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Monetary Policy Shocks and Exchange Rate Dynamics in Small Open Economies

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ABSTRACT

This paper investigates whether the effects of monetary policy shocks on real exchange rates have changed over time and, if so, whether these changes stem from shifts in transmission mechanisms or from variation in the volatility of the shocks themselves. Using a time-varying parameter VAR with stochastic volatility for six small open economies, we first show that a constant-parameter VAR with stochastic volatility provides the best fit to the data in all six cases. We then employ an identification strategy that combines short- and long-run restrictions to isolate monetary policy shocks, and we evaluate its robustness using high-frequency monetary policy surprises as external instruments. Our results support Dornbusch's overshooting hypothesis in most countries. However, uncovered interest parity is frequently violated, as foreign excess returns diverge from zero following monetary policy shocks. Finally, we document a substantial decline in the volatility of monetary policy shocks since the 1990s, leading to a reduced contribution to exchange rate and macroeconomic fluctuations.

JEL Classification: C32, E52, F31, F41

1 | Introduction

Understanding the interactions between interest rates and exchange rates has long been central to open-economy macroeconomics.[1] For small open economies (SOEs), the exchange rate channel is a key element of the monetary transmission mechanism, influencing inflation, output, and external competitiveness (Cushman and Zha 1997). However, exchange rates have exhibited substantial fluctuations over the past few decades (Rossi 2021), raising questions about the stability of the transmission mechanism. Structural changes in monetary policy frameworks-most notably the widespread adoption of inflation targeting in the 1990s-may have altered how policy shocks propagate through the economy. Ignoring such time variation risks misleading conclusions and policy recommendations. For example, Kim et al. (2017) show that monetary policy shocks significantly drive exchange rate fluctuations in the United States but appear to have minimal effects when policy regimes are pooled. Similarly, Kim and Lim (2018) emphasize that transitions between policy regimes in small open economies can mask true policy effects, underscoring the importance of accounting for evolving monetary frameworks when studying exchange rate dynamics.

This paper asks whether the interactions between monetary policy and exchange rate dynamics have changed over time, and if so, how. Specifically, we examine whether the empirical relationships among key macroeconomic variables exhibit systematic changes in transmission patterns or whether the observed changes primarily reflect shifts in the volatility of shocks.

To address this question, we conduct a model comparison exercise across six economies-Australia, Canada, Norway, New Zealand, Sweden, and the United Kingdom-using variants of the vector autoregressive (VAR) framework that allow for different forms of time variation. Following Chan and Eisenstat (2018), we compute marginal likelihoods to compare four competing specifications: a time-varying parameter VAR with stochastic volatility (TVP-VAR-SV), a time-varying parameter VAR with homoscedastic shocks (TVP-VAR), a constant-parameter VAR with stochastic volatility (VAR-SV), and a conventional homoscedastic VAR. Across all economies, the VAR-SV model provides the best fit, implying that time variation is largely driven by changing volatility of shocks rather than evolving transmission coefficients. We therefore use the VAR-SV as our preferred specification for the structural analysis that follows.

Having established this empirical specification, we identify monetary policy shocks and examine their dynamic effects on key macroeconomic variables. Identification combines short-run and long-run restrictions following Bjørnland (2009), which allow for contemporaneous interaction between the policy rate and the exchange rate while imposing long-run neutrality of monetary policy with respect to the real exchange rate.

In addition to this baseline identification, we also assess robustness using high-frequency monetary policy surprises as a proxy for the structural monetary policy shocks-an approach that has become standard in the modern monetary policy literature. Specifically, by integrating the surprises into the VAR as an exogenous variable following Paul (2020), we estimate a monthly VARX with stochastic volatility using the monetary policy surprises of Choi et al. (2024), and for Australia those constructed by Hambur and Haque (2024). We show that the resulting impulse responses closely mirror those from the baseline identification approach.

Our analysis yields several key findings. First, a contractionary monetary policy shock triggers an immediate and persistent rise in policy rates across all economies, followed by a decline in output-though the magnitude of the real activity response varies by country. Inflation displays a mild price puzzle, in line with earlier evidence such as Bjørnland (2009).

Turning to exchange rates, we find that a contractionary policy shock typically induces an immediate appreciation, although the strength and statistical significance of this response differ across economies. In cases where an impact appreciation is clearly identified, the subsequent gradual depreciation aligns with Dornbusch's overshooting hypothesis (Dornbusch 1976), and we find no evidence of delayed overshooting.[2]

Second, we show that UIP, when conditioned on a monetary policy shock, holds only in a subset of the economies. This indicates that conditional deviations from UIP remain widespread even once policy innovations are isolated.

Third, we document a pronounced decline in the volatility of monetary policy shocks since the 1990s across all six economies. This reduction coincides with the adoption of inflation-targeting frameworks and is reflected in a markedly smaller contribution of monetary policy shocks to both macroeconomic and exchange rate fluctuations.

Taken together, these results suggest that monetary policy in small open economies has become more predictable and less idiosyncratic over time, with correspondingly reduced effects on exchange rate dynamics and macroeconomic volatility.

The findings contribute to several strands of the literature. Most notably, in terms of studying the effects of monetary policy shocks on the real exchange rate in small open economies, and whether these effects are time-varying. While we generally confirm Dornbusch's overshooting hypothesis as in Bjørnland (2009), we also document a substantial decline in the influence of monetary policy shocks on exchange rate fluctuations since the 1990s, driven largely by a marked reduction in shock volatility. This suggests that models abstracting from stochastic volatility may overstate the contribution of monetary policy shocks to macroeconomic dynamics. Moreover, we find that UIP is frequently violated even when exchange rate responses align with overshooting, echoing the conclusions of Scholl and Uhlig (2008).

Empirically, our study builds on a substantial literature examining how monetary policy affects exchange rates in small open economies. Recent work-including Inoue and Rossi (2019), Rüth (2020), Castelnuovo et al. (2022), and Rüth and Van der Veken (2022) shows that once identification is handled credibly, the traditional exchange rate puzzles largely vanish, and exchange rate responses to monetary policy shocks become consistent with theory. These advances underscore the centrality of robust identification strategies and motivate our use of combined short- and long-run restrictions, supplemented by high-frequency policy surprises as external instruments.

Methodologically, our work relates to the growing literature that employs time-varying VARs to capture evolving macroeconomic dynamics. Only a limited number of studies, however, have applied such models to exchange rate behaviour. Mumtaz and Sunder-Plassmann (2013) examine Canada, the Euro Area, and the UK, showing that the influence of demand and nominal shocks on the real exchange rate increased after the mid-1980s. Yang and Zhang (2021) use a time-varying VAR following Paul (2020) to study U.S. monetary policy spillovers on small open economies and find that exchange rate responses were stronger during the unconventional policy period of 2008–2012.[3]

The remainder of the paper is organized as follows. Section 2 outlines the empirical framework, including the model comparison exercise used to assess the relevance of time variation. Section 3 presents the structural analysis, discussing identification, dynamic responses, and the evolution of policy shock volatility. Section 4 reports robustness checks, including results based on external instruments for identification. Section 5 concludes.

2 | Time-Varying Dynamics in Small Open Economies

We begin by examining whether the responses of key macroeconomic variables to monetary policy shocks have changed over time in small open economies, and, if so, whether these shifts stem from evolving transmission mechanisms or from changes in shock volatility. To investigate this, we employ a unified

VAR framework featuring time-varying coefficients and stochastic volatility, and compare a sequence of nested model specifications. This approach serves two aims: it assesses whether time variation is truly required by the data, and it guides the choice of the most appropriate empirical model for the subsequent structural analysis.

Let $\boldsymbol{Y}_t$ denote an $n \times 1$ vector of endogenous variables. We work within the general framework of a time-varying parameter VAR with stochastic volatility (TVP-VAR-SV), defined as follows:

$$\boldsymbol{Y}_t = c_t + B_{1,t}\boldsymbol{Y}_{t-1} + \cdots + B_{p,t}\boldsymbol{Y}_{t-p} + u_t, \qquad u_t \sim N(0, \Omega_t), \tag{2.1}$$

where c_t and the coefficient matrices $B_{i,t}$ may evolve over time and the reduced-form covariance matrix Ω_t is allowed to be time-varying and decomposed as

$$\Omega_t = A_t^{-1}\Sigma_t\Sigma_t'(A_t^{-1})',$$

where A_t is lower triangular with ones on the diagonal and Σ_t is diagonal, so that $u_t = A_t^{-1}\Sigma_t\varepsilon_t$ with $\varepsilon_t \sim N(0, I_n)$. Time variation in the coefficients and volatilities, when allowed for, is modelled as independent random walks, following the specification in Primiceri (2005). The full state-space formulation, prior specifications, and MCMC implementation details are provided in the Online Appendix.

Within this general framework, we consider four nested specifications:

1. *VAR*: constant coefficients and homoscedastic shocks ($c_t = c$, $B_{i,t} = B_i$, $A_t = A$, $\Sigma_t = \Sigma$);
2. *TVP–VAR*: time-varying coefficients ($c_t, B_{i,t}$) with homoscedastic shocks ($A_t = A$, $\Sigma_t = \Sigma$);
3. *VAR–SV*: constant coefficients (c, B_i, A) with stochastic volatility in Σ_t;
4. *TVP VAR SV*: time-varying coefficients and stochastic volatility as in (2.1).

Each of these models is obtained from (2.1) by imposing restrictions on the evolution of the relevant parameter blocks. This nesting structure enables a coherent comparison across specifications and helps identify the model most strongly supported by the data.

2.1 | Baseline Specification

We model the joint dynamics of a small open economy using a five-variable system: $\boldsymbol{Y}_t = [R_t^*,\ \pi_t,\ \Delta y_t,\ R_t,\ \Delta re_t]'$, where R_t^* is the trade-weighted foreign interest rate, π_t the domestic inflation rate, Δy_t real GDP growth, R_t the domestic policy rate, and Δre_t the change in the trade-weighted real exchange rate. Quarterly data are used from 1983Q1 to 2019Q4 for Australia, Canada, Norway, Sweden, and the United Kingdom, and from 1988Q1 for New Zealand to exclude the early transition years of large structural reform.[4] Each model is estimated with three lags ($p = 3$), consistent with Bjørnland (2009).[5]

2.2 | Model Selection

To assess whether time variation is an essential feature of the data, we formally compare the in-sample fit of the four model variants using their marginal likelihoods. Within a Bayesian framework, the marginal likelihood of a model $\boldsymbol{M}_k$ integrates the likelihood of the data over the parameter space:

$$p(\boldsymbol{Y} \mid \boldsymbol{M}_k) = \int p(\boldsymbol{Y} \mid \boldsymbol{\theta}_k, \boldsymbol{M}_k)\, p(\boldsymbol{\theta}_k \mid \boldsymbol{M}_k)\, d\boldsymbol{\theta}_k,$$

where $\boldsymbol{Y}$ denotes the observed data and $\boldsymbol{\theta}_k$ the model parameters. Comparing any two models $\boldsymbol{M}_i$ and $\boldsymbol{M}_j$, the Bayes factor

$$BF_{ij} = \frac{p(\boldsymbol{Y} \mid \boldsymbol{M}_i)}{p(\boldsymbol{Y} \mid \boldsymbol{M}_j)}$$

measures the relative support the data provide for one model over the other. A larger value of BF_{ij} indicates stronger evidence in favour of $\boldsymbol{M}_i$; by convention, values above 6 or 10 are interpreted as strong or very strong evidence (Kass and Raftery 1995). The marginal likelihood can also be viewed as the model's one-step-ahead density forecast of the data (Geweke and Amisano 2011), so it offers a coherent measure of overall fit.

Computing marginal likelihoods for high-dimensional time-varying models can be nontrivial. Early methods based on conditional likelihoods or harmonic-mean approximations are now known to perform poorly in finite samples (Chan and Grant 2015). We therefore adopt more accurate integrated-likelihood estimators: Chan and Grant (2016) for the VAR and TVP-VAR, and Chan and Eisenstat (2018) for the VAR-SV and TVP-VAR-SV. The log-marginal likelihoods (log-ML) are reported in Table 1, along with the implied Bayes factors relative to the constant-parameter VAR benchmark.

The results reveal a consistent pattern across countries. Allowing for stochastic volatility markedly improves model fit, while allowing for time-varying coefficients does not. The VAR-SV

TABLE 1 | Log-marginal likelihoods across model specifications.

Country	VAR	VAR-SV	TVP-VAR	TVP-VAR-SV
Australia	−1204.0	**−1061.9**	−1307.5	−1184.8
	(0)	(142.1)	(−103.5)	(19.2)
Canada	−1135.5	**−1066.3**	−1232.1	−1159.7
	(0)	(69.2)	(−96.6)	(−24.2)
New Zealand	−1423.3	**−1310.4**	−1517.6	−1420.6
	(0)	(112.9)	(−94.3)	(2.7)
Norway	−1231.0	**−1146.3**	−1349.2	−1256.7
	(0)	(84.7)	(−118.2)	(−25.7)
Sweden	−1206.9	**−1116.2**	−1323.2	−1227.7
	(0)	(90.7)	(−116.3)	(−20.8)
United Kingdom	−1101.7	**−1006.3**	−1210.0	−1137.0
	(0)	(95.4)	(−108.3)	(−35.3)

Note: Values in parentheses report twice the difference in log-marginal likelihoods relative to the constant-parameter VAR benchmark, equivalent to log Bayes factors. Higher log-ML values indicate better fit.

specification achieves the highest log-ML in every case-often by a substantial margin-whereas the TVP-VAR performs worse than even the homoscedastic VAR. This evidence suggests that variations in the volatility of shocks, rather than in the underlying structural relationships such as policy transmission, account for most of the time variation in these economies.

3 | Dynamic Effects of Monetary Policy Shocks

3.1 | Baseline Identification Strategy

Having established the VAR-SV model as the preferred empirical specification, we now analyze the dynamic effects of monetary policy shocks through the lens of this model. The identification of policy shocks in our baseline analysis combines short-run and long-run restrictions in a small open economy framework, following Bjørnland (2009). The objective is to isolate exogenous innovations in the policy rate-those unrelated to contemporaneous macroeconomic conditions-while allowing for simultaneous interaction between the policy rate and the exchange rate.

We impose a recursive structure among the macroeconomic variables and the domestic policy rate to ensure that output and inflation do not respond contemporaneously to monetary policy shocks, consistent with sluggish price and quantity adjustment. In contrast, the policy rate may react immediately to developments in these variables. The exchange rate, treated as a forward-looking asset price, can respond instantaneously to all shocks, while its pass-through to real activity and inflation occurs gradually due to nominal rigidities. To account for external influences, the foreign interest rate is ordered first, followed by domestic inflation and output-reflecting the small open economy assumption that domestic variables may react contemporaneously to foreign monetary disturbances, but not vice versa. Importantly, the responses to domestic monetary policy shocks are invariant to this ordering.

A key feature of the identification scheme is that it does not impose a recursive restriction between the domestic policy rate and the real exchange rate. Recursive schemes, such as the Cholesky decomposition, typically assume either that monetary policy does not respond contemporaneously to exchange rate movements (Eichenbaum and Evans 1995) or that the exchange rate does not respond immediately to policy shocks (Marcellino and Favero 2004; Mojon and Peersman 2001). Both assumptions are implausible: the former contradicts central bank practices, while the latter is inconsistent with the asset-price nature of exchange rates. We therefore allow for contemporaneous feedback between monetary policy and the exchange rate.

Identification is completed by imposing a long-run neutrality restriction, which assumes that monetary policy shocks have no permanent effect on the level of the real exchange rate. Since the real exchange rate enters the VAR in first differences, this restriction ensures that the cumulative response of the level converges to zero. This neutrality assumption, standard in open-economy models, allows monetary policy and exchange rate shocks to be disentangled while preserving contemporaneous interaction between them.

To impose these restrictions in each MCMC draw, we use the algorithm of Rubio-Ramirez et al. (2010) (RWZ) to recover the orthogonal rotation consistent with the identifying assumptions. Let $L_{0,t} = A^{-1}\Sigma_t$ denote the contemporaneous response matrix and $L_{\infty,t} = (I - \sum_{i=1}^{p} B_i)^{-1} L_{0,t}$ the accumulated long-run effects. Identification consists of selecting zeros in $(L_{0,t},\ L_{\infty,t})$ that rule out an immediate effect of monetary policy on foreign interest rate, domestic inflation, and output, while imposing that monetary policy has no permanent level effect on the real exchange rate. This allows the policy rate and exchange rate to react contemporaneously without recursive ordering.

The algorithm is implemented as follows. For each posterior draw:

1. Compute the Cholesky factor Z_t of the reduced-form covariance Ω_t, which serves as the initial candidate for the impact matrix.
2. Form the short-run and long-run candidate responses as $L^*_{0,t} = Z_t$ and $L^*_{\infty,t} = (I - \sum_{i=1}^{p} B_i)^{-1} Z_t$.
3. Find an orthogonal matrix P_t such that $(L^*_{0,t}P_t, L^*_{\infty,t}P_t)$ satisfies the zero restrictions, and set $L_{0,t} = L^*_{0,t}P_t$.

The full restriction matrices, rank conditions, and details of the monetary policy application are documented in the Online Appendix.

3.2 | Transmission of Monetary Policy Shocks

Figures 1 and 2 display the impulse responses of inflation, output, the domestic interest rate, and the real exchange rate to a contractionary monetary policy shock for the six countries in our sample. Following Nakajima (2011), the size of the shock is normalised to the average magnitude of identified policy shocks over the sample period, ensuring comparability of responses across time.

Across all economies, a contractionary monetary policy shock produces a clear and persistent rise in the policy rate. The tightening in financial conditions translates into lower real activity, though the magnitude and persistence of the contraction vary across countries. Output responses are particularly pronounced in Canada, Norway, and Sweden, whereas they are more muted in Australia, New Zealand, and the United Kingdom, suggesting meaningful cross-country differences in the strength of monetary transmission to the real economy. We also document a modest "price puzzle," with inflation rising in the short run after a contractionary policy shock. This behaviour is consistent with the findings of Bjørnland (2009), who reports similar inflation dynamics for most of the small open economies in her sample.

With regards to the exchange rate response, in New Zealand, Sweden, and the United Kingdom, the exchange rate appreciates

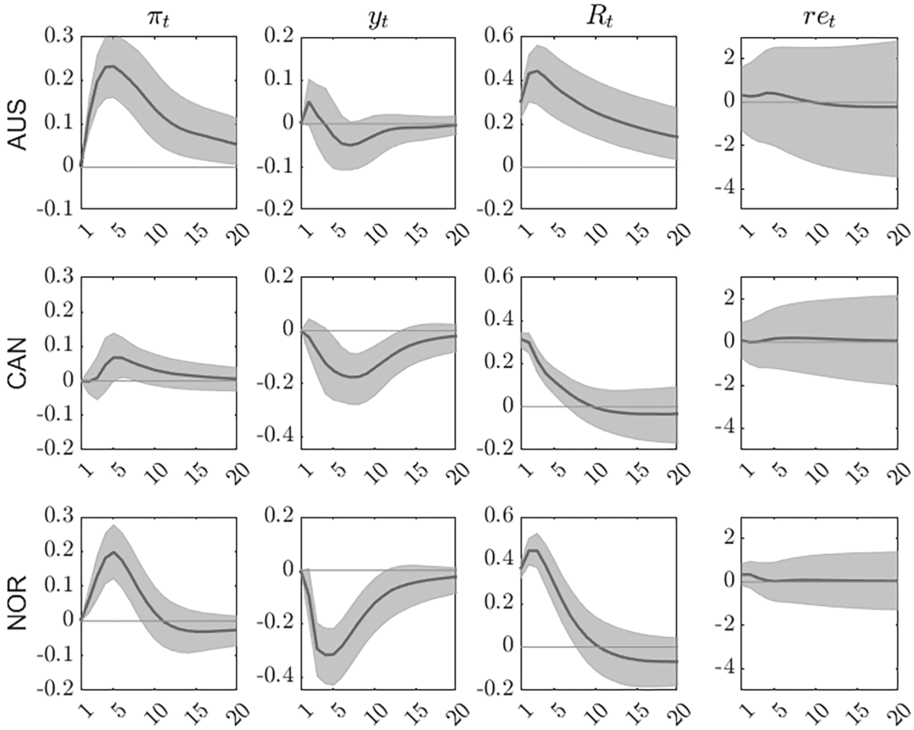

FIGURE 1 | Australia, Canada, Norway-Impulse responses to a monetary policy shock from the VAR-SV model. Solid lines depict the posterior median estimates while the gray shaded area represents 68% posterior credible intervals around the posterior median.

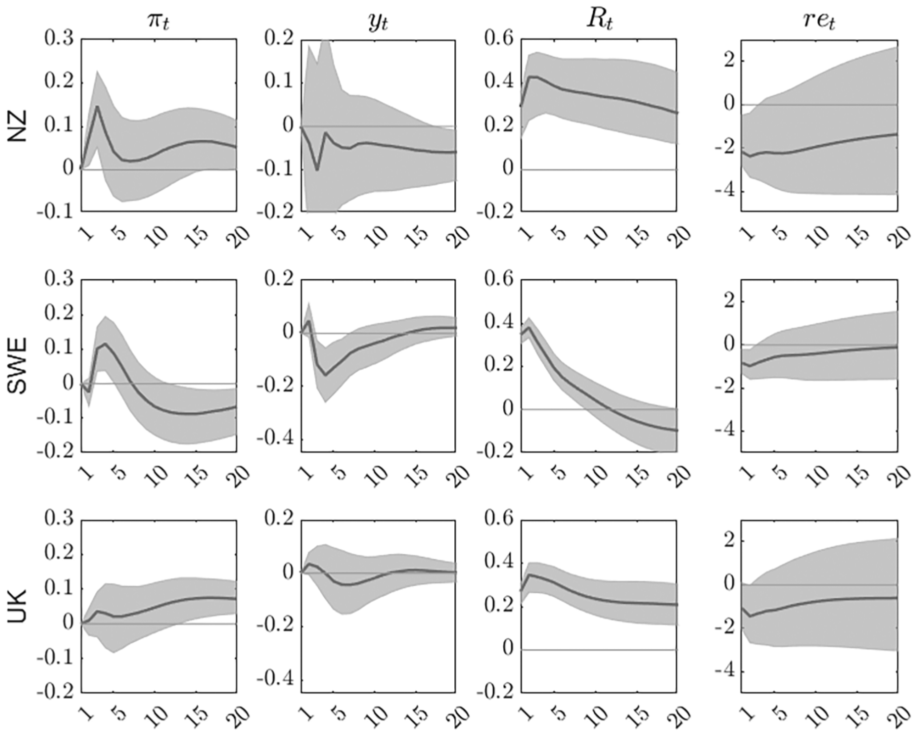

FIGURE 2 | New Zealand, Sweden, United Kingdom-Impulse responses to a monetary policy shock from the VAR-SV model. Solid lines depict the posterior median estimates, while the gray shaded area represents 68% posterior credible intervals around the posterior median.

immediately following the policy shock, consistent with the view of the exchange rate as a forward-looking asset price. However, the responses for Australia, Canada, and Norway are statistically insignificant, pointing to a weaker exchange rate channel for policy transmission. Importantly, we find no evidence of an "exchange rate puzzle" in any of the countries-unlike the findings of Grilli and Roubini (1995)-as the exchange rate never depreciates on impact after a tightening.

The subsequent exchange rate path also displays features consistent with Dornbusch's (1976) overshooting mechanism. In economies where the impact response is statistically significant, the appreciation is followed by a gradual depreciation, reflecting the unwinding of the interest-rate differential that initially drives the currency above its longer-run value. More generally, all countries exhibit exchange rate dynamics without evidence of delayed overshooting. As imposed by our long-run restriction, the real exchange rate eventually converges back to its initial level, ensuring that monetary policy shocks have no permanent effect on relative prices, in line with standard open-economy monetary theory.

3.3 | Uncovered Interest Parity (UIP)

Having established the dynamic effects of monetary policy shocks, we next examine the UIP condition. While it is well documented that UIP fails to hold unconditionally-see, among others, Fama (1984), Engel (1996), Burnside et al. (2006), and Burnside (2019)-for policymakers, the relevant question is whether UIP holds conditionally on monetary policy shocks. If it does, then a contractionary (expansionary) policy shock that raises (lowers) domestic interest rates should be exactly offset by an expected depreciation (appreciation) of the exchange rate, leaving expected excess returns unchanged.

The empirical literature provides mixed evidence on this conditional version of UIP. Some studies, including Eichenbaum and Evans (1995) and Faust and Rogers (2003), report that UIP fails to hold even in the short run, while others, such as Bjørnland (2009), find that exchange rate responses to policy shocks are broadly consistent with UIP. In contrast, Scholl and Uhlig (2008) show that UIP violations persist in U.S. data even after accounting for the delayed overshooting puzzle, arguing that the well-known forward discount bias reflects a distinct phenomenon rather than a by-product of sluggish exchange rate adjustment.

To investigate this issue, we compute the ex-post excess return from holding foreign rather than domestic short-term bonds. Denoting this differential by ψ_t, the excess return measured in domestic currency is defined as

$$\psi_t = R_t^* - R_t + 4(s_{t+1} - s_t), \tag{3.1}$$

where s_t and s_{t+1} are the nominal exchange rate (domestic price of foreign currency) and its one-quarter-ahead value, respectively.[6] Under UIP, the expected excess return should be zero for all horizons $j \geq 0$:

$$E_t(\psi_{t+j}) = 0, \tag{3.2}$$

where $E_t(\cdot)$ denotes expectations based on information available at time t.

We test this implication by examining the impulse responses of ψ_t to a domestic monetary policy shock. If UIP holds conditionally, the increase in the domestic-foreign interest rate differential following a policy tightening should be exactly offset by an expected depreciation of the exchange rate, such that the expected excess return remains zero.

Figure 3 reports the median impulse responses and 68% credible intervals of ψ_t derived from the VAR-SV model.[7] The results indicate significant deviations from UIP in most countries. In Australia and Norway, the expected return on foreign bonds falls relative to domestic bonds following a contractionary policy shock, with a delayed adjustment in Australia. In Sweden and the United Kingdom, the deviation from UIP is immediate but short-lived, while in Canada and New Zealand, the responses fluctuate closely around zero, consistent with the parity condition.

Overall, our findings point to conditional UIP violations in the short run for most economies, even in cases where the exchange rate dynamics are broadly consistent with Dornbusch's overshooting hypothesis. This evidence contrasts with Bjørnland (2009), who finds conditional UIP to hold in all countries except Canada, but aligns with the results of Scholl and Uhlig (2008), who document persistent forward discount bias even in the absence of delayed overshooting.

3.4 | Policy Shock Volatility and Macroeconomic Fluctuations

We now turn to the role of stochastic volatility by examining how the volatility of monetary policy shocks has evolved over time. Following Canova and Gambetti (2009), the policy rate equation is viewed as containing a systematic component-reflecting the endogenous response of the policy rate to its own lags and to current and lagged macroeconomic conditions-and a nonsystematic component, which represents the exogenous policy shock. The volatility of this structural shock captures the extent of policy uncertainty or discretionary intervention at each point in time.

To recover the variance of the monetary policy shock, we normalise the contemporaneous coefficient on the interest rate in its own equation to one, following Canova and Gambetti (2009). This implies that the policy shock can be expressed as $\varepsilon_t^{mp} = (1/l_{44,t})\,\varepsilon_{4,t}$, with variance $(1/l_{44,t})^2$, where $l_{44,t}$ denotes the element of the contemporaneous impact matrix associated with the domestic interest rate equation. The corresponding posterior distribution of this standard deviation provides a direct measure of time variation in monetary policy shock volatility.

Figure 4 displays the median estimates (solid lines) and 68% credible intervals (gray shaded areas) of the posterior standard deviations of monetary policy shocks for each country. The figure reveals a pronounced decline in volatility across all economies, with policy shocks becoming almost negligible since the early 2000s. This steady reduction coincides with the widespread adoption of inflation-targeting regimes and reflects an improvement in the conduct of monetary policy: central banks have become more systematic and less prone to large discretionary adjustments. The results underscore the importance of allowing for stochastic volatility in the VAR specification.

Given the marked decline in policy shock volatility, we next assess its implications for macroeconomic and exchange rate fluctuations by analysing forecast error variance decompositions (FEVDs). Figures 5–6 present the one-year-ahead FEVDs for monetary policy shocks across the six economies.[8] These

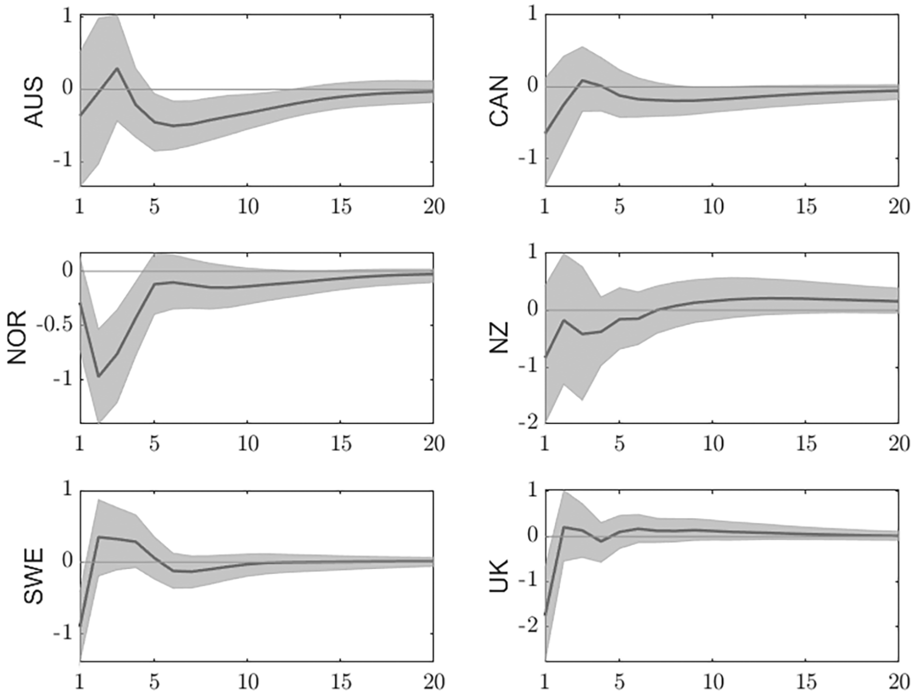

FIGURE 3 | Conditional excess returns from the VAR-SV model. Solid lines depict the posterior median estimates while the gray shaded area represents 68% posterior credible intervals around the posterior median.

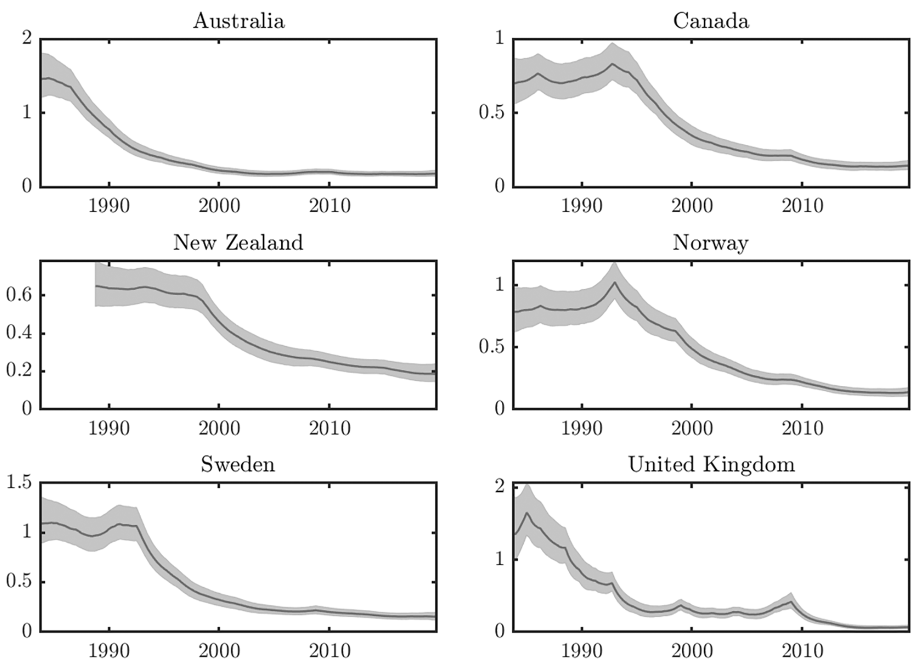

FIGURE 4 | Estimated standard deviations of monetary policy shocks from the VAR-SV model. Solid lines depict the posterior median estimates, while the gray shaded area represents 68% posterior credible intervals around the posterior median.

decompositions illustrate how the relative contribution of monetary policy shocks to forecast error variance has changed over time.

The results show that monetary policy shocks explained between 20% and 60% of exchange rate fluctuations in the 1980s, but their influence has declined markedly since the 1990s. This reduction coincides with the adoption of inflation-targeting frameworks across the sample, which not only stabilized inflation expectations but also reduced the frequency and magnitude of policy shocks. By the 2000s, the contribution of monetary policy shocks to exchange rate volatility had become negligible in Canada and Norway, and by the 2010s in the United Kingdom. This stands in contrast to Bjørnland (2009), who found policy shocks to be an important source of exchange rate fluctuations. Our findings suggest instead that once stochastic volatility is accounted for,

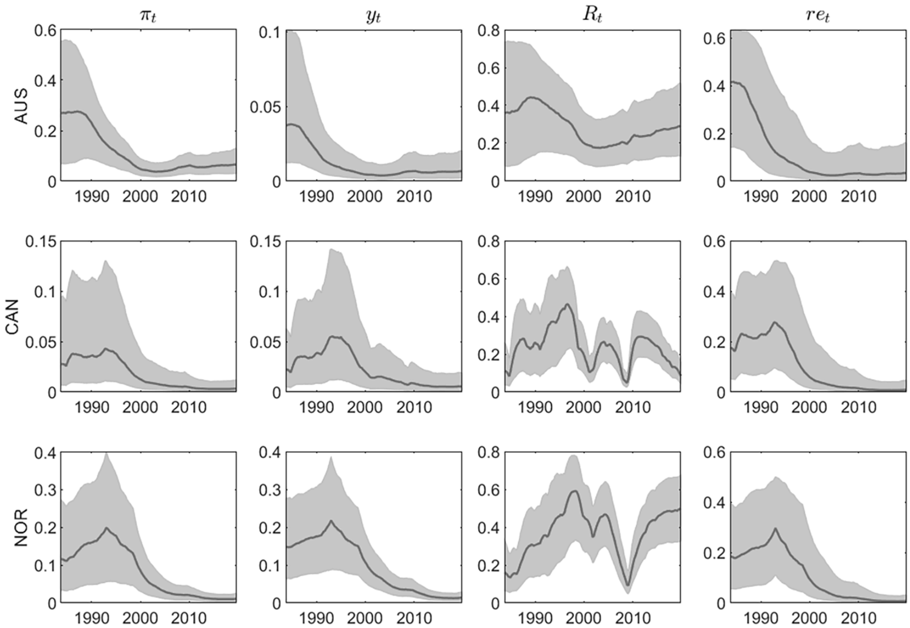

FIGURE 5 | Australia, Canada, Norway-One-year-ahead forecast error variance decomposition for monetary policy shocks from the VAR-SV model. Solid lines depict the posterior median estimates, while the gray shaded area represents 68% posterior credible intervals around the posterior median.

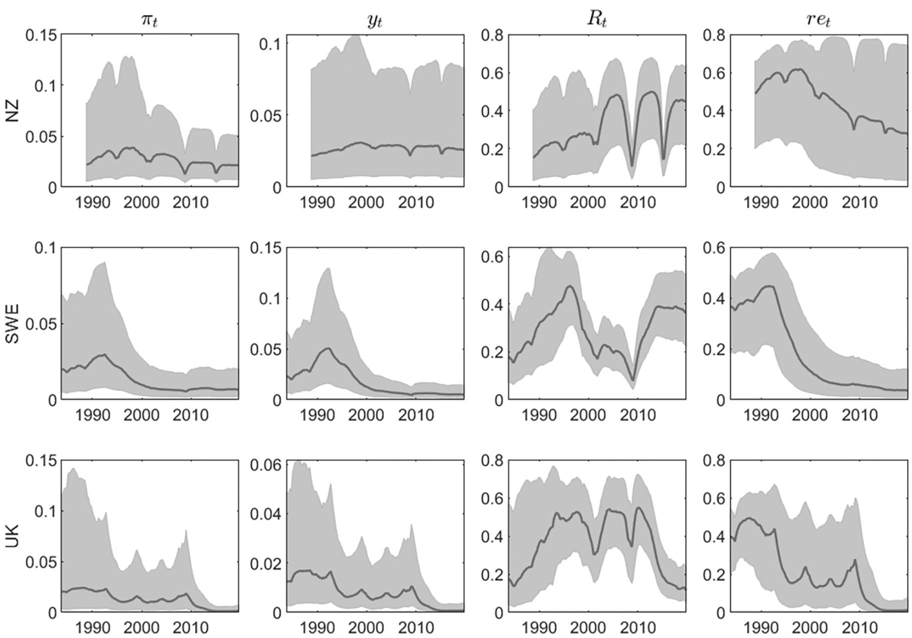

FIGURE 6 | New Zealand, Sweden, United Kingdom-One-year-ahead forecast error variance decomposition for monetary policy shocks from the VAR-SV model. Solid lines depict the posterior median estimates, while the gray shaded area represents 68% posterior credible intervals around the posterior median.

monetary policy shocks cease to be a major driver of exchange rate movements in small open economies.

Turning to other macroeconomic variables, monetary policy shocks explain only a modest share of output and inflation volatility, consistent with the broader literature on monetary transmission. Moreover, their contributions have declined over time, reflecting the broader reduction in policy shock volatility. Overall, monetary policy shocks have become largely inconsequential for fluctuations in output and inflation in the post-2000s period.

These findings complement the earlier model selection evidence, which showed that incorporating stochastic volatility improves model fit. Taken together, the results suggest that the dominant source of temporal instability in small open economies lies in the changing volatility of structural shocks-particularly monetary policy shocks-rather than evolving policy rules or transmission mechanisms. The steady decline in shock volatility over the past four decades thus reflects both greater monetary policy credibility under inflation targeting and a more stable macroeconomic environment in which policy disturbances have become less frequent and less consequential for business cycle dynamics.

4 | Sensitivity Analysis

We conduct a range of robustness checks to assess the stability of our findings. These include (i) alternative model specifications, (ii) different lag lengths, (iii) alternative prior choices, (iv) augmenting the information set with additional variables, and (v) alternative identification strategies.

Regarding model specification, we address differences with Bjørnland (2009), who estimate a constant-parameter VAR with a linear time trend, by detrending output. We adopt a quadratic trend, which yields output series comparable to hers over the overlapping sample period (see Figure S.1 in Online Appendix). For lag length, we consider a specification with two lags instead of three, following common practice in quarterly VARs with time variation (e.g., Mumtaz and Sunder-Plassmann 2013; Yang and Zhang 2021). To examine the sensitivity to prior choices, we employ tighter priors on the variance and covariance states; this allows us to assess whether the decline in monetary policy shock volatility reflects genuine time variation or prior-driven drift. Finally, because several economies in our sample are significant oil exporters (Canada, Norway, and the United Kingdom), we include oil price growth as an additional variable, ordered last, to account for possible exchange-rate effects mediated through commodity markets (Bjørnland and Halvorsen 2014).

Figures S.5–S.9 in Online Appendix document the results. In each figure, we display the baseline results for the VAR-SV model and overlay the estimated posterior medians obtained from the robustness exercises. In all cases, the main conclusions remain intact: there is no evidence of the exchange rate puzzle or delayed overshooting, monetary policy shocks typically generate conditional violations of UIP, and the contribution of monetary policy shocks to exchange rate and macroeconomic volatility declines substantially after the 1990s. The stability of these findings across a wide set of robustness exercises reinforces the reliability of our baseline results.

4.1 | Alternative Identification Strategies

We further examine robustness using alternative identification schemes. We begin with recursive identification, the most common approach in earlier VAR studies (e.g., Grilli and Roubini 1995; Christiano et al. 1999). Because the contemporaneous ordering between the interest rate and the real exchange rate is ambiguous in small open economies, we estimate two recursive models: one placing the interest rate before the exchange rate ("R-re") and one placing the exchange rate before the interest rate ("re-R"). Online Appendix Figure S.10–S.11 reports the resulting exchange rate responses. The responses are either mostly insignificant or exhibit an exchange rate puzzle, with depreciation following a contractionary monetary policy shock, for example, UK in R-re ordering, and NZ, Sweden, and UK in re-R ordering.

We next consider an alternative identification approach using high-frequency monetary policy surprises. High-frequency identification has become a standard tool for isolating exogenous monetary policy shocks, following Kuttner (2001) and subsequent large literature. The key idea is that asset price movements in narrow windows around policy announcements capture revisions in monetary policy expectations and can therefore serve as valid external instruments.

To implement this approach, we draw on the monetary policy surprise database of Choi et al. (2024) for all countries except Australia, for which we rely on the series constructed by Hambur and Haque (2024). Because these instruments are measured at the monthly frequency, we estimate a monthly VARX model, following the framework of Paul (2020). The high-frequency surprise enters contemporaneously as an exogenous regressor. We also incorporate stochastic volatility to align with our baseline VAR-SV model. This VARX SV specification allows us to retain the reduced-form dynamics of the VAR while incorporating the information contained in the monthly shocks. Industrial production replaces real GDP as the monthly real-activity indicator, and the model is estimated with nine lags to maintain comparability with the three-lag structure of our quarterly baseline.[9]

For comparability, we also re-estimate the baseline VAR-SV model using the combined short- and long-run restrictions on the same monthly sample windows. Since the availability of high-frequency surprises differs across economies, the estimation spans are necessarily shorter than in the quarterly baseline and vary across countries.[10]

Figures 7 and 8 show the impulse responses. For comparability, we normalize the impact response of interest rates for the external instrument identification approach to be the same as the average estimated stochastic volatility over the sample from the VAR-SV estimation. Despite differences in identification strategy, the instrument-based results closely resemble those of our baseline identification. Exchange rates generally appreciate on impact following a contractionary policy shock and then gradually depreciate, consistent with Dornbusch-style overshooting. In some cases, such as Australia and Norway, the appreciation is more pronounced in the high-frequency specification.[11] Inflation responses continue to display a mild price puzzle in some countries, a feature also noted by Paul (2020) for the US when using the external instrument approach, who shows that removing the price puzzle requires imposing additional zero contemporaneous restrictions on slow-moving macroeconomic variables. Overall, the broad alignment of impulse responses across our baseline and external instrument-based identification schemes suggests that results are not driven by the particular identification assumptions used.

5 | Conclusion

This paper investigates whether the effects of monetary policy on real exchange rates in small open economies have changed over time and, if so, what form this time variation takes. To address this question, we combine a model comparison exercise with a

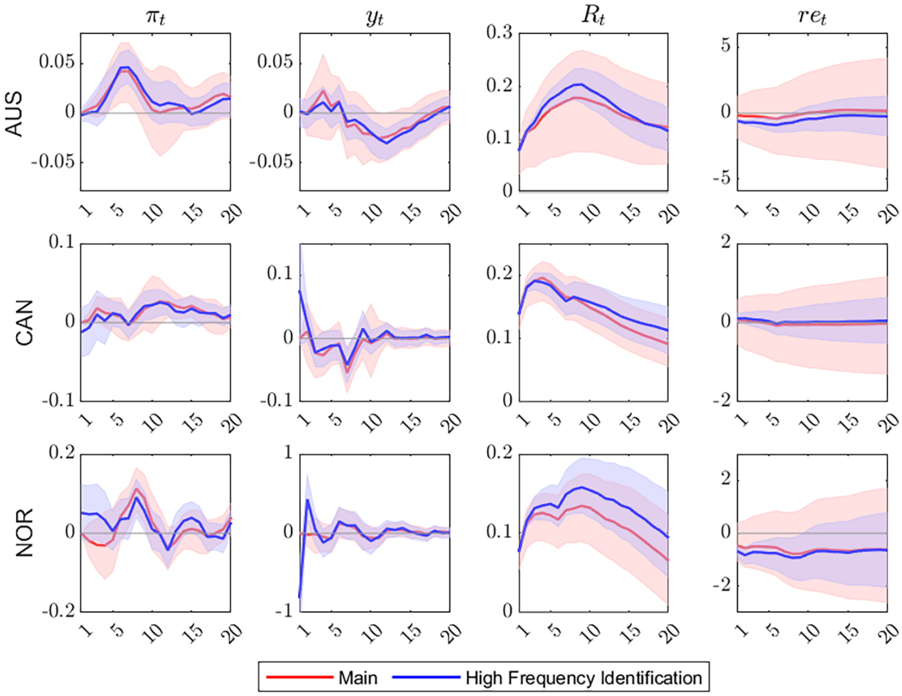

FIGURE 7 | Impulse responses to a contractionary monetary policy shock for Australia, Canada, and Norway, comparing the baseline VAR-SV model (red) with the external-instrument VARX-SV approach using high-frequency monetary policy surprises (blue). Solid lines represent posterior medians and shaded areas show 68% posterior credible intervals.

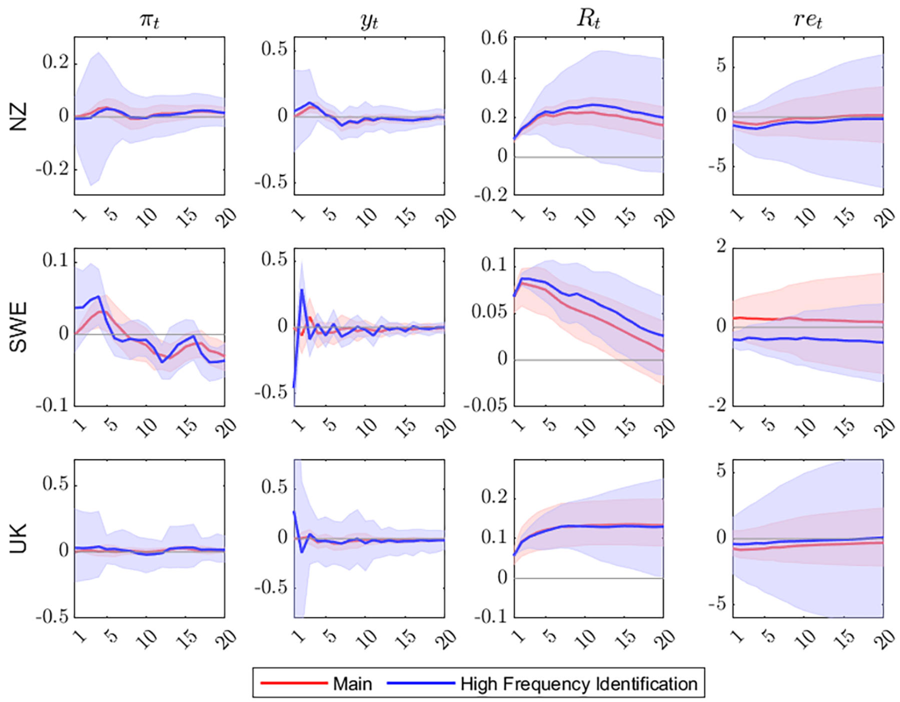

FIGURE 8 | Impulse responses to a contractionary monetary policy shock for New Zealand, Sweden, and the United Kingdom, contrasting the baseline VAR-SV model (red) with the VARX-SV model identified using high-frequency monetary policy surprises (blue). Solid lines represent posterior medians and shaded areas show 68% posterior credible intervals.

structural analysis of monetary policy shocks using data from six widely studied small open economies.

We begin by assessing the importance of time variation through marginal likelihood comparisons across a suite of VAR specifications. The results consistently favour a constant-parameter VAR with stochastic volatility (VAR-SV) for all economies in our sample. This finding implies that the transmission mechanism itself has remained broadly stable over time, while the volatility of underlying structural shocks has shifted.

Using the best-fitting VAR-SV specification, we then identify monetary policy shocks through the combination of short- and long-run restrictions. First, a contractionary monetary policy shock generally leads to an immediate appreciation of the real exchange rate, followed by a gradual depreciation-consistent with Dornbusch's overshooting hypothesis-and we find no evidence of delayed overshooting. Second, we examine whether UIP holds conditional on monetary policy shocks. In most countries, it does not: foreign excess returns typically fall following a domestic policy tightening, echoing the forward discount puzzle. Consistent with Scholl and Uhlig (2008), these results reinforce the idea that the forward discount puzzle and the delayed overshooting puzzle are distinct phenomena.

A further contribution of the paper is to document the evolution of monetary policy shock volatility. Across all six economies, monetary policy shocks exhibit a pronounced decline in volatility beginning in the 1990s. This decline coincides with the widespread adoption of inflation-targeting frameworks and suggests a shift toward more systematic and predictable monetary policy behavior. The reduction in shock volatility, in turn, leads to a substantial decline in the contribution of monetary policy disturbances to both exchange rate fluctuations and broader macroeconomic variability, as reflected in our forecast error variance decompositions.

Taken together, the evidence points to a coherent narrative: while the immediate exchange rate response to monetary policy has remained broadly consistent with standard open-economy theory, the overall influence of monetary policy shocks on exchange rate and macroeconomic dynamics has diminished over time, driven largely by a sharp reduction in the volatility of these shocks. This pattern reflects the improvement of monetary policy frameworks in small open economies and highlights the value of explicitly modelling stochastic volatility when analyzing the transmission of monetary policy to exchange rates.

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Data Availability Statement

The data that support the findings of this study are openly available in the Journal Data Archive at https://doi.org/10.15456/jae.2026041.1155110440.

Endnotes

[1] For an early review of this literature, see Taylor (1995), and for more recent insights into exchange rate predictability, see Rossi (2013).

[2] The delayed overshooting puzzle is often linked to the forward discount puzzle, as it implies a violation of uncovered interest parity (UIP). More generally, a forward discount puzzle can arise even without delayed overshooting; see Scholl and Uhlig (2008).

[3] Paul (2020) extend the time-varying parameter VAR framework of Cogley and Sargent (2001) by incorporating high-frequency monetary policy surprises as external instruments for structural shocks.

[4] Data sources and transformations are described in the Appendix.

[5] As these specifications incorporate stochastic volatility when relevant, we do not use time dummies to account for temporal variations in volatility, nor do we detrend output prior to estimation. That said, later in the robustness section, we show that the results are robust to alternative lag lengths and (quadratically) detrending output.

[6] The exchange rate term is multiplied by four to annualize quarterly changes, ensuring consistency with the annualized interest rates.

[7] To obtain the nominal exchange rate effect, we adjust for domestic prices using $s_t = re_t - p_t^* + p_t$, where re_t is the real exchange rate. Foreign prices are not included in the VAR, implying the plausible small open economy assumption that domestic monetary policy has negligible effects on foreign prices. See Bjørnland (2009) for details.

[8] Results are robust to shorter (one-quarter) and longer (three-year) horizons. See Figures S.2–S.3 in the Online Appendix.

[9] For Australia and New Zealand, CPI and industrial production are only available at the quarterly frequency; we linearly interpolate these series to a monthly frequency.

[10] Estimation samples are as follows: Australia: 2001m4–2019m12; Canada: 1983m1–2019m12; Norway: 1999m1–2019m12; New Zealand: 2001m1–2019m12; Sweden: 1999m1–2019m12; United Kingdom: 1998m1–2019m12.

[11] For most economies, the posterior credible intervals are tighter under the external-instrument VARX-SV approach. The exceptions are New Zealand and the United Kingdom, where intervals widen, suggesting weaker instrument strength.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Data S1**: jae70051-sup-0001-Supinfo.pdf.