Measuring the Stance and Effects of Monetary Policy: Evidence from Four Advanced Economies

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Abstract

We examine the macroeconomic effects of monetary policy using market-based measures of its stance for four advanced economies: Canada, the euro area, Japan, and Sweden. Consistent with economic theory, panel local projection regressions show that a 25 basis points contractionary stance shock reduces inflation 0.1 percentage points within the first year, with effects persisting for up to two years, while industrial production contracts up to 0.4 percentage point, with the peak decline materializing 6-12 months after the shock. Moreover, our market-based stance measures reflect both conventional and unconventional monetary policies and are not subject to any lower bounds.

JEL Classification: C32, E43, E52, E58

Keywords: term structure modeling, monetary policy shocks, rstar, financial frictions, liquidity risk

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1 Introduction

Swedish economist Knut Wicksell famously argued that one cannot judge inflation by looking at interest rates alone. High market interest rates do not necessarily imply that inflation is increasing, nor do low rates mean that the economy is experiencing deflation. Instead, the outlook for inflation depends on where short-term interest rates are relative to the natural rate of interest, widely known as r_t^*. Hence, for policymakers to optimally deliver their preferred policy, it is important for them to measure the stance, which is the relative gap between the real policy rate r_t and r_t^*. The key empirical challenge in doing so is that neither short-term real rates nor r_t^* are directly observable and instead have to be inferred from data. In this paper, we consider a unified measure of the stance of monetary policy constructed from yield data that quantifies both r_t and r_t^* and can be applied to a wide set of economies as we demonstrate. Importantly, its availability does not require the existence of an exotic liquid market for interest rate derivatives. Instead, a sufficiently deep market for inflation-indexed government bonds suffices.

Monetary policy plays a central role in stabilizing the economy, primarily by influencing aggregate demand through various transmission mechanisms. In the economic literature, a widely accepted approach to assessing the stance of monetary policy considers the gap between the real policy rate r_t and its natural level r_t^*. If the economy is in steady state with no output gap, monetary policy is considered expansionary if r_t is below r_t^*, and contractionary if r_t exceeds r_t^*. The stance of monetary policy, measured as the gap, is a powerful indicator for communicating monetary policy and evaluating its macroeconomic effects. The policy stance, whether expansionary or contractionary, refers to the overall orientation of central bank actions aimed at achieving price stability, full employment, and sustainable economic growth. When central banks adjust their stances, typically through changes in policy interest rates or other instruments such as asset purchases and reserve requirements, the resulting effects ripple through the economy, affecting a wide range of macroeconomic variables, including industrial production, inflation, employment, and the exchange rate.

In the existing literature, much attention has been paid to high-frequency surprises in the prices of a limited set of extremely liquid financial derivatives around key policy announcements. Despite its elegance and ability to address issues of endogeneity, the high-frequency surprises examined in this literature are typically on the order of a few basis points registered around a limited set of announcement dates. As Nakamura and Steinsson (2018) acknowledge, this creates a fundamental power problem: The signal is small relative to the noise in macroeconomic variables. This makes it challenging to draw reliable inference about economic effects at the medium-term horizons relevant for monetary policy. Our market-based stance measure, by contrast, captures the cumulative, persistent orientation of monetary policy that actually matters for output and inflation at horizons policymakers care about.

The impulse responses in our panel local projection study show that, after a 25 basis point

contractionary shock in the monetary policy stances, inflation declines 0.1 percentage point, industrial production contracts up to 0.4 percentage point, and exchange rates appreciate modestly. These results are not only statistically significant, but also economically significant, and of a magnitude consistent with those implied by many calibrated theoretical models in the literature. High-frequency studies routinely find effects an order of magnitude smaller, while still claiming statistical significance. This should not be taken to imply that monetary policy is weak, but these small surprises are simply not equivalent to a contractionary change in the stance maintained for 12 to 18 months or longer as we saw it in response to the post-pandemic inflation shock.

2 Literature

Measuring the macroeconomic effects of monetary policy—conventional as well as unconventional—is a daunting task because monetary policy typically reacts to the state of the economy, and therefore using the policy rate directly would likely lead to readings distorted by issues tied to endogeneity or reverse causality. In other words, one would not be able to distinguish whether macroeconomic variables are reacting to policy actions or to the state of the world, since the policy actions themselves depend on the state of the economy. Hence, the key to measuring the effects of monetary policy is to isolate its exogenous variations, i.e., the variations that go above and beyond the state of the economy.

In the literature, two main avenues have been pursued to this end: monetary policy surprises and shocks. Surprises are measured as high-frequency changes in the prices of key financial contracts (Kuttner, 2001). Typically, a single factor is insufficient to characterize the surprises, and instead, two factors are needed and given a structural interpretation of target (actions) and path (statements) (Gürkaynak et al., 2005). The use of such financial market surprises relies on three key assumptions: (i) Monetary news is revealed in a discontinuous way, specifically monetary policy announcement days carry a disproportional amount of information about monetary policy actions; (ii) markets are efficient, i.e., all publicly available information is reflected in market prices instantaneously; and (iii) only news about monetary policy is revealed in the narrow windows around monetary policy announcements, allowing for discontinuity-based identification using event study technology. Some of these assumptions can be questioned based on recent evidence in the literature. For instance, Swanson (2023) finds that other days (e.g. speeches and Congressional testimony by the Fed chair) carry even more important information about monetary policy than announcements do.

Similarly, using VAR evidence, Bianchi et al. (2023) show that Trump tweets have an important impact on actual monetary policy, the stock market, bond premia, and the macroeconomy. Moreover, there is evidence that monetary policy announcements may convey information about the central bank's belief about the state of the economy, also known as the Fed information effects, about the Fed's response to news, or about other non-monetary news

such as economic growth and news affecting financial risk premia (Romer and Romer, 2000; Nakamura and Steinsson, 2018; Cieslak and Schrimpf, 2019; Jarociński and Karadi, 2020; Bauer and Swanson, 2023). Finally, Gorodnichenko et al. (2023) provide evidence that emotions embedded in press conferences and how policy messages are communicated can move financial markets.

This evidence does not necessarily invalidate the measured shocks or question their assumed exogeneity. However, it does suggest that existing studies in the high-frequency literature may only be capturing a fraction of the actual news about monetary policy. Clearly, if an important fraction of news reach the markets on days and at times not covered by the event windows, it will inevitably lower the statistical power of any inferences about the economic effects of monetary policy.

In contrast, a market-based approach like ours that naturally reflects the cumulative changes to the stance of monetary policy by design will not leave out any news or events, but it comes at the price of not establishing causality, but merely correlations and statistical regularities. Is this a significant downside to our approach? We think it is much less of an issue than the impression one will get from reading the high-frequency literature. In terms of practical policy making, policymakers appear reluctant to overly rely on the causality effects of their policy tools. Why else would they constantly talk and care about the perceived credibility of their policy if they knew with certainty that their policies had a clear and direct causal effect on the economy? And why would they repeatedly refer to the long and varying lags with which monetary policy affects the real economy? Obviously, this is because the economy is constantly changing and evolving, and they are not comfortable making the bet that it will continue to perform exactly as it has in the past going forward. For all these reasons the obsession with exogenous shocks to establish causality may be a bit overrated when it comes to actual real-time policymaking.

The alternative to high-frequency surprises is to use monetary policy shocks constructed using a structural (econometric or economic) model. Structural econometric models include Vector Autoregression (VAR) models (e.g. Gertler and Karadi, 2015; Jarociński and Karadi, 2020), while economic models include Dynamic Stochastic General Equilibrium (DSGE) models (e.g. Smets and Wouters, 2007; Christiano et al., 2018). The key here is to use these structural models to isolate the predictable or standard reaction of the central bank to fundamentals (rule) from the exogenous response of the central bank that goes above and beyond what fundamentals or expected policymaker preferences dictate (unpredictable monetary policy shock). Unlike high-frequency surprises that are model-free, monetary policy shocks are model dependent, and hence, the credibility of the shock depends on the assumptions built into the model. For example, in the years following the Global Financial Crisis, short-term nominal interest rates were close to zero, and central banks expanded the scope of their tools with the use of unconventional monetary policies (e.g., quantitative easing, liquidity provi-

sion, forward guidance), requiring most structural models to account for these changes with the imposition of the zero lower bound or the use of shadow rates to proxy for unconventional policies (Wu and Xia, 2016; Mouabbi and Sahuc, 2019). Thus, this literature is fraud with questions about the identification and specification of the models used that are very difficult to address in an objective and satisfying way.

Our market-based measures of the stance of monetary policy are not subject to this critism. Their construction exploit the well-documented factor structure in bond yield data. As bond prices naturally react to both conventional and unconventional monetary policy, so do our stance measures. Finally, they are not subject to any lower bounds as they are constructed from inflation-indexed bond prices, as also emphasized by Christensen and Rudebusch (2019).

3 Effects of Monetary Policy

As noted above, the literature has put a strong emphasis on causality when measuring the effects of monetary policy. Its primary focus has been to capture exogenous variation in monetary policy, i.e., changes that are unpredictable and go beyond reflecting the state of the economy, in order to quantify the causal effects of monetary policy. Moreover, it has emphasized the strength of high-frequency identification as a means to address endogeneity concerns. However, this approach often comes at the cost of low statistical power, as asset price changes around a few events usually only yield small shocks of a few basis points. In particular, Nakamura and Steinsson (2018) note that the power problem also precludes estimating the effect of surprises on future output, given that output several quarters in the future can be influenced by many other shocks, causing the signal-to-noise ratio to be too low for reliable inference.

In this paper, we offer a complementary approach to the literature by "downplaying" causality and instead focusing on the cumulative persistent effects of monetary policy. This has the advantage of bypassing the low power problem entirely. In order to evaluate the effects of monetary policy, we use market-based measures of the stance of monetary policy available in the existing term structure literature. Of course, our proposed method comes at the cost of more endogeneity. However, we show that our measured effects do not generate output or price puzzles. Thus, we think of our stance measures as reasonable empirical proxies for the true unobserved stance of monetary policy. At a minimum, by revealed preferences, policymakers could have changed the policy rate and thereby the stance at any point in time, but chose not to. This reinforces the notion that our considered measures are reasonable proxies of the policy stance.

3.1 Measuring the Stance of Monetary Policy

In theory, the stance of monetary policy would be given by the difference between the current real instantaneous short rate and its natural level as reflected in r_t^*, i.e., it would be defined as

$$\zeta_t = r_t - r_t^*.$$

The intuition behind this definition is straightforward. When the current real short rate is above its natural level, interest rates of all kinds are likely to be above their steady-state level and will provide some headwind for economic activity through higher borrowing costs and help slowdown the economy. And vice versa, when the current real short rate is below its natural level, the general interest rate level is likely to be below what is needed to maintain trend growth, and businesses and households may take advantage of that by making investments in new projects or housing at cheap financing rates, which will help boost economic activity.

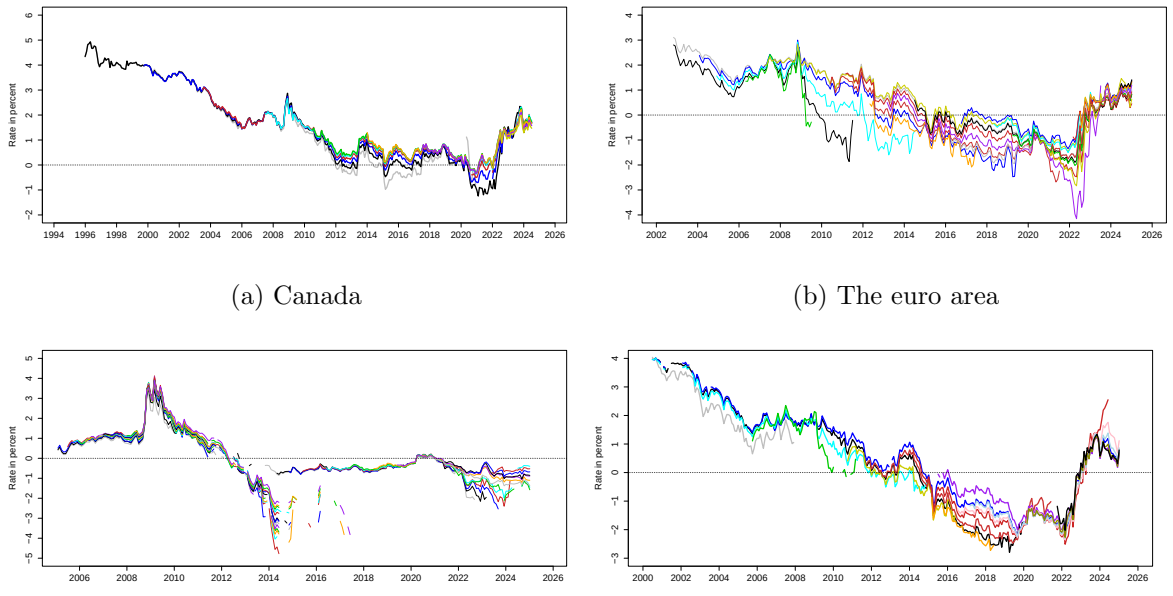
In constructing our market-based measure of the stance of monetary, we follow Christensen and Mouabbi (2024) and define it as

$$\zeta_t = \widehat{y}_t^R(1) - r_t^*, \tag{1}$$

where $\widehat{y}_t^R(1)$ is the fitted one-year real yield, while r_t^* is defined as the average expected real short rate over a five-year period starting five years ahead as in Christensen and Rudebusch (2019).

To make this operational, we turn to government bond market data from four advanced economies: Canada, the euro area, Japan, and Sweden. To get estimates of both $\widehat{y}_t^R(1)$ and r_t^*, we leverage four existing dynamic term structure studies. Specifically, our Canadian measure is obtained from the model described in Christensen, Rudebusch, and Shultz (2025), our euro-area measure is taken from Christensen and Mouabbi (2024), our Japanese estimate comes from Christensen and Spiegel (2026), while our Swedish market-based measure of the stance of monetary policy comes from Christensen and Zhang (2025). In all cases, we estimate the models using end-of-month data with the same start dates as in the supporting academic papers above, but with end of December 2024 as common end date. Moreover, we add any new bonds that have been issued in each market to the historical samples examined in the supporting academic papers; see the online appendix for details.

Our market-based measures offer several advantages. First, similar to Inoue and Rossi (2021), they are informed by market prices along the entire yield curve, so, unlike Gürkaynak et al. (2005), Swanson (2021) and Altavilla et al. (2019), one does not need to make a choice about the horizon at which (conventional and unconventional) monetary policy is the most relevant. Second, the methodology employed can be extended to any economy with a sufficiently developed market for inflation-indexed government bonds. This means that our approach does not hinge on the existence of highly liquid derivatives markets. Third, the



(a) Canada

(b) The euro area

(c) Japan

(d) Sweden

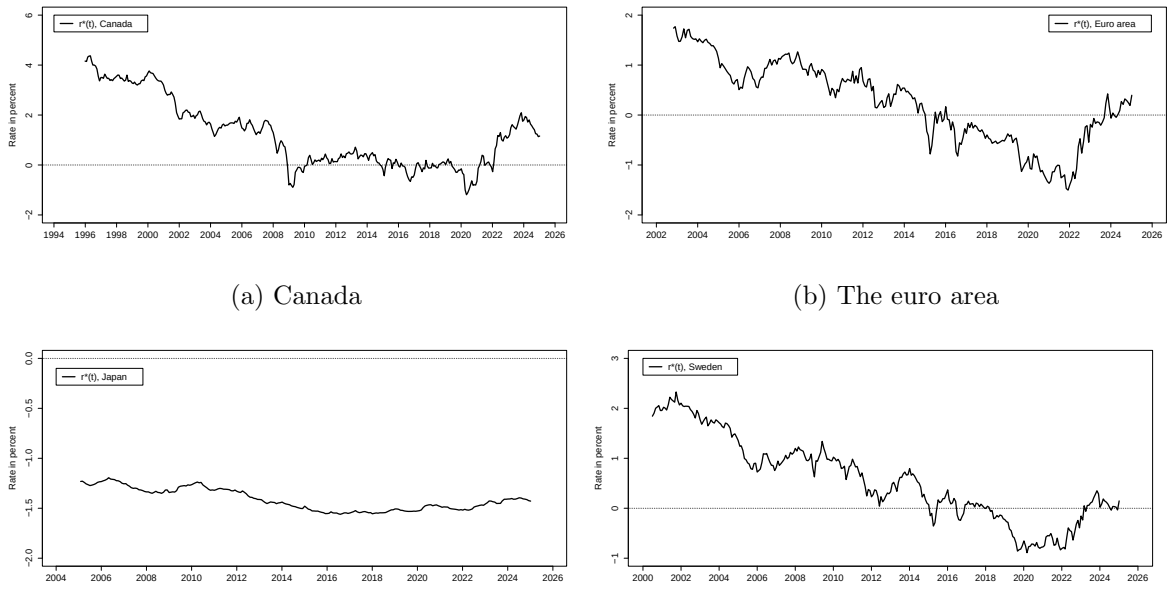
Figure 1: **Yield to Maturity of Inflation-Indexed Bonds**
Illustration of the yield to maturity of inflation-indexed bonds from Canada, the euro area, Japan, and Sweden. The Canadian sample starts in December 1995, the euro-area sample starts in October 2002, the Japanese sample starts in Janaury 2005, while the Swedish sample starts in June 2000. All samples end in December 2024.

stance measures account for any changes in the bond markets that may arise from large-scale asset purchase programs, including changes in convenience yields. Moreover, the r_t^* estimates we use are obtained using a methodology that does not require a stable or correct macroeconomic specification and can be executed in real time, as it relies on data that are directly observed and not subject to revisions.

3.2 The Bond Data and Monetary Policy Stance Measures

Turning to the data, Figure 1 shows the yield to maturity of the individual inflation-indexed bonds observed in each bond market. Note that the real yields in all four markets are characterized by pronounced business cycle fluctuations in the shape of the yield curve combined with persistent trends in the general level of yields. Moreover, real yields across these four advanced economies operate at broadly similar levels. At the same time, it is worthwhile stressing that each market is unique with spells of idiosyncratic shocks not mimicked by the other markets.

To begin, we estimate the model for each market exactly as described in the corresponding academic paper. Importantly, the models allow us to take out both bond-specific liquidity and general term premia from the inflation-indexed bond yields shown in Figure 1. This leaves us with measures of investors' actual real rate expectations that we use to calculate the market-



(a) Canada

(b) The euro area

(c) Japan

(d) Sweden

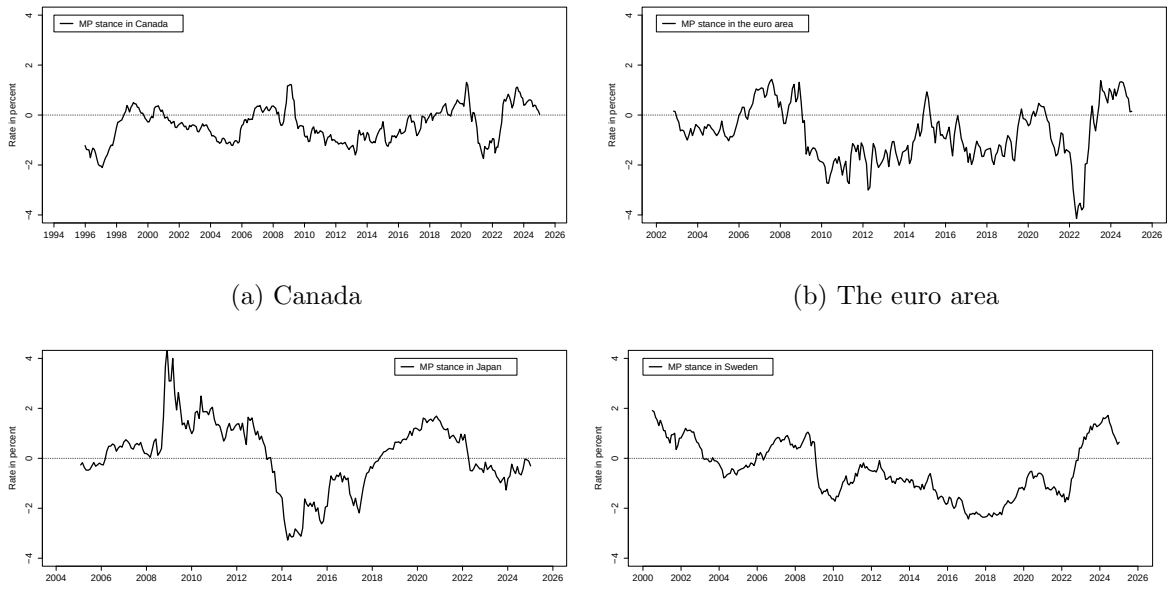
Figure 2: **Market-Based Estimates of the Natural Rate of Interest**
Illustration of the market-based estimates of the natural rate of interest r_t^* for Canada, the euro area, Japan, and Sweden. The Canadian sample starts in December 1995, the euro-area sample starts in October 2002, the Japanese sample starts in Janaury 2005, while the Swedish sample starts in June 2000. All samples end in December 2024.

based measures of the natural rate of interest r_t^* as described in Christensen and Rudebusch (2019). Figure 2 shows the resulting four r_t^* series. Note that these series are relatively stable with few sharp gyrations. Thus, in the near term, our market-based r_t^* estimates typically do not fluctuate much. However, over medium- and long-term horizons, four r_t^* series are characterized by persistent trends. Thus, to have reliable measures of the stance of monetary policy, it is imperative to account for these time-varying trends in r_t^* and our approach allows us to do exactly that.

Finally, the estimated models also provide us with estimates of one-year real yields $\widehat{y}_t^R(1)$ that we use to construct our market-based measures of the stance of monetary policy based on equation (1). These are shown in Figure 3.

We note several important common characteristics. First, the market-based stance measures are persistent and move in cycles in tandem with monetary policy and the business cycle of the economy. Second, they tend to be restrictive, i.e., in positive territory, going into and during recessions. Third, periods with QE and other unconventional monetary policies are typically associated with an accommodative stance well below zero. Note also that by focusing on real yields for the construction of the market-based measures we bypass the challenges associated with the effective lower bound that plague measures based on nominal yields.

The empirical question we are interested in is whether a restrictive stance of monetary pol-



(a) Canada

(b) The euro area

(c) Japan

(d) Sweden

Figure 3: **Market-Based Measures of the Stance of Monetary Policy**
Illustration of the market-based measure of the stance of monetary policy, ζ_t, for Canada, the euro area, Japan, and Sweden. The Canadian sample starts in December 1995, the euro-area sample starts in October 2002, the Japanese sample starts in Janaury 2005, while the Swedish sample starts in June 2000. All samples end in December 2024.

icy for some period of time is associated with subsequent lower inflation and weaker economic growth—the standard textbook effects monetary policy is widely assumed to have.

We stress that our focus is limited to this correlation and that we do not aim to establish any type of causality one way or the other. The primary goal is to establish that there is a statistical relationship between the stance of monetary policy as captured by our market-based measure and key economic variables. By relying on a measure of the stance of monetary policy that maps directly to the textbook definition, we hope to obtain clearer and more definitive results than previous studies.

4 Empirical results

In this section, we present evidence that macroeconomic variables respond to changes in the measures of the monetary policy stance in a theory-consistent way. We rely on panel local projections and local projections for each economy to establish that the impact flowing from changes in the stance of monetary policy in the four advanced economies we consider is significant economically and statistically.

4.1 Panel Local Projections

We begin by analyzing the impact of monetary policy stances on the four economies jointly using the following panel local projection model

$$y_{i,t+h} = \alpha_h + \beta_i + \sum_{i=1}^{p} \gamma_h \omega_{i,t} + \gamma_h x_{i,t} + u_{h,t+h}, \tag{2}$$

which includes country fixed effects β_i and horizon fixed effects α_h. The impulse responses we plot are constructed from the estimates of γ_h over varying horizons and represent the responses to shocks from changes in the monetary policy stances. The outcome variables of interest include inflation π_{t+h}, industrial production (output) q_{t+h}, the exchange rate e_{t+h}, and the unemployment rate u_{t+h}. We included lagged variables of inflation, industrial production, exchange rates and unemployment rates as key control variables in X_t.[1]

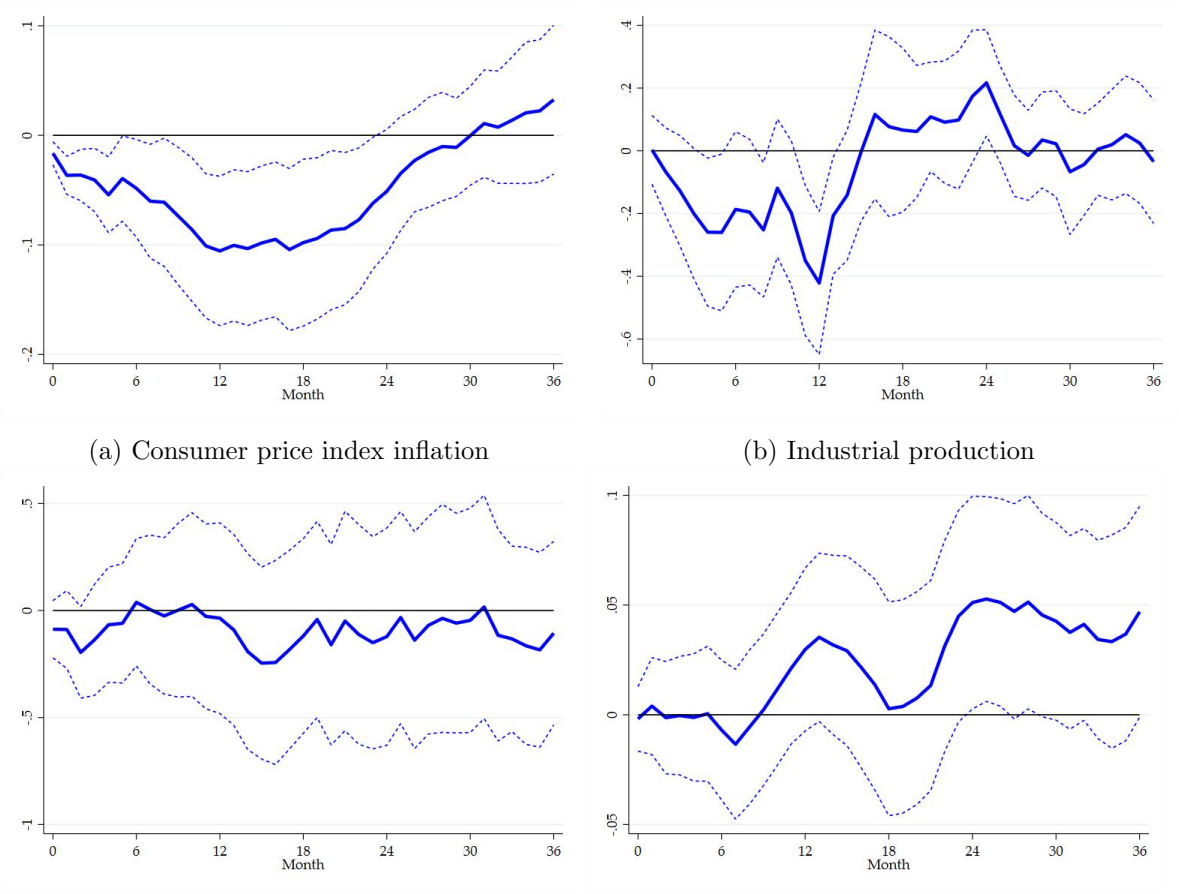
We estimate separate impulse responses at each horizon by directly projecting an outcome at a future horizon on current covariates, including lags of the variables. As a semi-parametric method, it imposes relatively mild assumptions on the data and the shape of the response. Panel Local Projections provide estimated dynamic effects, impulse response functions, from panel data. Our empirical analysis is based on a panel of the four advanced economies. It offers a comprehensive assessment of the effects of the market-based monetary policy stance measures on key macroeconomic variables.

Figure 4 shows the impulse response functions to a increase of monetary policy stances from the panel local projection. In the upper left panel, the inflation rate is negatively affected by changes in the monetary policy stances. The drop of inflation rate is almost immediate and the effect lasts about almost 2 years. The upper right panel shows that output declines in response to a contractionary shock of monetary policy stances, however, the decline appears after around 6 months with the strongest impact after 1 year. The response of output is statistically significant for a quarter or two, while the response of the price level is significant for about 2 years. The responses plotted are mostly consistent with basic theory. A contractionary monetary policy stance will lead to a mild decline in output, but an immediate decrease of inflation rates that is long-lasting.

The lower two panels present the corresponding effects on exchange rates and unemployment rates following a contractionary shock of monetary policy stances. The results on exchange rates are mostly insignificant, although the initial effect seems to be negative indicating an appreciation of the local currency. On the other hand, the unemployment rate increases when the monetary policy stance turns to be contractionary, and the effect is significant after 2 years. These results are also consistent with the theoretical predictions.

We have provided panel data evidence that the monetary policy stance measures con-

[1] We also ran regressions including financial variables, such as the stock market returns, in the list of control variables. Our main findings still hold.



(a) Consumer price index inflation

(b) Industrial production

(c) Exchange Rate

(d) Unemployment Rate

Figure 4: **Impulse response from the Panel Local Projection**

Notes: The panels show the impulse response functions estimated from the panel local projection regression in equation (1) for consumer price index inflation, industrial production, the exchange rate, and the unemployment rate following a 25 basis points contractionary shock in the stance of monetary policy. We also plot the 95% confidence bands, using Newey-West standard errors with four lags.

sidered in this paper can produce meaningful and significant effects on key macroeconomic variables.

4.2 Country-Specific Local Projections and Smooth Local Projections

The effects of changes in the monetary policy stance on macroeconomic variables can differ across countries. To capture this heterogeneity, we employ local projection methods and estimate the responses separately for each country.

We use the local projection regression as in Jorda (2005), for each month/horizon $h = 0, ..., 36$, with the following equation:

$$y_{i,t+h} = \alpha_{i,h} + \beta_{i,h} x_{i,t} + \sum_{i=1}^{p} \gamma_{i,h} \omega_{i,t} + \gamma_h X_{i,t} + u_{i,h,t+h}, \tag{3}$$

where $u_{h,t+h}$ is the prediction error term, with the key parameter denoted as β_h that is the dynamic multiplier in the local projection regressions. **?** proposes to run $H+1$ least squares regressions to recover β_h. **?** argued that the parameterization of β_h can cause excess variability, so they recommend to approximate an alternative methodology based on linear B-splines basis function expansion.

$$\beta_h \approx \sum_{k=1}^{K} b_k B_k(h), \tag{4}$$

where B_k is a set of B-spline basis functions. Then the Local projection function is rewritten if we apply the B-spline basis approximation to the coefficients $\theta = (\alpha_h, \beta_h, \gamma_h)'$.

$$y_{t+h} \approx \sum_{k=1}^{K} \alpha_k B_k(h) + \sum_{k=1}^{K} b_k B_k(h) x_t + \sum_{i=1}^{p} \sum_{k=1}^{K} c_{i,k} B_k(h) \omega_{i,t} + u_{h,t+h}. \tag{5}$$

As the Smooth LP shrinks the impulse response function to a polynomial of order $r-1$. We choose r to be 2, so that the impulse response function shrinks towards a line. We select the shrinkage parameter λ using the k-fold cross-validation as in **?** and **?**.

? argue that the smoothing of impulse responses across horizons that the penalized LP estimator performs is usually attractive whenever, except at very short and very long horizons. By "betting on smoothness", penalized LP achieves a substantial variance reduction relative to the un-penalized LP procedures, at the expense of a moderate increase in bias, see Fig. 2, Fig. 3. In fact, there is a region of Fig. 6 with intermediate horizons and moderately high weight on bias where penalized LP (green with diagonal cross-hatching) is the single best estimator. These findings underscore our conclusion that, across the majority of the DGPs, the use of bias-corrected LP can only be justified by committing to a nearly exclusive focus on minimizing bias, with little regard for precision.

We run regressions following both the local projection and the smooth local projects, reflected in Equations 3 and 5, for each of the economies in the panel: Canada, Euro Area, Japan, and Sweden. The outcome variables of interest are the same as in the panel local projection, including inflation π_{t+h}, industry production (output) q_{t+h}, the exchange rate e_{t+h}, and the unemployment rate u_{t+h}. In addition, we add lagged variables of inflation, industry production, exchange rates and unemployment rates as key control variables in X_t. As the local projects are ran at the economy level, we do not control for country fixed effects or time fixed effects.

Figure 5 illustrates the local projection results for Canada, reporting the impulse responses to a tighter monetary policy stance, with two estimators overlaid. The red line shows standard local projection IRFs and the blue line shows smoothed local projections; shaded bands indicate uncertainty bands. CPI inflation moves down quickly, reaching roughly -0.2 to -0.4 percentage points within a year before drifting back toward zero by the end of the horizon with

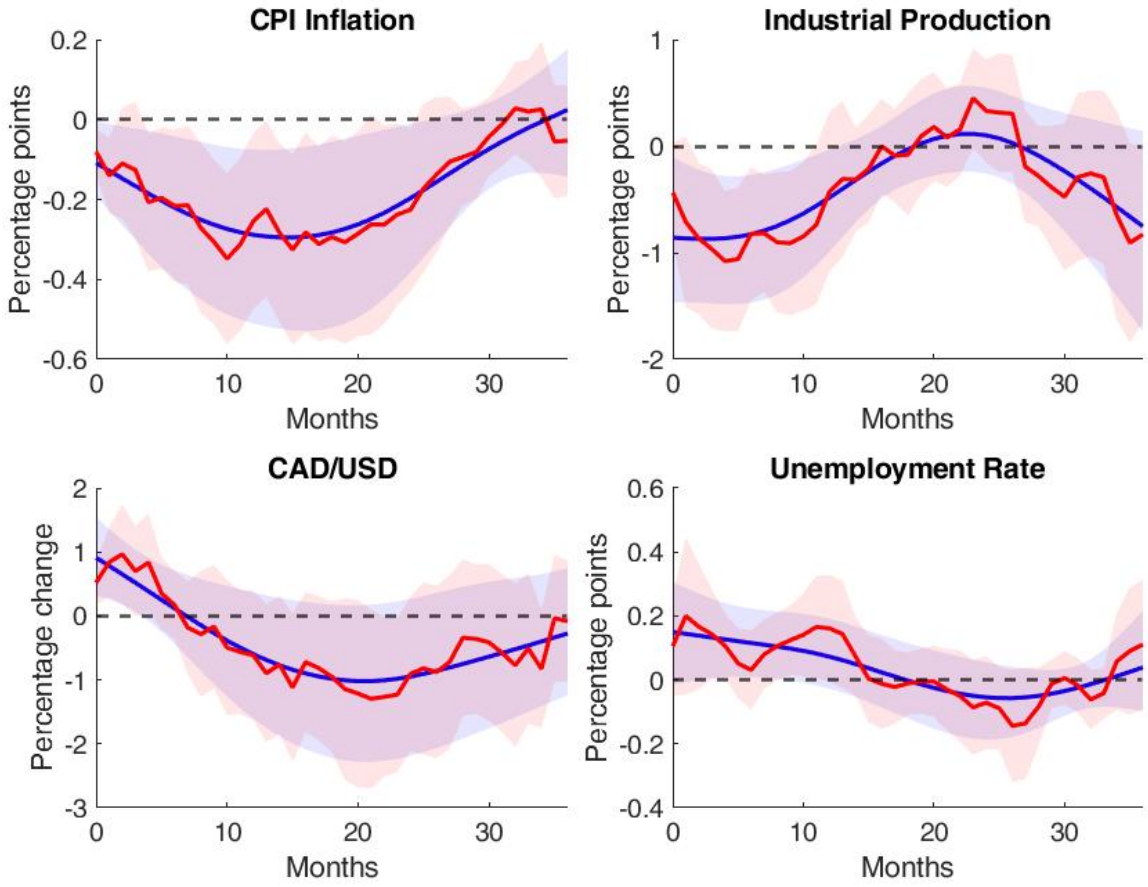


Figure 5: **Local projection results: Canada**
Smooth local project (in blue) and local projection results, with 90% confidence bands for Canada.

both estimators tell a similar story. Industrial production displays a hump-shaped reaction to the monetary policy stance tightening. It drops immediately at month 0, and rises modestly through 12 to 20 months, then gives way to weakness after about two years although it is not statistically significant. The exchange rate CAD/USD (the bottom-left panel) falls by about 1-1.5%, an appreciation of the Canadian dollar, with the largest move in the first year and gradual mean-revert thereafter. Unemployment rates reactions are small and insignificant in most periods. The initial effects is a small increase of unemployment rate, but it dips slightly below zero through the second year and edges back toward (and briefly above) zero late in the sample. The smoothed LP results confirm the same findings with a smoother path.

Taken together, the results align with standard transmission on prices and the exchange rate: the inflation rate declines with a tightening in monetary policy stances and the Canadian dollar appreciates after a contractionary shock. Real activity responses are more nuanced: output initially dropped, as a sign of softening real activities. It also shows front-loaded exchange-rate and expectation channels with a later demand slowdown, while labour market did not react strongly to the change of monetary policy stances. Tighter policy in Canada

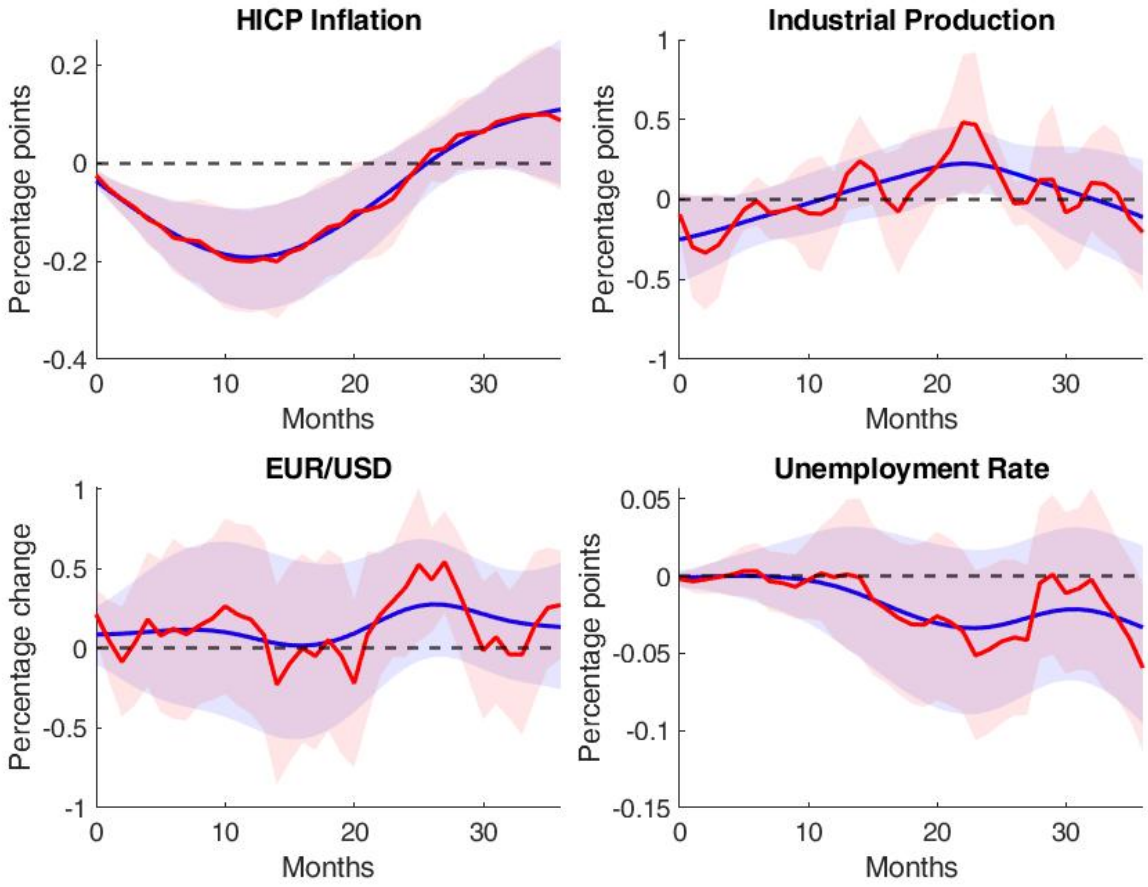


Figure 6: **Local projection results: Euro Area**
Smooth local project (in blue) and local projection results, with 90% confidence bands for Euro Area.

strengthens the currency and lowers inflation, with modest and delayed real-side costs that appear smaller and less precisely estimated. The empirical findings are largely consistent with monetary policy theoretical predictions.

Figure 5 illustrates the local projection results for Euro Area with the tightening of monetary policy stances in the monetary union. The HICP inflation rate falls fairly quickly, reaching its trough (around -0.2 to -0.3 percentage points) within the first year before gradually returning toward and slightly above—zero in roughly two years. Industrial production shows a mild, hump-shaped path: small positives through the 12 to 24-month window, then easing back toward zero or slightly negative late in the investigated horizons. The EUR/USD exchange rates response is sluggish, with little movements early on. A modest euro appreciation emerging only later, however, the results are not statistically significant. Unemployment rates stays close to zero throughout, with at most a very small dip around 18–24 months. The confidence bands expands towards the end of the horizons.

Overall, the empirical findings point to standard monetary policy theory but the transmission is a little muted, in comparison with Canada. Tightening reduces price pressures

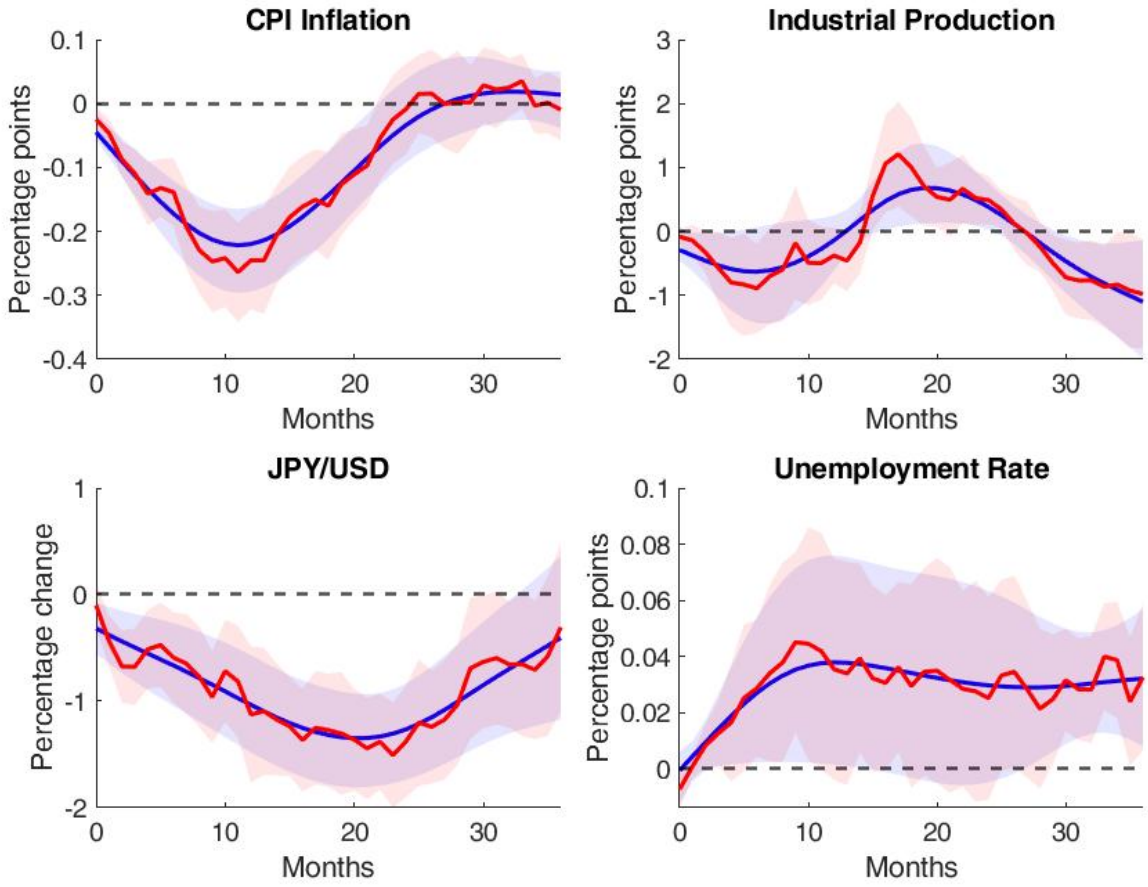


Figure 7: **Local projection results: Japan**
Smooth local project (in blue) and local projection results, with 90% confidence bands for Japan.

with a short lag; real-activity and labour-market effects are small and short-lived on average; and the exchange-rate channel does not operate with significance or magnitude.

Figure 5 illustrates the local projection results for Japan. After a tighter policy stance, the CPI inflation in Japan falls quickly, by roughly 0.2–0.3 percentage points within the first year—then drifts back toward zero by after the second year. Industrial production dips slightly at first but then displays a pronounced hump, peaking around 12–20 months with around 0.5 percentage points before the effects reverse and go into the negative territory. The JPY/USD exchange rate declines by about 1 to 1.5%, an appreciation of the Japanese Yen, most clearly within the first year. Unemployment rate rises only gradually and by a few basis points (around 0.03 to 0.05) and the effect is persistent.

The strong results are consistent with the observation that the Bank of Japan monetary policy has been very active in the sample. Such moves operate powerfully through the expectations and FX channels: the yen appreciates and the CPI inflation goes down. Under the monetary policy regime operated by the Bank of Japan, a modest steepening of the curve can initially improve bank margins and credit supply, temporarily supporting output, which

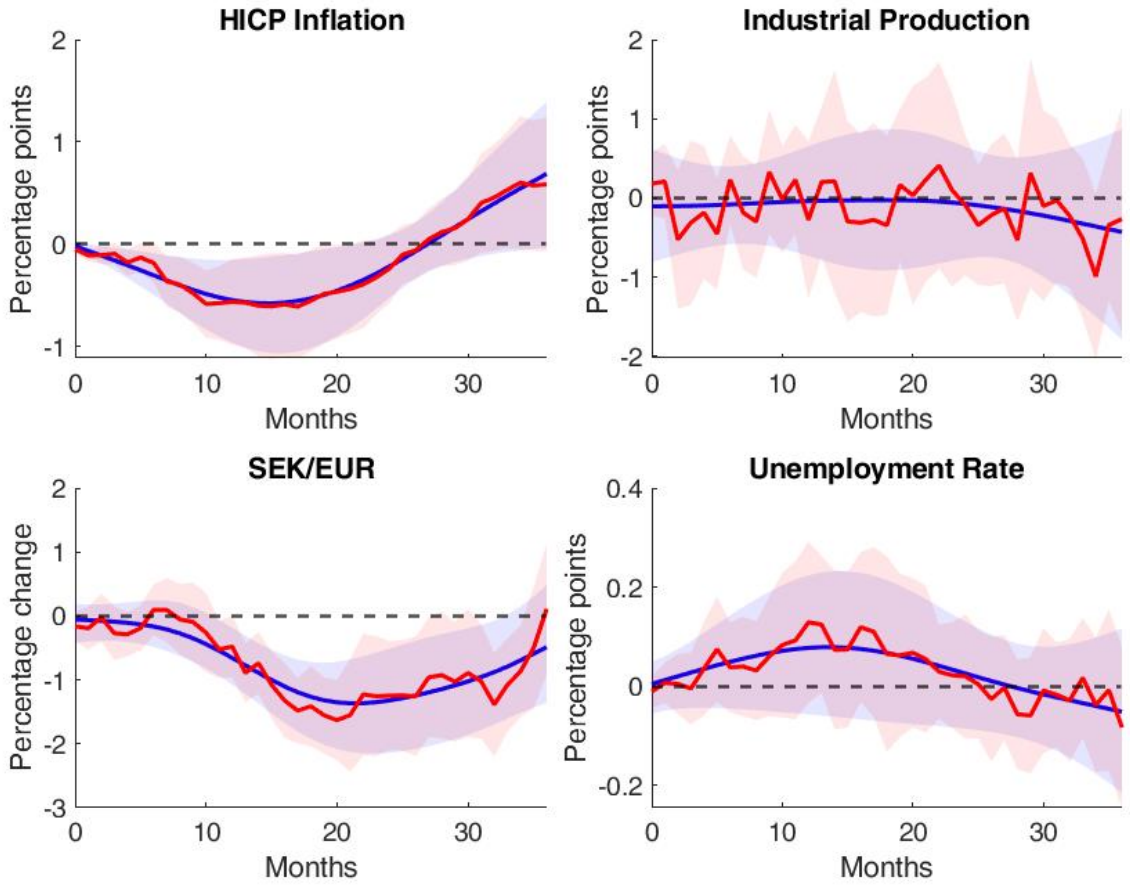


Figure 8: **Local projection results: Sweden**
Smooth local project (in blue) and local projection results, with 90% confidence bands for Sweden.

is consistent with the hump in industrial production. Japan's highly rigid labour market and long stretch of ultra-low rates help explain why unemployment responds only slightly and with a delay.

In our sample, normalisation of the BoJ's unconventional monetary regime coincides with a short-run lift to activity via healthier financial intermediation, but over the medium term the net effect is the familiar one. We see lower inflation, yen appreciation, and small increases in unemployment as output momentum softens, responding to the tightening of monetary policy stances.

Figure 5 displays impulse responses of four Swedish macroeconomic variables to a tighter Riksbank monetary policy stance. Each panel shows the point estimate (solid red line) with uncertainty bands and the smooth local projection results (solid blue line) with uncertainty bands. The HICP inflation in the top-left panel drops below zero immediately when the monetary policy stances change, bottoms out around 12–18 months, and slowly reverts, with a mild late-horizon overshoot. Industrial production (top-right) is persistently weak—small but negative for most of the 3-year window. The exchange rate SEK/EUR panel shows a

quick appreciation of the Swedish Krona (a fall in SEK/EUR of roughly 1–2%) that gradually fades. The unemployment rate rises modestly, but the effect is not significant.

The findings are consistent with standard monetary transmission. A contractionary stance strengthens the currency, softens real activity, and raises unemployment slightly, while lowering inflation with a lag; most effects peak within 12–24 months and then mean-revert. In short, Riksbank tightening cools the economy and gradually reduces price pressures, with real-side costs that appear moderate in size and temporary in duration.

4.3 Robustness checks

The Covid-19 pandemic and its aftermath triggered one of the most significant inflationary episodes in decades. Initially, global supply chains were severely disrupted as lockdowns curtailed production and shipping bottlenecks constrained the flow of goods. At the same time, unprecedented fiscal and monetary support boosted household incomes and demand, particularly for durable goods. As economies reopened, demand recovered faster than supply, generating persistent price pressures. Energy and food shocks—exacerbated by the war in Ukraine—further intensified headline inflation. These dynamics produced a combination of cost-push and demand-pull inflation.

Central banks have taken various policy actions to control inflationary pressures in the economies. These policies have been broadly effective in slowing inflation, which has declined from its post-Covid peaks across most economies. Although the disinflation process has proven uneven, the monetary policy stances have been very responsive to the collection of policy actions. To mitigate the concern that the local project results we show are merely driven by the latest inflationary episodes, we run sub-sample (smooth) local project regressions using samples cut off by the end of 2021.

Figure 9 shows that the pre-2022 Canadian subsample results are largely consistent with the full-sample findings. CPI inflation still declines following a contractionary stance shock, falling by approximately 0.2 percentage points within the first year before reverting toward zero, though the trough is shallower than in the full sample. Industrial production displays a similar hump-shaped pattern, with an initial softening followed by a modest recovery around 12 to 20 months before weakening again. Notably, the CAD/USD exchange rate response is more variable in the pre-2022 subsample, with the initial appreciation signal less precisely estimated, suggesting that the exchange rate channel may have been amplified by the post-COVID tightening episode. Unemployment responses remain small and statistically insignificant, consistent with the full-sample findings. Overall, the pre-2022 results for Canada are consistent with the baseline findings.

For the euro area, Figure 10 confirms the robustness of the baseline results. HICP inflation declines by around 0.05 to 0.1 percentage points in the subsample, a little muted than in the full sample but qualitatively consistent. The industrial production response retains its

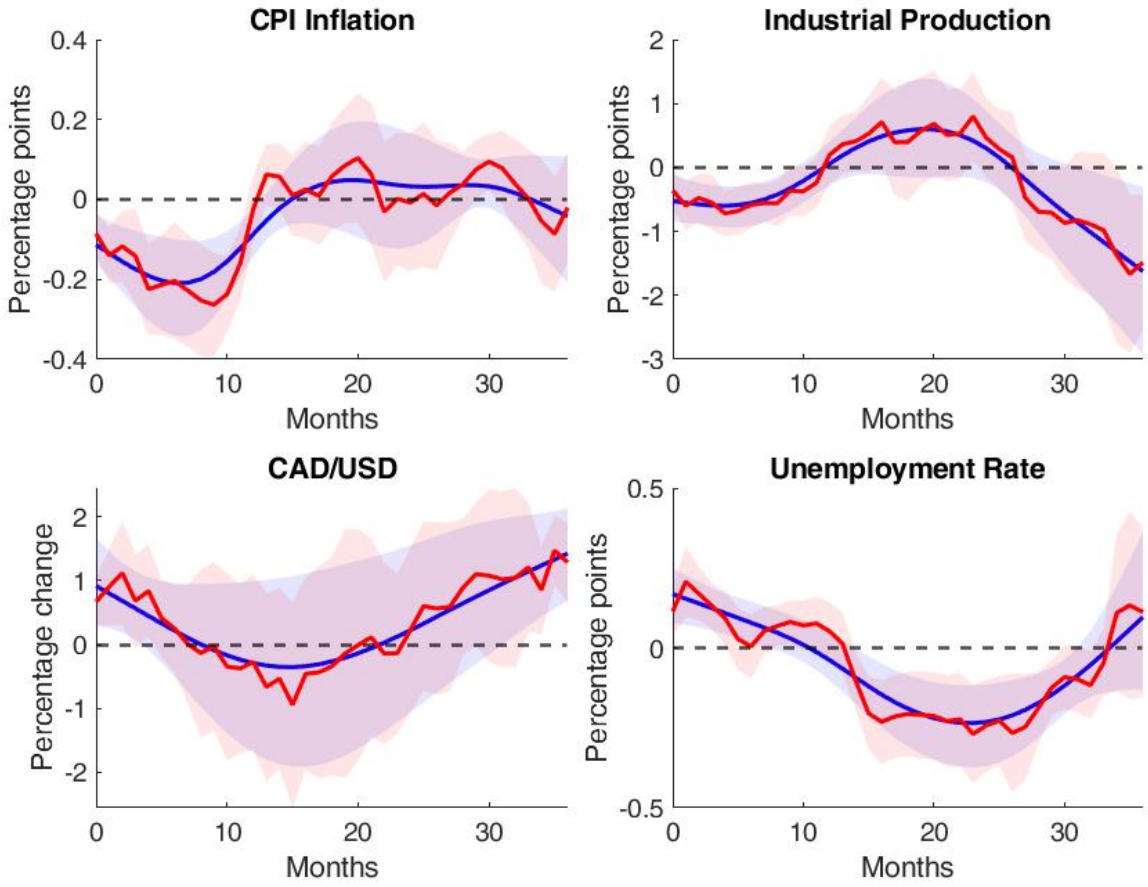


Figure 9: **Local projection results: Canada**
Smooth local project (in blue) and local projection results, with 90% confidence bands for Canada. The regression sample ends in 2021.

mildly positive hump shape in the medium term before fading. The EUR/USD exchange rate exhibits a modest appreciation that emerges with a delay, though again statistical significance is limited. Unemployment shows a small negative dip around 18 to 24 months, which is slightly more pronounced than in the full sample but remains well within the confidence bands. The subsample results thus reinforce the conclusion that the euro area monetary transmission operates primarily through the price channel, with limited and short-lived real-side effects.

For Japan, Figure 11 reveals that the pre-2022 subsample results are strikingly similar to the full-sample estimates, reflecting the fact that the Bank of Japan's monetary policy was particularly active throughout the earlier part of the sample under its yield curve control (YCC) framework, providing substantial variation in the stance measure even before 2022. CPI inflation falls by 0.1 to 0.2 percentage points within the first year, and industrial production again displays a pronounced hump-shaped response, peaking at around 12 to 20 months before reversing. The JPY/USD appreciation of approximately 0.5 to 1 percent in the first year is slightly smaller in the subsample but remains clearly visible. Unemployment rises

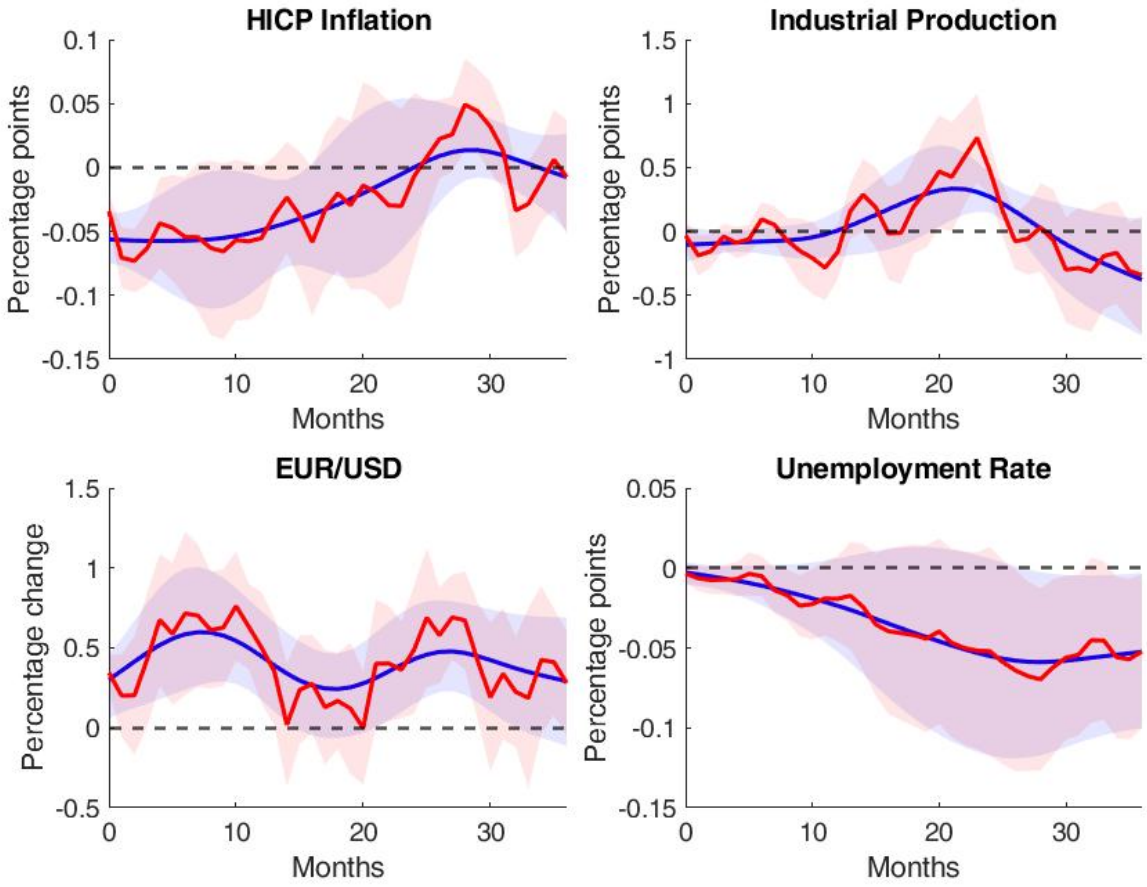


Figure 10: **Local projection results: Euro Area**
Smooth local project (in blue) and local projection results, with 90% confidence bands for Euro Area. The regression sample ends in 2021.

gradually and persistently, consistent with the full-sample pattern. The stability of Japan's results across subsamples suggests that the monetary policy transmission documented in the full sample is a robust feature of the Japanese economy, driven in large part by the expectations and foreign exchange channels.

For Sweden, Figure 12 shows that the pre-2022 subsample results broadly corroborate the full-sample findings, though with some differences in the inflation and unemployment dynamics. HICP inflation still declines following a contractionary shock, but the trough is somewhat delayed relative to the full sample, occurring around 18 to 24 months rather than 12 to 18 months. Industrial production remains persistently weak across the horizon, consistent with the full-sample pattern. The SEK/EUR appreciation is less sharp in the subsample, with the exchange rate response more gradual and less precisely estimated. Unemployment rises modestly, and notably the subsample point estimates suggest a larger and more persistent increase than in the full sample, though the effect remains within the confidence bands. These differences may reflect the fact that the Riksbank's tightening cycle post-2022 was particularly

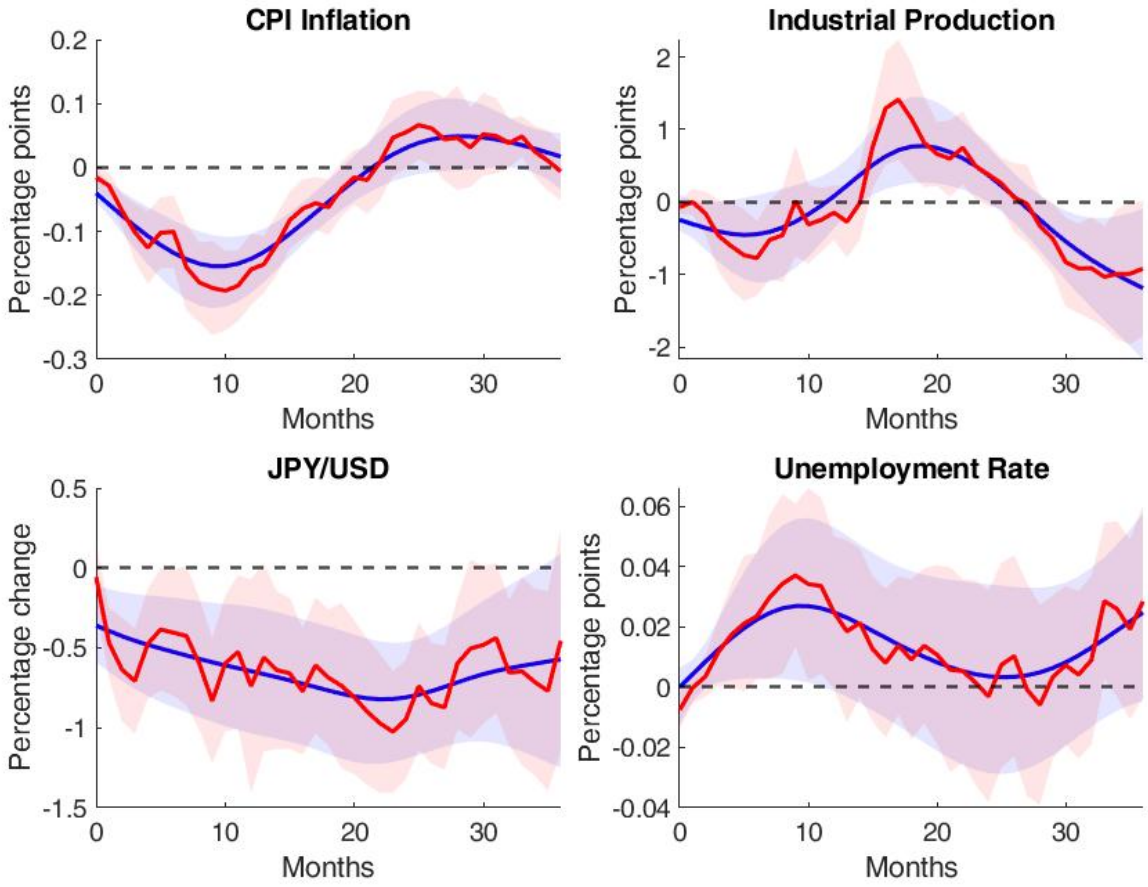


Figure 11: **Local projection results: Japan**
Smooth local project (in blue) and local projection results, with 90% confidence bands for Japan. The regression sample ends in 2021.

swift, compressing some of the dynamics that would otherwise unfold more gradually.

Taken together, the subsample results across all four economies provide similar supporting evidence that the macroeconomic effects of monetary policy stance changes documented in the baseline regressions are not simply a reflection of the extraordinary post-COVID tightening cycle. The sign, rough magnitude, and timing of the impulse responses are broadly preserved when the analysis is restricted to the pre-2022 period. Where differences arise, they are quantitatively modest and economically interpretable, consistent with the view that the post-COVID episode amplified rather than generated the transmission patterns identified in our baseline analysis.

5 Conclusion

This paper examines unified and internationally comparable measures of the stance of monetary policy for a panel of four advanced open economies: Canada, the euro area, Japan, and

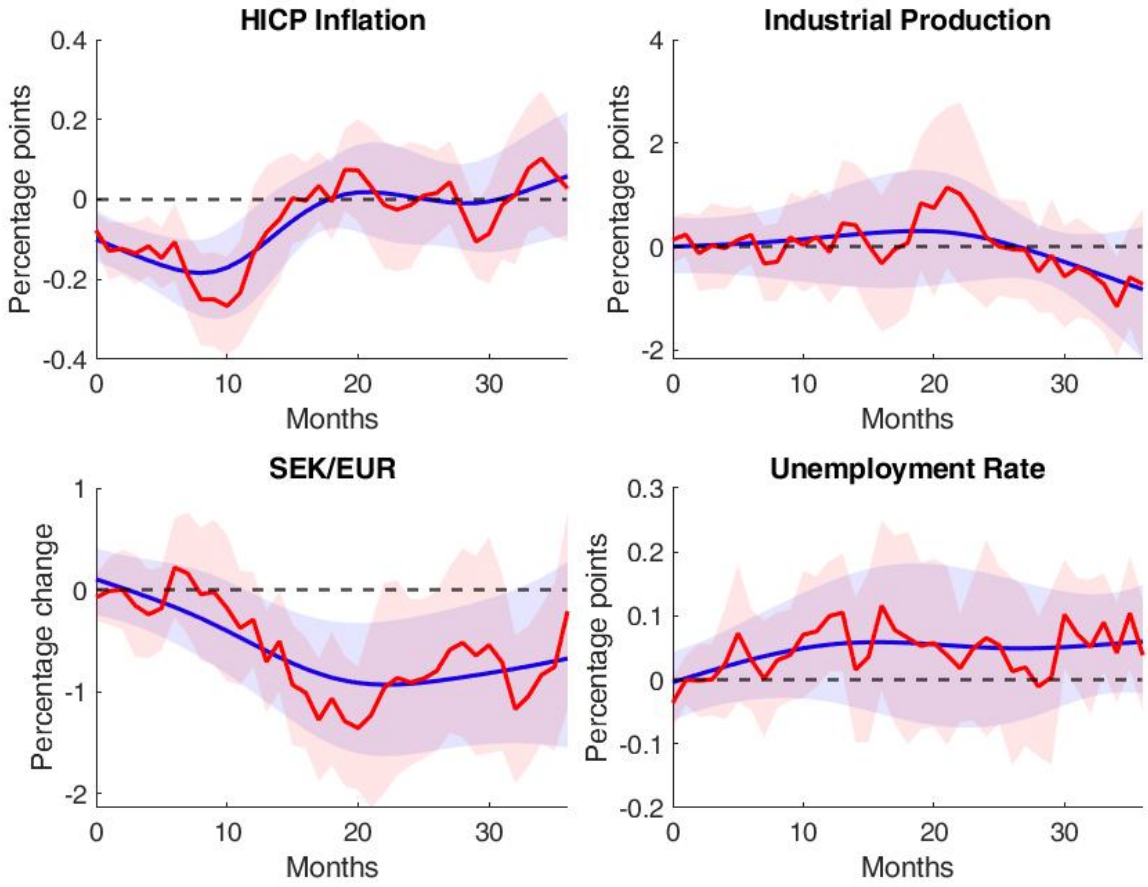


Figure 12: **Local projection results: Sweden**
Smooth local project (in blue) and local projection results, with 90% confidence bands for Sweden. The regression sample ends in 2021.

Sweden. The stance is defined as the difference between the short-term real interest rate r_t and the natural rate of interest r_t^*, both estimated from the prices of inflation-indexed government bonds using state-of-the-art dynamic term structure models from the literature. Our finance-based approach offers several advantages over existing methods. It does not require a stable macroeconomic model specification, it relies solely on asset prices that are observed in real time and not subject to revision, and it is applicable to any economy with a sufficiently developed inflation-indexed bond market. Crucially, it captures the effects of both conventional and unconventional monetary policies, including quantitative easing and tightening, forward guidance, and yield curve control, within a unified coherent framework.

Our empirical analysis demonstrates that shocks to our finance-based measures of the stance of monetary policy are correlated with macroeconomic responses that are both economically meaningful and theory-consistent. Using panel local projections, we find that a contractionary stance shock of 25 basis points reduces inflation by 0.1 percentage points within the first year, with the effect persisting for up to two years. Industrial production

contracts up to 0.4 percentage point, with the peak decline occurring around six to twelve months after the shock, consistent with the well-documented delayed transmission of monetary policy to real activity. While domestic currencies appreciate modestly, these effects are not significant. Finally, with some delay, unemployment eventually rises steadily and reaches a peak effect of 0.05 percentage point two years out that is statistically significant. Using country-specific local projections, we find meaningful heterogeneous effects across countries. In Japan, the expectations and foreign exchange channels are particularly powerful. In the euro area, transmission operates primarily through the price channel, with real-side and exchange rate effects that are smaller and less persistent than elsewhere. In Canada and Sweden, the full set of transmission channels is operative, with exchange rate and inflation responses largely consistent with theoretical predictions. Our findings are robust to the exclusion of the post-COVID inflationary episode, using the subsample ending in 2021.

A key methodological contribution of this paper is to offer a complement to the high-frequency surprise-based identification approach that dominates the empirical monetary policy literature. The absence of price and output puzzles in our impulse responses—even without imposing the stringent orthogonality conditions required by high-frequency identification—suggests that our monetary policy stance measures capture meaningful policy-driven variation in real interest rates. At the same time, we view our stance measures as complementary to, rather than a substitute for, surprise-based methods. Together, these approaches provide a more complete picture of the transmission of monetary policy.

Several avenues for future research emerge naturally from our analysis. First, the framework could be extended to a broader set of economies, including emerging markets with sufficiently developed inflation-linked bond markets, to examine whether the transmission patterns documented here generalize beyond advanced economies or whether there are structural differences and different dynamics. Second, the stance measure could be used to revisit classic questions in the international monetary policy literature, including the degree of monetary policy spillovers across borders and the role of global versus domestic factors in driving r_t^*. We leave these extensions to future research.

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A Appendix: Data sources

Variable	Source
Monetary policy stances	Authors' calculation
Canada unemployment rate	Macrobond (collected from Statistics canada: Labour force characteristics by age group and sex, seasonally adjusted)
Euro Area unemployment rate	Macrobond (collected from Eurostat: Euro indicators - Eurostat)
Sweden unemployment rate	Macrobond (collected from SCB: Labour Force Surveys (LFS))
Mexico unemployment rate	Macrobond (collected from Mexican National Institute of Geography & Statistics)
Japan unemployment rate	Macrobond (collected from Japanese Statistics Bureau: Statistics Bureau Home Page/Labour Force Survey/Monthly Results)

Table A1: List of variables used in the paper