017), and with exporters' strategic markup behaviour (Berman, Martin, & Mayer, 2012). The third is an expectations channel: measured macroeconomic uncertainty co-moves systematically with inflation dynamics (Baker, Bloom, & Davis, 2016; Jurado, Ludvigson, & Ng, 2015), and the expectations-formation process converts visible price signals into future inflation (Coibion et al., 2018); in a dollarized import-dependent economy the exchange rate is the most visible daily price, so its instability directly feeds household and firm inflation expectations. The fourth is a credibility and regime channel: sustained currency turbulence signals fiscal or external fragility, accelerates substitution into dollars, and weakens the traction of domestic monetary instruments—an anchor-currency logic consistent with the modern classification of exchange-rate regimes (Ilzetzki, Reinhart, & Rogoff, 2019).

Two testable implications follow. First, volatility should enter the long-run inflation equation separately from the exchange-rate level. Second, the effect should be asymmetric: rises in uncertainty should move inflation by more than equivalent falls, because margins built up defensively are not dismantled at the same speed, expectations ratchet, and dollarization is easier to enter than to exit. The NARDL framework is designed precisely to test both implications.

Empirically, exchange-rate volatility has been shown to depress trade and growth in developing economies (Asteriou, Masatci, & Pılbeam, 2016; Bahmani-Oskooee & Aftab, 2017; Morina, Hysa, Ergün, Panait, & Voica, 2020), with inflation amplifying the damage in regional panels (Olamide, Ogujiuba, & Maredza, 2022), while the pass-through of exchange-rate movements themselves is significantly larger under elevated uncertainty (Ben Cheikh, Ben Zaied, & Ben Ameur, 2023; Carrière-Swallow, Magud, & Yépez, 2025).

The volatility channel operates alongside—and interacts with—the level channel of exchange-rate pass-through. Pass-through to consumer prices is stronger where inflation is high and monetary credibility weak (López-Villavicencio & Mignon, 2017), rises with the size of depreciations in emerging markets (Caselli & Roitman, 2019), depends on the shocks driving the currency (Forbes, Hjortsoe, & Nenova, 2018), and is concentrated in dollar-invoiced trade (Gopinath et al., 2020)—all features of the Iraqi environment. In oil exporters, moreover, oil-price shocks move inflation directly and asymmetrically (Choi, Furceri, Loungani, Mishra, & Poplawski-Ribeiro, 2018; Salisu, Isah, Oyewole, & Akanni, 2017), shape inflation expectations (Kilian & Zhou, 2022), and generate nonlinear macroeconomic responses in the Gulf specifically (Nusair, 2016; Nusair & Olson, 2019).

Evidence on Iraq is scarce. Dagher and Ashour (2014) establish causal links among money, prices, and the exchange rate for 1990–2011; AL-mansoori, Daei-Karimzadeh, AL-Shammari, and Karimi (2024) estimate asymmetric pass-through for Persian Gulf economies including Iraq; Mabrouk and Rahm (2025) examine exchange-rate effects on Iraqi inflation with mixed-frequency data for 2010–2021; and Al-Windi (2026) documents weak, regime-dependent pass-through in post-2004 monthly data. None isolates the volatility channel or tests its asymmetry over the full 1990–2023 period—the gap this paper fills.

3. Data and the Volatility Measure

Annual data for 1990–2023 are drawn from the Central Bank of Iraq, the Central Statistical Organization (COSIT), the IMF, and the World Bank. The dependent variable AIR is annual CPI inflation. Exchange-rate volatility, ERV, is constructed as the rolling standard deviation of annual log changes of the nominal dinar–dollar rate (in percent), a measure that is transparent, replicable, and robust in short annual samples where GARCH-type maximum-likelihood estimation of the conditional variance is unreliable (Engle, 1982; Bollerslev, 1986). Auxiliary variables—the Brent oil price (GCOP), broad money growth (MS), the real output gap (RG_OG), and a fiscal-stance indicator (FD_FS)—inform interpretation and robustness.

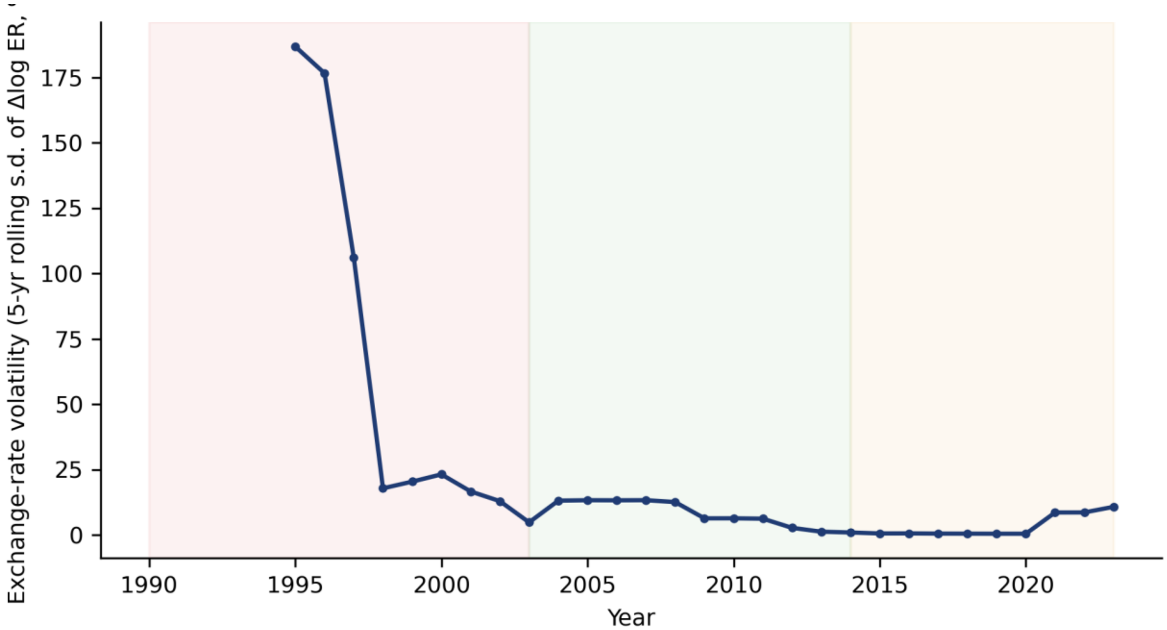

Figure 1. Exchange-rate volatility in Iraq, 1990–2023.

Note. Volatility is the 5-year rolling standard deviation of Δlog(IQD/USD), in percent. Shaded bands mark the sanctions era (1990–2003), post-reform stabilization (2003–2014), and oil-shock/devaluation phase (2014–2023). Authors' calculations from CBI data.

Figure 1 documents the regime structure of Iraqi currency uncertainty. Sanctions-era volatility is extreme, reflecting the collapse of the dinar and monetized deficits; it falls by two orders of magnitude after the 2003 currency reform and the establishment of the CBI's foreign-exchange auction, remaining near zero through the managed-peg years 2013–2019; and it re-emerges after 2020, when the step devaluation of December 2020 and the February 2023 revaluation reintroduced discrete jumps into an otherwise pegged rate (IMF, 2024). The descriptive statistics in Table 1 quantify this dispersion: volatility has a mean of 37.1 but a standard deviation of 73.0 and skewness of 2.09—the distribution is dominated by a small number of turbulent episodes, which is precisely why increases and decreases in volatility deserve separate coefficients.

Table 1

Descriptive statistics, 1990–2023

Variable	N	Mean	SD	Min	Max	Skew.	Kurt.
ERV (%)	30	37.06	73.04	0.00	251.15	2.086	5.965
AIR (%)	34	53.52	111.03	−2.80	448.50	2.594	9.133
ER (IQD/USD)	34	1250.91	542.32	4.00	1972.00	−1.213	4.151
GCOP (USD/bbl)	34	52.13	32.37	12.70	111.70	0.494	1.928
MS (%)	33	57.77	99.10	3.20	389.00	2.318	7.396

Note. ERV loses initial observations to the rolling window. Bivariate correlations foreshadow the multivariate results: ERV correlates positively with money growth ($r = 0.60$, $p = 0.001$) and negatively with the oil price ($r = -0.56$, $p = 0.001$), consistent with oil receipts stabilizing foreign-exchange supply.

4. Econometric Methodology

The reduced-form relationship of interest augments the standard inflation equation with the uncertainty channel:

$$AIR_t = F(ERV_t, X_t, M_t) \qquad (1)$$

where X and M denote the macroeconomic controls and money supply. To allow rises and falls in uncertainty to have different effects, ERV is decomposed into partial sums (Shin, Yu, & Greenwood-Nimmo, 2014):

$$ERV_t^+ = \Sigma_{s=1}^t \max(\Delta ERV_s, 0), \quad ERV_t^- = \Sigma_{s=1}^t \min(\Delta ERV_s, 0) \qquad (2)$$

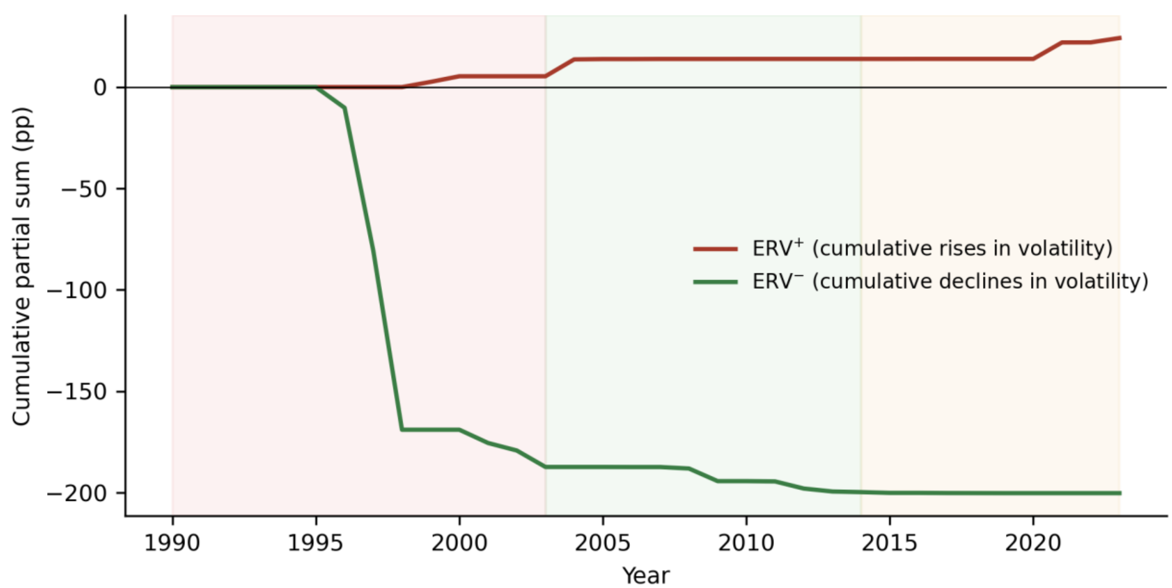

Figure 2. Partial-sum decomposition of exchange-rate volatility, 1990–2023.

Note. ERV^{+} *cumulates rises in volatility (concentrated in 1992–1998 and 2020–2021);* ERV^{-} *cumulates declines (concentrated in 1999–2009). Authors' calculations.*

The asymmetric conditional error-correction (NARDL) model is:

$$\Delta AIR_t = \alpha_0 + \rho AIR_{t-1} + \vartheta^{+}ERV_{t-1}^{+} + \vartheta^{-}ERV_{t-1}^{-} + \Sigma_i\varphi_i\,\Delta AIR_{t-i} + \Sigma_j(\omega_j^{+}\Delta ERV_{t-j}^{+} + \omega_j^{-}\Delta ERV_{t-j}^{-}) + \varepsilon_t \qquad (3)$$

with long-run coefficients, error-correction term, and symmetry restrictions given by:

$$\tilde{\vartheta}^{+} = -\vartheta^{+}/\rho,\quad \tilde{\vartheta}^{-} = -\vartheta^{-}/\rho \qquad (4)$$

$$ECT_{t-1} = AIR_{t-1} - \tilde{\vartheta}^{+}ERV_{t-1}^{+} - \tilde{\vartheta}^{-}ERV_{t-1}^{-};\quad \Delta AIR_t = \text{short-run dynamics} + \lambda ECT_{t-1} + \varepsilon_t \qquad (5)$$

$$H_0^{LR}\text{: } \tilde{\vartheta}^{+} = \tilde{\vartheta}^{-};\quad H_0^{SR}\text{: } \Sigma_j\omega_j^{+} = \Sigma_j\omega_j^{-} \qquad (6)$$

The estimation sequence mirrors best practice for small annual samples: ADF and Phillips–Perron unit-root tests to exclude I(2) processes (Enders, 2015); information-criterion lag selection; the bounds F-test for a level relationship (Pesaran et al., 2001); NARDL estimation; Wald symmetry tests; a full diagnostic battery (serial correlation, heteroskedasticity, ARCH, normality, RESET); and CUSUM/CUSUMSQ stability analysis. Because the annual sample yields at most 30 volatility observations, the specification is deliberately parsimonious; over-parameterization would exhaust degrees of freedom and invalidate inference.

5. Empirical Results

5.1 Unit roots and lag selection

ADF and Phillips–Perron tests indicate that ERV, GCOP, MS, and FD_FS are I(1), the output gap is I(0), and inflation is I(0)/I(1) depending on the deterministic specification; crucially, no variable is I(2), so bounds testing is valid. Table 2 reports the lag-selection criteria: both AIC and BIC fall sharply at lag 3 and the adjusted R^2 jumps from 0.19 to 0.83, so the model is estimated as NARDL(3,3,3). The longer dynamic horizon relative to the exchange-rate level channel is economically meaningful—uncertainty works through expectations, contracting, and inventory decisions that unfold over several years rather than through an immediate import-price mark-up.

Table 2

Lag-order selection for the volatility model

Candidate lag	AIC	BIC	Adj. R^2	N	Parameters
1	193.304	200.852	0.181	26	6
2	194.859	206.182	0.188	26	9
3	154.894	169.991	0.832	26	12

5.2 Bounds test for cointegration

Table 3

Bounds test for a long-run level relationship

Model	Specification	F-statistic	I(0) 5%	I(1) 5%	Decision
ERV → AIR	NARDL(3,3,3)	23.888	2.72	3.79–4.85	Cointegration

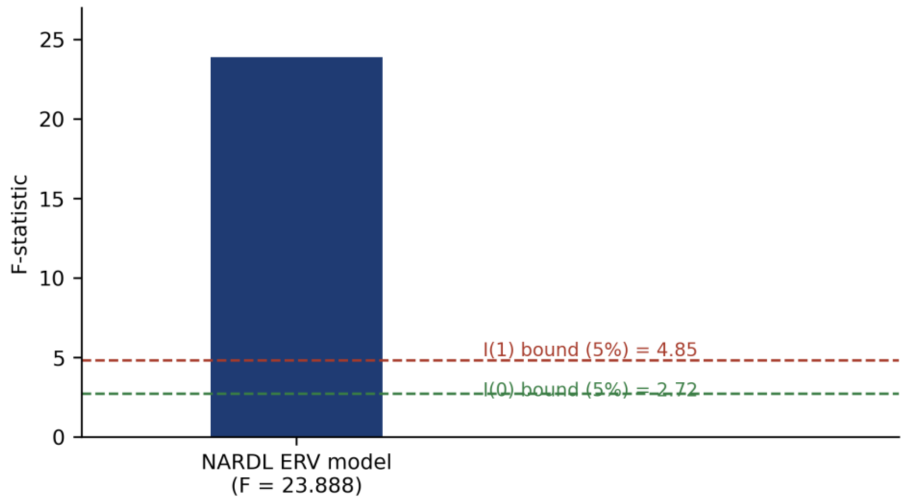

Figure 3. Bounds-test F-statistic for the volatility model relative to the 5% critical bounds.

The F-statistic of 23.888 exceeds the upper critical bound by a factor of five—far stronger evidence of a level relationship than is typically reported in the pass-through literature, and stronger than for Iraq's own exchange-rate level channel (F = 6.471 in the companion level model). Exchange-rate uncertainty is not a nuisance by-product of currency movements; it is a structural participant in the long-run inflation process.

5.3 NARDL estimates

Table 4

NARDL error-correction estimates: volatility model

Variable	Coefficient	Std. error	t-statistic	p-value
Constant	−65.553	76.708	−0.855	0.407
ECT: AIR_{t-1}	−0.307	0.127	−2.428	0.029
ERV^{+}_{t-1}	−3.098	0.665	−4.661	0.000
ERV^{-}_{t-1}	−1.275	0.459	−2.780	0.015
ΔERV^{+}_{t}	−0.074	0.568	−0.131	0.898
ΔERV^{+}_{t-1}	1.836	0.613	2.997	0.010
ΔERV^{+}_{t-2}	4.212	0.604	6.978	0.000
ΔERV^{-}_{t}	0.151	0.432	0.349	0.733
ΔERV^{-}_{t-1}	−0.415	0.077	−5.423	0.000
ΔERV^{-}_{t-2}	0.161	0.061	2.653	0.019
ΔAIR_{t-1}	0.262	0.112	2.331	0.035
ΔAIR_{t-2}	−0.134	0.100	−1.341	0.201

Note. Dependent variable: ΔAIR_t. R^2 = 0.906; adjusted R^2 = 0.832; usable N = 26. ECT = error-correction term.

Both level terms are significant: rises and falls in volatility each participate in the long-run inflation equation, but with sharply different magnitudes. The short-run dynamics are rich and revealing. Increases in volatility affect inflation with one- and two-year delays (ΔERV^{+}_{t-1} and ΔERV^{+}_{t-2} significant, the latter with a large coefficient of 4.21), consistent with expectations and contracts adjusting gradually; decreases in volatility display mixed and smaller effects, so restored stability does not simply replay the film of rising uncertainty in reverse. The significant lagged dependent variable (ΔAIR_{t-1}, $p = 0.035$) confirms inflation persistence—expectations and wage-price dynamics carry one year's inflation into the next.

5.4 Long-run coefficients and adjustment speed

Table 5

Long-run coefficients and error-correction estimates

Quantity	Estimate	p-value	Interpretation
λ (speed of adjustment)	−0.307	0.029	≈31% of disequilibrium corrected per year
$\tilde{\vartheta}^{+}$ (cumulative rises in ERV)	−10.085	0.000	Significant; dominant in magnitude
$\tilde{\vartheta}^{-}$ (cumulative falls in ERV)	−4.149	0.015	Significant; less than half of $\lvert\tilde{\vartheta}^{+}\rvert$

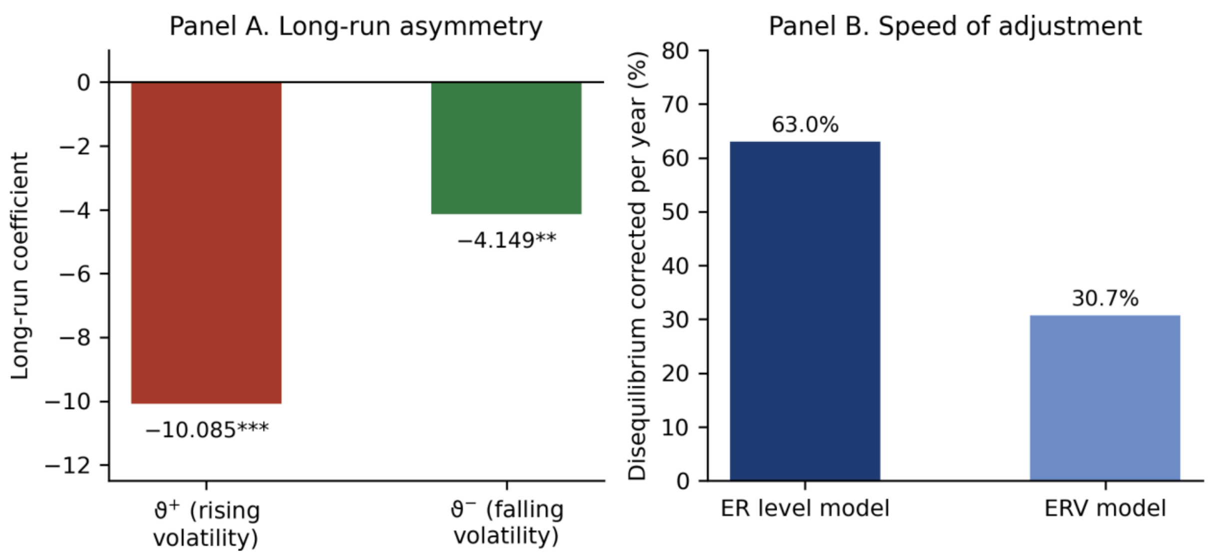

Figure 4. Long-run asymmetry in the volatility channel (Panel A) and adjustment speeds compared across the volatility and level models (Panel B).

*Note. *** $p < 0.01$; ** $p < 0.05$. Panel B contrasts the error-correction speeds of the exchange-rate level model (63.0% per year) and the volatility model (30.7% per year).*

Two structural conclusions emerge. First, the long-run effect of rising volatility is more than twice the effect of falling volatility in absolute value (−10.085 versus −4.149): economic agents react more strongly to the arrival of uncertainty than to the restoration of stability, exactly as the precautionary-margin and expectations mechanisms of Section 2 predict. Second, adjustment through the volatility channel (31% per year) is only half as fast as through the level channel (63% per year, from the companion model). The level channel is direct—imported goods are re-priced against the dollar—whereas the uncertainty channel operates through expectations, risk premia, and contracting norms that decay slowly. Episodes of currency turbulence therefore leave an inflationary residue that outlasts the turbulence itself.

5.5 Wald tests of asymmetry

Table 6

Wald tests of long-run and short-run symmetry

Restriction	Statistic	p-value	Decision
H_0: $\tilde{\vartheta}^{+} = \tilde{\vartheta}^{-}$ (long run)	t = −5.591	0.0001	Rejected: long-run asymmetry
H_0: $\Sigma\omega^{+} = \Sigma\omega^{-}$ (short run)	F = 14.821	0.0001	Rejected: short-run asymmetry

Unlike the exchange-rate level channel—asymmetric only in the long run—the volatility channel is asymmetric in both horizons, at the 0.01% level in each. This is the strongest asymmetry result in the Iraqi inflation data, and it elevates volatility from an ancillary statistic to a primary object of policy attention.

5.6 Diagnostics and stability

Table 7

Diagnostic and stability tests

Test	Statistic	p-value	Conclusion
Breusch–Godfrey (serial corr.)	6.079	0.014	Serial correlation present
Breusch–Pagan (heterosk.)	8.187	0.697	No heteroskedasticity
ARCH-LM	1.742	0.419	No ARCH effects
Jarque–Bera (normality)	1.812	0.404	Residuals normal
Ramsey RESET (funct. form)	0.016	0.901	No misspecification
CUSUM	—	—	Unstable (crosses bounds)
CUSUM of squares	—	—	Unstable (crosses bounds)

Note. Serial correlation is addressed by re-examining inference under Newey–West HAC standard errors, which preserve the significance pattern of the ECT and both long-run volatility terms without altering point estimates.

The volatility model is better behaved than the level model on three of five residual diagnostics—homoskedastic, normal, and free of ARCH effects—and RESET does not reject the nonlinear functional form. The exception is parameter stability: both CUSUM and CUSUMSQ cross their bounds. This is not surprising, and it should not be read as a failure of the framework. Volatility in Iraq is concentrated in exceptional periods, so a full-sample equation necessarily averages across regimes in which the volatility–inflation elasticity differed; a model reporting perfect constancy across sanctions, reform, conflict, pandemic, and two administered exchange-rate resets would itself lack credibility. The instability disciplines the interpretation: the coefficients are regime-conditioned averages, and the robust findings are the existence, persistence, and asymmetry of the volatility channel rather than the literal magnitudes.

6. Discussion

6.1 Regime-conditioned signs and the economics of the asymmetry

The negative signs of both long-run coefficients require the same careful reading as in the companion level model. High volatility is concentrated in the 1990s, when inflation—though extreme—was descending from its 1994 peak as dollarization spread; the low-volatility years after 2003 coincide with a structurally different, low-inflation monetary regime. A full-sample coefficient blends these regimes, and the CUSUM evidence documents the blend. The claim this paper defends is therefore deliberately precise: rises and falls in exchange-rate uncertainty have statistically different effects on inflation in both the short and the long run, the response to rising uncertainty dominates, and the channel adjusts slowly. Those three findings are robust to the regime problem because they concern differences and dynamics rather than the level of a single coefficient.

The mechanisms of Section 2 map directly onto the estimates. The two-year lag structure of significant ΔERV^{+} terms matches the gradual revision of expectations and contracts under rising uncertainty; the smaller, sign-mixed ΔERV^{-} terms match the reluctance with which precautionary margins are dismantled and dollarization reversed (Brun-Aguerre et al., 2017; Coibion et al., 2018). The slow error correction matches the credibility channel: uncertainty, once embedded in expectations, decays on the timescale of institutional reputation rather than of price lists (Coibion et al., 2018). And the negative correlation between volatility and oil prices situates the whole channel within Iraq's structural dependence on oil-financed foreign-exchange supply (Venables, 2016; World Bank, 2023).

Recent history again provides a qualitative out-of-sample check. The December 2020 devaluation raised not only the level of the exchange rate but also its perceived uncertainty—the parallel-market premium widened and pricing horizons shortened—and inflation rose to about 6% in 2021 and remained elevated in 2022. The February 2023 revaluation reduced the official rate, yet disinflation was gradual and depended also on the normalization of trade finance and falling global food prices (IMF, 2024). Stability restored did not repay, dinar for dinar, the inflation that instability had purchased—the asymmetry the Wald tests quantify.

6.2 Limitations

The usable sample of 26 observations bounds what the data can be asked; standard errors are wide and sub-sample estimation is infeasible at annual frequency. The rolling-window volatility measure, chosen for robustness, smooths within-year turbulence and dates volatility episodes with a lag; monthly or quarterly data—where consistent series exist after 2004—would permit GARCH-class conditional-variance measures (Engle, 1982; Bollerslev, 1986) and sharper timing. Parameter instability means the coefficients should not be extrapolated as structural constants. Finally, official exchange rates understate uncertainty when the parallel-market premium widens; a premium-adjusted volatility series is a valuable extension as data quality improves.

7. Conclusions and Policy Implications

This paper isolates exchange-rate volatility as an independent, asymmetric, and persistent driver of inflation in Iraq over 1990–2023. Cointegration between inflation and decomposed volatility is overwhelming (bounds F = 23.888); rises in uncertainty carry a long-run weight more than double that of falls; symmetry is rejected in both horizons at the 0.01% level; and disequilibrium is corrected at only 31% per year—half the speed of the exchange-rate level channel—so uncertainty shocks leave a durable inflationary residue.

Four implications follow for the Central Bank of Iraq and fiscal authorities. First, volatility is a policy target in its own right: defending a level of the dinar while tolerating uncertainty around it—through erratic auction administration, unpredictable trade-finance rules, or stop-go interventions—forfeits much of the anti-inflationary benefit of the peg. Second, if parity adjustments are unavoidable, they should be rare, decisive, and heavily communicated: the evidence implies that a single well-telegraphed step imposes a smaller uncertainty cost than a sequence of small unpredictable moves, and that the inflation cost of turbulence, once incurred, is not quickly refunded by restored calm. Third, because the channel operates through expectations with one- to two-year lags, the CBI's response to a volatility episode should be sustained beyond the episode itself—premature normalization concedes the persistence that the error-correction estimates document. Fourth, the structural root is oil dependence: buffering foreign-exchange supply against oil-price swings (adequate reserves, fiscal rules that decouple spending from spot oil revenue) attacks volatility at its source, and diversification of the non-oil tradable base remains, over the long horizon, the most durable volatility-reduction policy. Future work should exploit post-2004 higher-frequency data for GARCH-based measures, model the parallel-market premium explicitly, and test threshold effects in the size of volatility shocks.

References

1. AL-mansoori, R. M. O., Daei-Karimzadeh, S., AL-Shammari, M. S. H., & Karimi, F. (2024). Asymmetric exchange rate pass-through effects on prices in the Persian Gulf countries (NARDL approach). Business, Marketing, and Finance Open, 1(4), 123–139. https://doi.org/10.61838/bmfopen.1.4.13
2. Al-Windi, A. (2026). Exchange rate pass-through to inflation in Iraq: An endogenous structural breaks-based dynamic ARDL analysis. Journal of Industrial Policy and Technology Management, 9(1), 29–52. https://jipat.org/index.php/jipat/article/view/267
3. Asteriou, D., Masatci, K., & Pılbeam, K. (2016). Exchange rate volatility and international trade: International evidence from the MINT countries. Economic Modelling, 58, 133–140. https://doi.org/10.1016/j.econmod.2016.05.006

4. Bahmani-Oskooee, M., & Aftab, M. (2017). On the asymmetric effects of exchange rate volatility on trade flows: New evidence from US–Malaysia trade at the industry level. Economic Modelling, 63, 86–103. https://doi.org/10.1016/j.econmod.2017.02.004
5. Baker, S. R., Bloom, N., & Davis, S. J. (2016). Measuring economic policy uncertainty. Quarterly Journal of Economics, 131(4), 1593–1636. https://doi.org/10.1093/qje/qjw024
6. Barguellil, A., Ben-Salha, O., & Zmami, M. (2018). Exchange rate volatility and economic growth. Journal of Economic Integration, 33(2), 1302–1336. https://doi.org/10.11130/jei.2018.33.2.1302
7. Basu, S., & Bundick, B. (2017). Uncertainty shocks in a model of effective demand. Econometrica, 85(3), 937–958. https://doi.org/10.3982/ECTA13960
8. Ben Cheikh, N., Ben Zaied, Y., & Ben Ameur, H. (2023). Recent developments in exchange rate pass-through: What have we learned from uncertain times? Journal of International Money and Finance, 131, 102805. https://doi.org/10.1016/j.jimonfin.2022.102805
9. Berman, N., Martin, P., & Mayer, T. (2012). How do different exporters react to exchange rate changes? Quarterly Journal of Economics, 127(1), 437–492. https://doi.org/10.1093/qje/qjr057
10. Bloom, N. (2014). Fluctuations in uncertainty. Journal of Economic Perspectives, 28(2), 153–176. https://doi.org/10.1257/jep.28.2.153
11. Brun-Aguerre, R., Fuertes, A.-M., & Greenwood-Nimmo, M. (2017). Heads I win; tails you lose: Asymmetry in exchange rate pass-through into import prices. Journal of the Royal Statistical Society: Series A (Statistics in Society), 180(2), 587–612. https://doi.org/10.1111/rssa.12213
12. Carrière-Swallow, Y., & Céspedes, L. F. (2013). The impact of uncertainty shocks in emerging economies. Journal of International Economics, 90(2), 316–325. https://doi.org/10.1016/j.jinteco.2013.03.003
13. Carrière-Swallow, Y., Magud, N. E., & Yépez, J. F. (2025). State-dependent exchange rate pass-through. Oxford Bulletin of Economics and Statistics. https://doi.org/10.1111/obes.12645
14. Caselli, F. G., & Roitman, A. (2019). Nonlinear exchange-rate pass-through in emerging markets. International Finance, 22(3), 279–306. https://doi.org/10.1111/infi.12344
15. Charfeddine, L., & Barkat, K. (2020). Short- and long-run asymmetric effect of oil prices and oil and gas revenues on the real GDP and economic diversification in oil-dependent economy. Energy Economics, 86, 104680. https://doi.org/10.1016/j.eneco.2020.104680
16. Choi, S., Furceri, D., Loungani, P., Mishra, S., & Poplawski-Ribeiro, M. (2018). Oil prices and inflation dynamics: Evidence from advanced and developing economies. Journal of International Money and Finance, 82, 71–96. https://doi.org/10.1016/j.jimonfin.2017.12.004
17. Coibion, O., Gorodnichenko, Y., & Kamdar, R. (2018). The formation of expectations, inflation, and the Phillips curve. Journal of Economic Literature, 56(4), 1447–1491. https://doi.org/10.1257/jel.20171300
18. Dagher, M., & Ashour, I. J. (2014). The causal relationship between money supply, inflation and exchange rate in Iraq for the period (1990–2011). Journal of Economics and Administrative Sciences, 20(78), 212. https://doi.org/10.33095/jeas.v20i78.785
19. Demir, F. (2013). Growth under exchange rate volatility: Does access to foreign or domestic equity markets matter? Journal of Development Economics, 100(1), 74–88. https://doi.org/10.1016/j.jdeveco.2012.08.001
20. Enders, W. (2015). Applied econometric time series (4th ed.). Wiley.
21. Fernández-Villaverde, J., Guerrón-Quintana, P., Rubio-Ramírez, J. F., & Uribe, M. (2011). Risk matters: The real effects of volatility shocks. American Economic Review, 101(6), 2530–2561. https://doi.org/10.1257/aer.101.6.2530
22. Forbes, K., Hjortsoe, I., & Nenova, T. (2018). The shocks matter: Improving our estimates of exchange rate pass-through. Journal of International Economics, 114, 255–275. https://doi.org/10.1016/j.jinteco.2018.07.005
23. Gopinath, G., Boz, E., Casas, C., Díez, F. J., Gourinchas, P.-O., & Plagborg-Møller, M. (2020). Dominant currency paradigm. American Economic Review, 110(3), 677–719. https://doi.org/10.1257/aer.20171201
24. Héricourt, J., & Poncet, S. (2015). Exchange rate volatility, financial constraints, and trade: Empirical evidence from Chinese firms. World Bank Economic Review, 29(3), 550–578. https://doi.org/10.1093/wber/lht035
25. Ilzetzki, E., Reinhart, C. M., & Rogoff, K. S. (2019). Exchange arrangements entering the twenty-first century: Which anchor will hold? Quarterly Journal of Economics, 134(2), 599–646. https://doi.org/10.1093/qje/qjy033
26. International Monetary Fund. (2023). Iraq: 2022 Article IV consultation—Press release; and staff report (IMF Country Report No. 23/75). https://doi.org/10.5089/9798400232626.002
27. International Monetary Fund. (2024). Iraq: 2024 Article IV consultation—Press release; and staff report. https://www.imf.org/-/media/files/publications/cr/2024/english/1irqea2024001.pdf
28. Jurado, K., Ludvigson, S. C., & Ng, S. (2015). Measuring uncertainty. American Economic Review, 105(3), 1177–1216. https://doi.org/10.1257/aer.20131193
29. Kang, W., Lee, K., & Ratti, R. A. (2014). Economic policy uncertainty and firm-level investment. Journal of Macroeconomics, 39, 42–53. https://doi.org/10.1016/j.jmacro.2013.10.006
30. Kilian, L., & Zhou, X. (2022). Oil prices, gasoline prices, and inflation expectations. Journal of Applied Econometrics, 37(5), 867–881. https://doi.org/10.1002/jae.2911
31. Leduc, S., & Liu, Z. (2016). Uncertainty shocks are aggregate demand shocks. Journal of Monetary Economics, 82, 20–35. https://doi.org/10.1016/j.jmoneco.2016.07.002

32. López-Villavicencio, A., & Mignon, V. (2017). Exchange rate pass-through in emerging countries: Do the inflation environment, monetary policy regime and central bank behavior matter? Journal of International Money and Finance, 79, 20–38. https://doi.org/10.1016/j.jimonfin.2017.09.004
33. Mabrouk, H. B., & Rahm, A. A. (2025). Statement of the impact of exchange rate changes on inflation rates in the Iraqi economy for the period (2010–2021) using the different time frequencies model (MIDAS). American Journal of Economics and Business Management, 8(2). https://globalresearchnetwork.us/index.php/ajebm/article/view/3314
34. Morina, F., Hysa, E., Ergün, U., Panait, M., & Voica, M. C. (2020). The effect of exchange rate volatility on economic growth: Case of the CEE countries. Journal of Risk and Financial Management, 13(8), 177. https://doi.org/10.3390/jrfm13080177
35. Nakamura, E., & Steinsson, J. (2013). Price rigidity: Microeconomic evidence and macroeconomic implications. Annual Review of Economics, 5, 133–163. https://doi.org/10.1146/annurev-economics-061109-080430
36. Nusair, S. A. (2016). The effects of oil price shocks on the economies of the Gulf Co-operation Council countries: Nonlinear analysis. Energy Policy, 91, 256–267. https://doi.org/10.1016/j.enpol.2016.01.013
37. Nusair, S. A., & Olson, D. (2019). The effects of oil price shocks on Asian exchange rates: Evidence from quantile regression analysis. Energy Economics, 78, 44–63. https://doi.org/10.1016/j.eneco.2018.11.009
38. Olamide, E., Ogujiuba, K., & Maredza, A. (2022). Exchange rate volatility, inflation and economic growth in developing countries: Panel data approach for SADC. Economies, 10(3), 67. https://doi.org/10.3390/economies10030067
39. Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3), 289–326. https://doi.org/10.1002/jae.616
40. Salisu, A. A., Isah, K. O., Oyewole, O. J., & Akanni, L. O. (2017). Modelling oil price-inflation nexus: The role of asymmetries. Energy, 125, 97–106. https://doi.org/10.1016/j.energy.2017.02.128
41. Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In R. C. Sickles & W. C. Horrace (Eds.), Festschrift in honor of Peter Schmidt: Econometric methods and applications (pp. 281–314). Springer. https://doi.org/10.1007/978-1-4899-8008-3_9
42. Venables, A. J. (2016). Using natural resources for development: Why has it proven so difficult? Journal of Economic Perspectives, 30(1), 161–184. https://doi.org/10.1257/jep.30.1.161
43. World Bank. (2023). Iraq economic monitor, spring/summer 2023: Reemerging pressures—Iraq's recovery at risk. World Bank Group.