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International Monetary Policy Spillovers between the Federal Reserve and the Bank of Japan: Evidence from a Bayesian Proxy SVAR

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Abstract

This study examines the cross-border transmission of monetary policy between the United States and Japan, with a particular focus on the asymmetry of spillovers between the two economies. Using monthly macrofinancial data and high-frequency monetary policy surprises as external instruments, we estimate a Bayesian Structural Vector Autoregression with external instruments (BSVAR-IV). Monetary policy shocks are normalized to a 25-basis-point increase in each country's one-year yield, allowing the domestic and cross-border transmission to be characterized within a common empirical framework.

The results reveal a substantial asymmetry in the international transmission of monetary policy shocks. US monetary policy spillovers to Japan operate mainly through financial conditions, with contractionary US shocks associated with a reduction of the credit and term spreads, while Japanese monetary policy produces a strong response in US long-term government yields. These findings highlight the importance of financial channels in the international transmission of monetary policy and show how the direction and magnitude of these spillovers depend on the role of each economy in global financial markets.

Contents

1 Introduction

Monetary policy has been understood as a central instrument for domestic policy control. Nevertheless, in recent decades, the world economic conditions have witnessed a rapid and vertiginous integration of the economies, and the decisions of the major central banks have become drivers of the world financial conditions, asset prices, and real activity at a cohesive international level. Therefore, understanding their spillovers is now an important dimension of monetary policy analysis.

During the second half of the twentieth century, the international monetary system experienced a major transformation. The Bretton Woods framework set the conditions for a system with fixed but adjustable exchange rates, agreements on foreign lending, and international trade. This was a period of prosperous years, rapid economic growth, and expanding international trade. However, the increasing pressures on the US dollar eventually led to the suspension of its convertibility into gold and the detriment of the system in the 1970s, followed by periods of severe inflationary instability, with US prices growing more than 10% in 1974 and 1980 (Bordo and Eichengreen, 1993; Goodfriend, 2007).

The world's response to this monetary break in the 1970s reshaped the way that monetary policy was addressed. Under Paul Volcker's mandate, the Federal Reserve pushed the inflation rate down to 4% by 1984, but at the cost of generating recessions in 1980-1982. In addition, during the Alan Greenspan mandate, the inflation rate stabilized below 2% by the early 2000s, under the so-called "effective price stability", consolidating the idea that low inflation could coexist with steady economic growth and low unemployment. A similar pattern was followed worldwide, supported by central bank independence, transparency and credibility, as well as academic developments and the emergence of the New Keynesian framework (Goodfriend, 2007).

Within this emerging consensus, the need for a nominal anchor to achieve price stability increasingly gained importance. As the monetary aggregates strategy proved to be ineffective, distorting and weakening the link between money growth and inflation. Thus, the inflation targeting framework emerged as a new monetary policy regime.

While monetary policy globally was gradually adopting the new framework at domestic levels, the rapid integration of the international financial markets was reshaping the environment in which central banks routinely operated.

Cross-border holdings of assets and liabilities expanded substantially. According to Lane and Milesi-Ferretti (2007), during the period 1970 to 2004, the measure of financial integration, defined as the quotient between the ratio of a country's total foreign assets and liabilities to its GDP, increased from 45% to over 300%, with a fairly gradual rise in the first decade but accelerating in the mid-1990s.

As a consequence, this financial globalization translated into an amplification of the transmission channels of monetary policy. Greater financial integration increased the scope for policy innovations in one economy to affect interest rates, credit conditions, asset prices, exchange rates, and ultimately economic activity abroad.

These international transmission mechanisms are not necessarily symmetric. The evidence is in favor of the U.S. dollar, which is deeply involved in international trade billing, serving as the major denominator of international debt and contributing from a particularly important position in the international monetary system. Accordingly, a growing literature has documented the capacity of US monetary policy to influence global financial conditions and has raised questions about the degree to which other major central banks can generate comparable spillovers.

With all this background, this thesis aims to investigate the domestic and cross-border effects of monetary policy shocks in the United States and Japan. Particularly, it seeks to answer whether the monetary policy movements and decisions generate symmetrical and uniform spillovers, and through which channels they are transmitted. To address this question, the analysis employs a Bayesian Structural Vector Autoregression methodology and considers monetary policy surprises around Federal Reserve and Bank of Japan announcements as external instruments. Four specifications are considered, distinguishing between domestic transmission in each economy and cross-border spillovers from the United States to Japan and from Japan to the United States.

2 Theoretical framework

In this context, several studies have explored how monetary policy is transmitted across major economies and how these interactions shape global economic and financial conditions.

International monetary-policy spillovers

Gerko and Rey (2017) attempt to characterize the monetary policy transmission between two of the main global financial centers, focusing on the effects on the mortgage and corporate spreads for the United States and the United Kingdom.

In their framework, they propose a high-frequency identification strategy with financial and macroeconomic variables, a so-called proxy SVAR (external-instrument identification), while attempting to disentangle the effects on the credit and risk-taking channels. As instruments, they use Fed Funds Futures (United States) and Short Sterling Futures (United Kingdom). The main result highlights the asymmetric effects of monetary policy, as the Fed's tightening impacts British financial conditions, but this behavior is not observed in the other direction. Alongside, in the local scenario, the currencies tend to show appreciation, and the mortgage spreads tend to move upward.

This study was especially relevant for our work, as it served as an important benchmark for both the external-instrumental identification strategy and the model structure. While Gerko and Rey (2017) implement the identification within a frequentist SVAR-IV framework, our analysis is built on this structure and incorporates the external-instrument identification into a Bayesian SVAR framework. In terms of results, their findings are consistent with ours, as a contractionary Fed shock widens financial spreads domestically, while producing the opposite effect on interest rate spreads in recipient economies.

Extending the review to another international setting, Miranda-Agrippino et al. (2020) study the interplay between the US and China, depicting the interaction of domestic monetary policy movements and a common set of global variables, which includes financial indicators but also elements related to world production, trade and capital flows.

The estimation was done through a medium-scale Bayesian VAR separated into US and China blocks. For the first one, a BSVAR-IV structure, identifying the external instruments as the high-frequency movements in the price of Federal Funds Futures around FOMC announcements, which is similar to the analytical structure that we present in this document. For the latter block, a BVAR with Cholesky recursive restrictions is introduced, given the impossibility of having a high-frequency instrument of the Bank of China. Addressing this circumstance, the authors employ the monetary policy indicator constructed by Xu and Jia (2019), which summarizes information from a variety of interest rates, whose shocks are identified by a Taylor-type rule in the recursive VAR.

The results pointed out by the authors suggest that the US monetary policy transmits through the financial markets and global asset prices, while the Chinese monetary policy transmits through trade, commodity prices, and global value chains.

Turning into the other economy at the centre of this analysis, there is an extensive literature on Japan's unconventional monetary policy period, which started in the 1990s and protracted well beyond the Great Recession (Krugman, 1998; Bernanke et al., 2004; Ugai, 2007), with structural evidence on its domestic real effects under the zero lower bound (Schenkelberg and Watzka, 2013) and on the subsequent quantitative and qualitative easing phase (Hausman and Wieland, 2014; Ikeda et al., 2024). Considerably less has been said, however, in terms of spillovers. Dekle and Hamada (2015) address the international dimension through a set of non-structural VARs and a Global VAR, finding that a Japanese monetary policy expansion depreciates the yen and raises Japanese stock prices and output, with the latter dominating, so that United States output is eventually raised in the medium and long-term. In the same line, Ganelli and Tawk (2016) estimate the spillovers of QQE on emerging Asia and find a positive and significant effect on output, transmitted mainly through expectations and confidence captured by stock prices rather than through balance sheet adjustments. Nevertheless, both contributions rely on reduced-form global frameworks centred on output and prices, while this thesis complements these contributions by identifying the monetary policy shock through high-frequency surprises and focuses on the financial channel of transmission.

High-frequency and external-instrument identification

This asymmetric essence of monetary policy spillovers has been considered between the United States and the Euro Area. Ca' Zorzi et al. (2020), examine, under a similar research structure, the spillovers between the Federal Reserve and the ECB monetary policy.

It is worth mentioning that in this approximation an important innovation is made in the way that the monetary policy shocks are identified. In particular, while the widely used Gertler & Karadi methodology attempts to approximate the monetary policy shock as the difference in the price of the contracts of the Federal Fund Futures in a window of 30 minutes around the

Federal Reserve announcement, the authors delve deeper into it by comparing the variation in the prices with the prices of the assets to classify the innovation as a pure monetary policy shock or as an information effect.

Specifically, they define s_m as the vector $(\Delta i_m,\ \Delta q_m)'$ which collects the high-frequency surprises in the policy rate and in the stock price index around FOMC announcement m. These surprises are treated then as a linear combination of two structural disturbances,

$$s_m = \begin{pmatrix} \Delta i_m \\ \Delta q_m \end{pmatrix} = \boldsymbol{A}\,\varepsilon_m = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} \begin{pmatrix} \varepsilon_m^{mp} \\ \varepsilon_m^{cbi} \end{pmatrix}, \tag{1}$$

where ε_m^{mp} is a pure monetary policy shock and ε_m^{cbi} a central bank information shock. The two are separated by sign restrictions on the contemporaneous co-movement of the two surprises:

$$\underbrace{a_{11} > 0, \quad a_{21} < 0}_{\text{monetary policy}} \qquad\qquad \underbrace{a_{12} > 0, \quad a_{22} > 0}_{\text{information}} \tag{2}$$

Thus, the outcomes obtained by the authors suggest that the spillovers of the US on euro area activity are small but statistically significant, especially on financial variables, corporate bond spreads, and unemployment. By contrast, ECB monetary policy spillovers on US real variables are not statistically significant beyond the short run.

Beyond bilateral spillovers, a broader angle of the literature examines the role of US monetary policy in shaping global financial conditions (Miranda-Agrippino and Rey, 2015). First, the authors extract from a vast panel of risky asset returns the Global Factor, understood as an index that captures the "mood" of the global financial markets. In a second step, the variable is included in a medium-size BSVAR in order to analyze jointly the interactions of financial, monetary and real variables, in the US and abroad.

Among the results, they highlight the fact that evidence was found regarding monetary policy spillovers from the US to the rest of the world and, in general, pushing the spreads up and down in variables like asset prices, cross-border credit, and leverage, mainly in the Euro area and the UK, after US, concluding that US monetary policy is an important driver of the Global Financial Cycle. An important aspect mentioned concerns the Mundellian trilemma, which may effectively become a dilemma under a global financial cycle, according to Rey's argument, as the model presents evidence that exchange rate movements cannot insulate a country from US monetary policy shocks and that a country with a flexible exchange rate cannot run a fully independent monetary policy.

Building on this Global Financial perspective, Miranda-Agrippino and Rey (2021) analyze the characteristics of the global financial cycle, identifying patterns and tendencies among real and financial variables. In addition, they present evidence of the causal effects of the monetary policies of the Federal Reserve System, the European Central Bank and the People's Bank of China.

In their empirical section, a proxy-VAR of real and financial variables is conducted, providing evidence that Federal Reserve monetary policy is an important driver of the Global Financial Cycle, affecting global capital flows, private liquidity, and risky asset prices. Although the asymmetry between the Fed and the ECB has diminished since the Global Financial Crisis and the implementation of unconventional monetary policies, the Federal Reserve remains the dominant driver of global financial conditions.

Taken together, this literature shows that monetary policy spills across borders in ways that are far from symmetric, and that the Federal Reserve sits at the center of global financial conditions.

Bayesian VAR methodology

Estimating these transmission mechanisms, however, poses an important empirical challenge, as VAR specifications incorporating several macroeconomic and financial variables can quickly become highly parameterized relative to the available sample.

An essential issue regarding the identification strategy is the increase in the number of parameters, taking into account not only the lags and the number of variables, but also the relatively short sample, as the typical macroeconomic sample does not cover more than 40 or 50 years normally. Addressing a similar issue, Bańbura et al. (2010) proposed a Bayesian VAR to overcome overparameterization using Minnesota and Litterman priors, centering the equations on random walks and thus keeping the variance controlled when the number of variables increases, making it feasible to estimate the models up to 130 variables at the time that the methodology records better forecast performances than the OLS ones.

More specifically, the report proposes four monetary models of 3, 7, 20 and 131 variables, starting from the interaction between employment, consumer price index and Federal Funds Rate to gradually adding real consumption indicators or stock prices, until getting a comprehensive model that includes monetary aggregates, orders and inventories, and several CPI disaggregations, using the complete 131 variables of the dataset of Stock and Watson (2005), considering sectoral and conjunctural information in addition to macroeconomic information.

In line with their research question, the results show consistent evidence that estimating over 100 variables is feasible in a Bayesian framework, and that it outperforms, in forecasting performance, the OLS approach, but the results are not much more robust than the medium 20-variable specification.

Within this Bayesian framework, Sims and Zha (1998) provide an important contribution by showing how economically meaningful priors can be incorporated into structural VARs, while preserving analytical and computational tractability. The methodology relies mainly on the treatment of the VAR's structural form,

$$y_t' A_0 = x_t' A_+ + \varepsilon_t', \tag{3}$$

and the fact that if the prior is specified conditionally on the matrix of contemporaneous structural coefficients A_0, the joint posterior obeys a docile Normal form, avoiding the inversion of the $nk \times nk$ matrices that a Bayesian framework would require. Thus, the prior mean $\mathbb{E}[A_+ \mid A_0]$

is centered so that, unconditionally, it simulates the Litterman random walk belief, and its behavior and dispersion depend on a small set of parameters (λ_0 for the tightness of beliefs about A_0), pointing out that this structure is what makes the proposal computationally convenient. They also demonstrate, with a non-big US macroeconomic VAR, that the imposed prior not only produces feasible error bands for proportionally larger systems but also improves forecasts, relative to priors that ignore the structural identification.

A further issue concerns the calibration of these priors, particularly the degree of shrinkage imposed on the VAR coefficients. Giannone et al. (2015) address this problem by defining a marginal likelihood criterion, in contrast to the heuristic procedures often practiced. In particular, they present an instance of hierarchical modeling where the choice of the prior tightness is treated on the same probabilistic footing as any other parameter of the model. For that purpose, a Gamma hyperprior is used to maximize the marginal likelihood of the overall tightness λ, the residual variance scaling ψ, and the sum-of-coefficients parameter μ.

The exercise states that the optimal λ decreases in the extent to which the model size grows relative to the sample, finding a proper balance between in-sample fit and the risk of overfitting, turning the "curse of dimensionality" into "blessing of dimensionality", with the forecast accuracy of the BVAR model that remains unchanged as more variables are added, outperforming heuristic alternatives and FAVAR techniques (Factor-Augmented Vector Autoregression), which had previously been considered as benchmark solutions to high dimensional macroeconomic forecasting. The Gamma hyperprior uses a mode of 0,2 and a standard deviation of 0,4, following Sims and Zha (1998), as previously referred.

Turning specifically to the conduct of monetary policy in the United States and Japan, **?** present an empirical examination of the hypothesis of the irrelevance of the effective lower bound (ELB) under unconventional monetary policy (UMP) conditions, in separate blocks for each country. In the specification used for their analysis, the authors imposed the ELB through a Censored and Kinked Structural VAR, allowing the policy rate to fluctuate above the bound but to stick to zero below it, so the coefficients and variance can differ between ELB and non-ELB regimes, permitting the shadow rate to be inferred from the model and not estimated separately beforehand.

The results denote that, in both countries, the irrelevance hypothesis is rejected, and the results suggest important patterns such that monetary policy, overall, tends to have stronger effects on inflation in the US, while in Japan the influence is 50% lower but with a longer temporary effect.

The importance of financial conditions for the identification and transmission of monetary policy shocks is further emphasized by Caldara and Herbst (2019), where through a Bayesian Structural VAR with internal instrumental variables, the authors search for the effects of monetary policy shocks in the Great Moderation period, 1994-2007, pointing out that the literature had tended to estimate the monetary policy effects on real activity, but without including the systematic response of the Federal Reserve to financial conditions, particularly to corporate credit spreads. An important remark relates to the fact that they follow the same Gertler and Karadi approach for high-frequency identification for the shocks, however, the role of those instruments is internal, as they are included in the unique variable system in an endogenous form, and compare this specification with the standard Cholesky restrictions, emphasizing the fact that the Fed cannot react in a contemporaneous sense to the spreads, underestimating the effects of the monetary policy.

The main findings indicate that monetary policy shocks have a strong and persistent negative effect on real sector variables, such as unemployment and industrial production, once financial conditions are properly introduced into the identification strategy, while they used this argument as the main description of why some previous studies found weak effects, and some other strong effects, of the monetary policy during the Great Moderation period. They also mention the countercyclical behavior of the Federal Reserve against the movements in the spreads.

3 Methodology

This chapter is organized into two sections. The first, Data, describes the sources of the variables, the transformations, the creation of the indicators and, in particular, the identification of the monetary policy shocks for the United States and Japan. The second, Analytical Development, presents the empirical model in detail, together with a set of criteria and robustness tools justifying the respective selection. The following chapter, Results, displays the estimates and discusses them in regard to the findings of consistent and comparable approaches in the literature.

3.1 The data

Talking about monetary policy spillovers requires taking into consideration the typical macroeconomic variables in addition to elements that allow us to analyze the effects of the central bank's decision in a comprehensive structure. With that purpose in mind, this study relies on a set of data that contains information from three blocks of supplementary information: real sector, financial sector, and external block variables.

Table 1 summarizes the variables per economic block, country, and source:

Table 1: Variables per economic block, country and source

Variable	Block	Source
1-Year Treasury rate	United States	Bloomberg
Industrial production	United States	FRED (Federal Reserve Bank of St. Louis)
CPI inflation	United States	FRED (Federal Reserve Bank of St. Louis)
Unemployment rate	United States	FRED (Federal Reserve Bank of St. Louis)
Consumer confidence	United States	FRED (Federal Reserve Bank of St. Louis)
Stock market index (S&P 500)	United States	Bloomberg
10-Year Treasury yield	United States	Bloomberg
Corporate bond spread	United States	Own construction

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Variable	Block	Source
Mortgage spread	United States	Own construction
Exchange rate	United States	FRED (Federal Reserve Bank of St. Louis)
Consumer Price Index	United States	FRED (Federal Reserve Bank of St. Louis)
1-Year Bond Yield	Japan	Bloomberg
Industrial production	Japan	FRED (Federal Reserve Bank of St. Louis)
CPI inflation	Japan	FRED (Federal Reserve Bank of St. Louis)
Unemployment rate	Japan	FRED (Federal Reserve Bank of St. Louis)
Exchange rate	Japan	FRED (Federal Reserve Bank of St. Louis)
Nikkei Index	Japan	Bloomberg
Consumer Price Index	Japan	FRED (Federal Reserve Bank of St. Louis)
Interest rate spread	Japan	Own construction
Credit spread	Japan	Own construction
Index of global real economic activity	External	Federal Reserve Bank of Dallas
Oil price - BRENT	External	FRED (Federal Reserve Bank of St. Louis)
Oil price - WTI	External	FRED (Federal Reserve Bank of St. Louis)
Board Options Exchange Market Volatility Index - VIX	External	FRED (Federal Reserve Bank of St. Louis)

As discussed previously, one of the main objectives of this thesis is to examine the effects of the monetary policy shocks on the financial conditions in both countries, as well as the interaction between the two economies. Accordingly, the manually constructed spread variables followed these steps:

For the United States block, the credit spread is calculated as Moody's Seasoned Baa Corporate Bond Yield minus the 10-year Treasury yield, aiming to capture the aggregate financial conditions representing corporate financial costs of companies with medium-grade investment corporate debt. Likewise, the mortgage spread is defined as the difference between the 30-year Primary Mortgage Market Survey and the 10-year Treasury yield, as the Freddie Mac survey is widely used as the benchmark measure of mortgage borrowing costs in the United States. With the use of the 10-year Treasury yield, we isolate the credit and interest risk premia from movements in the risk-free interest rate, providing measures of corporate and mortgage financing conditions, respectively.

Unlike the United States, the Japanese financial system has always been more bank-based than market-based. Traditionally, companies rely on bank credit instead of issuing bonds. Therefore, the corporate spreads traded in the market have a less important role, and there are no standardized indices such as the Moody's Baa spread. Regarding the mortgage market, there is no benchmark measure, as the market is more fragmented between commercial banks and public entities. Hence, the spreads employed are the term spread, defined as the difference between the 1 and 10-year bond yields, and the credit spread, defined as New Loans and Discounts/Total/Domestically Licensed Banks minus 1-Year Bond Yield, in line with a Japanese financial system strongly dependent on bank lending.

Having described the structure of the spreads included in the analysis, the next step is the identification of exogenous monetary policy shocks.

Consequently, in the methodology for the construction of the shocks, we follow the high-frequency identification proposed by Gürkaynak et al. (2005) and widely boosted by cornerstone studies such as Gertler and Karadi (2015) and Gerko and Rey (2017). On this basis, the high-frequency change in the fourth Federal Funds Futures contract from 10 minutes before to 20 minutes after the FOMC announcement is used as an external instrument for the monetary policy surprise, in the case of the United States. It is important to consider that this futures contract provides information about market expectations for the Fed Funds rate 3 months onwards, given the new information released by the FOMC. Therefore, it is possible for the change observed during the 30-minute window to be related to the spot prices but also to future readjustments, mainly according to the balance between the policy decision and the discounted beliefs. Hence, these surprises do not reflect only a pure monetary policy shock but also a forward guidance shock, considered as information about the future of the policy or the economy.

Given the 30-minute announcement window, the monetary policy surprise based on Federal Funds Futures (FF4) can be written as

$$MP_t^{US} = FF4_t^{post} - FF4_t^{pre}, \tag{4}$$

where $FF4^{pre}$ denotes the implied interest rate embedded in the fourth-month Federal Funds Futures contract observed 10 minutes before the FOMC announcement, while $FF4^{post}$ corresponds to the implied rate observed 20 minutes after the announcement.

In this way, we used this approach, whose dataset is currently periodically updated on Peter Karadi's website. However, three external instruments were considered, as the exercise was also replicated using the methodology proposed by Jarociński and Karadi (2020), previously discussed in the literature review, and its more recent extension. While the former refines monetary policy surprises by incorporating equity-price information to separate pure monetary policy shocks from central bank information shocks, the latter further incorporates a broader factor of interest-rate surprises, constructed from the first principal component of several high-frequency rate surprises. Nevertheless, the Gertler and Karadi instrument constitutes the baseline specification. The estimations obtained using the two Jarociński-Karadi alternatives are reported in Appendix A as robustness exercises.

In the Japanese case, analogously, and following Kubota and Shintani (2022), we used the Euroyen futures, which are contracts on the 3-month Tokyo Interbank Offered Rates (TIBOR), denoted EYF3, and contain current expectations of the 3-month interest rate over the near future and whose changes in prices around Bank of Japan policy announcements give an idea of unexpected monetary policy innovations. Regarding the measure, a 30-minute window is used, and monetary policy announcements are understood as various types of events associated with information released by the Bank of Japan, starting with the "Statement of Monetary Policy" press release, which takes place immediately after the monetary policy meetings, which had been held once or twice a month since 1998 but whose frequency was adjusted to eight times a year from January 2016, and a public calendar.

Analogously, the monetary policy surprise for Japan is measured as the change in the 3-month Euroyen Futures contract within the same announcement window:

$$MP_t^{JP} = EYF3_t^{post} - EYF3_t^{pre}, \tag{5}$$

where $EYF3^{pre}$ and $EYF3^{post}$ denote the implied interest rates observed 10 minutes before and 20 minutes after the Bank of Japan policy announcement, respectively. Since the contract embeds market expectations of short-term Japanese interest rates, the resulting change provides a measure of the unexpected component of Bank of Japan monetary policy.

The following graph displays the high-frequency instruments consolidated for the entire sample:

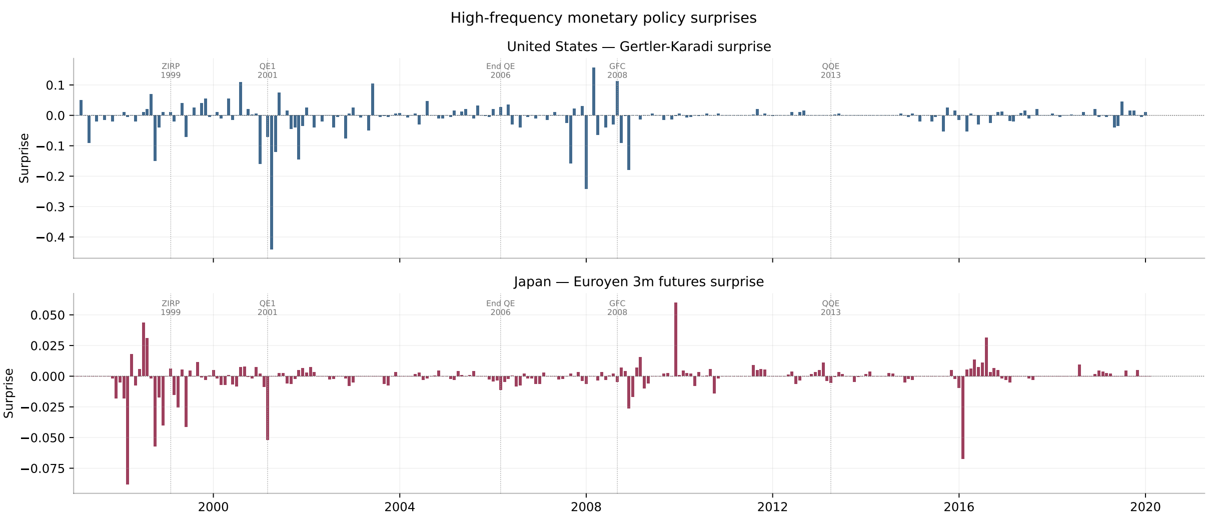

Figure 1: High-frequency monetary policy surprises, United States and Japan

As in Gertler and Karadi (2015) and Gerko and Rey (2017), and with the objective of capturing the effects of forward guidance on macrofinancial variables, we use FF4 surprises to instrument the 1-year Treasury yield in the US specifications. Likewise, the 1-year Japanese government bond yield is used as the monetary policy indicator in the Bank of Japan specifications.

3.2 Analytical Development

The section above describes the dataset considered to examine an exercise of international spillovers of monetary policy between two pillars of the global financial system. Based on that idea, this section introduces the Bayesian Structural Vector Autoregression with external instruments (BSVAR-IV), which constitutes the core empirical framework of this thesis. The model aims to exploit high-frequency monetary policy surprises to identify structural shocks, combined with the Bayesian estimation flexibility to improve inference under possible overparametrization contexts.

In line with the research proposal and, therefore, in the interest of identifying the domestic and international effects of monetary policy in the United States and Japan, we estimate four model specifications: two domestic models, to characterize the transmission of monetary policy shocks within each economy, and two cross-country specifications, to account for the spillovers of a monetary policy shock originating in one country on the other economy. In this way, the specifications proposed are as follows:

Table 2: Endogenous variables by model. The policy variable, in bold, is ordered first in every specification and carries the identified shock.

	USA Local	**Japan Local**	**US $\rightarrow$ JP**	**JP $\rightarrow$ US**
1	**1-Year U.S. Treasury Yield**	**1-Year Japanese Govt. Bond Yield**	**1-Year U.S. Treasury Yield**	**1-Year Japanese Govt. Bond Yield**
2	Global Real Economic Activity Index	Global Real Economic Activity Index	Global Real Economic Activity Index	Global Real Economic Activity Index
3	U.S. Inflation	Japan CPI Inflation	Japan CPI Inflation	U.S. Inflation
4	U.S. Industrial Production	Japan Industrial Production	Japan Industrial Production	U.S. Industrial Production
5	10-Year U.S. Treasury Yield	10-Year Japanese Govt. Bond Yield	10-Year Japanese Govt. Bond Yield	10-Year U.S. Treasury Yield
6	U.S. Mortgage Spread	Japan Credit Spread	Japan Credit Spread	U.S. Mortgage Spread
7	U.S. Corporate Bond Spread	Japan Interest Rate (Term) Spread	Japan Interest Rate (Term) Spread	U.S. Corporate Bond Spread
8	S&P 500 Return	Nikkei 225 Return	Nikkei 225 Return	S&P 500 Return
9	U.S. Dollar Exchange Rate	Yen Exchange Rate	Yen Exchange Rate	U.S. Dollar Exchange Rate

To develop a comprehensive analysis, exploiting as much information as possible from the variables and blocks described above, working under a Vector Autoregression baseline, would initially raise two considerable concerns. First, the reduced-form innovations are linear combinations of all possible disturbances, so, typically, policy rates respond within the month to macroeconomic conditions just as they respond to that policy. Second, the number of parameters required for a system with 6 or 12 lags and more than 3 variables would be relatively large for the sample corresponding to a dataset of macroeconomic variables, whose timespan in standard modern time series is not frequently large.

Then, for the reduced-form VAR representation of order p, we have, for an $n \times 1$ vector of endogenous variables

$$Y_t = c + A_1 Y_{t-1} + \cdots + A_p Y_{t-p} + u_t, \tag{6}$$

where A_j are $n \times n$ matrices of autoregressive coefficients, c is an intercept, and u_t is the vector of one-step-ahead forecast errors, with covariance matrix Σ.

The external instrument identification is the mechanism that allows the innovations to move from the reduced form u_t to the structural monetary policy shock. The reduced-form innovations are related to the structural shocks by

$$u_t = B\,\varepsilon_t, \tag{7}$$

where ε_t contains the structural innovations and B is the contemporaneous impact matrix. Let m_t denote the external instrument used to identify the monetary policy shock, ε_t^1, and according to the SVAR-IV approach (Mertens and Ravn, 2013; Stock and Watson, 2012), it is required for the instrument to satisfy three conditions: relevance, such that it is correlated with the monetary policy shock, exogeneity, such that it is orthogonal to all other structural shocks, and fundamentalness, such that the structural shocks can be retrieved from current and past observed variables (Plagborg-Møller and Wolf, 2021).

$$\text{(i)}\quad \mathbb{E}[\varepsilon_t^1 m_t] = \phi \qquad \text{(Relevance)} \tag{8}$$

$$\text{(ii)}\quad \mathbb{E}[\varepsilon_t^{2:n} m_t] = 0 \qquad \text{(Contemporaneous Exogeneity)} \tag{9}$$

$$\text{(iii)}\quad \varepsilon_t = \mathit{Proj}(\varepsilon_t \mid Y_t, Y_{t-1}, \dots) \qquad \text{(Fundamentalness/Invertibility)} \tag{10}$$

Under these conditions, the covariance between m_t and the reduced-form innovations u_t identifies the column of B associated with the monetary policy shock, allowing the structural impulse responses to the identified monetary policy shock to be recovered.

Therefore, the inclusion of 9 variables with 12 lags would result in more than a thousand parameters to be estimated from a sample spanning approximately 20 years. The estimation of a VAR with a Bayesian approach is thought to overcome this dimensionality curse and, based on relevant literature, we implement a specification with a Normal-Inverse-Wishart prior, which combines the Minnesota approach of Litterman (1986) with the dummy-observation of Bańbura et al. (2010):

The cornerstone principle of the Minnesota prior is that all equations are centered around the random walk with drift, which would work as a natural anchor for macroeconomic series. The prior mean can be associated with this representation:

$$Y_t = c + Y_{t-1} + u_t \tag{11}$$

And it works by reducing the elements of A_1 towards 1 and the non-diagonal elements of $A_1, \dots, A_p$ towards 0. In this manner, under this prior specification, the more recent lags provide more reliable information, and the own lags are more informative than lags of other variables.

Nevertheless, in the original Litterman (1986) specification, the residual variance results in a diagonal matrix, which makes the structural setup impossible. Therefore, following the Kadiyala and Karlsson (1997) approach, a Normal-Inverse Wishart prior is imposed on the VAR coefficients, retaining the main Minnesota features as well as the non-diagonal information in the residual covariance matrix. Thus, the Normal-Inverse-Wishart prior has the form:

$$\Sigma \sim \mathcal{W}^{-1}(\Psi, \nu), \tag{12}$$

$$\beta \mid \Sigma \sim \mathcal{N}(b, \Sigma \otimes \Omega) \tag{13}$$

The coefficient distributions follow the following moment settings:

$$\mathbb{E}[(A_i)_{jk}] = \begin{cases} \delta_j & i = 1,\ j = k \\ 0 & otherwise \end{cases} \qquad \mathbb{V}ar[(A_i)_{jk}] = \begin{cases} \dfrac{\lambda^2}{i^2} & j = k \\ \dfrac{\lambda^2}{i^2}\dfrac{\sigma_j^2}{\sigma_k^2} & otherwise, \end{cases} \tag{14}$$

The tightness of the prior is ruled by the hyperparameter λ: as $\lambda \to 0$ the posterior tends to the random-walk prior, while as $\lambda \to \infty$ it converges to the unrestricted OLS estimate. Regarding the rest of the parameters: $(A_i)_{jk}$ represents the coefficient matrix (j = equation, k = variable). In the first Litterman approach, $\delta_j = 1$ for all the variables, considering the idea that all variables are ruled under a random walk process, nevertheless, it is not proper for those variables with a strong mean reversion. For them, the white noise prior belief is imposed, with $\delta_j = 0$. The factor $1/i^2$, where i is the square of the lags involved, is assumed to be proportional to the variance of the elements in A_i.

The implementation of the prior requires the following dummy observations:

$$Y_{NIW} = \begin{pmatrix} diag(\delta_1\sigma_1, \ldots, \delta_n\sigma_n)/\lambda \\ \mathbf{0}_{n(p-1)\times n} \\ \cdots\cdots\cdots\cdots \\ diag(\sigma_1, \ldots, \sigma_n) \\ \cdots\cdots\cdots\cdots \\ \mathbf{0}_{1\times n} \end{pmatrix} \qquad X_{NIW} = \begin{pmatrix} J_p \otimes diag(\sigma_1, \ldots, \sigma_n)/\lambda & \mathbf{0}_{np\times 1} \\ \cdots\cdots\cdots & \cdots\cdots \\ \mathbf{0}_{n\times np} & \mathbf{0}_{n\times n} \\ \cdots\cdots\cdots & \cdots\cdots \\ \mathbf{0}_{1\times np} & \epsilon \end{pmatrix} \tag{15}$$

Where the first block of dummies imposes prior beliefs on the autoregressive coefficients, the second one applies the coefficients in the covariance matrix, and the third one enacts a diffuse prior in the intercepts.

To determine the degree of shrinkage, we followed Giannone et al. (2015), using the hierarchical modeling to estimate the appropriate value of the shrinkage hyperparameter λ for the Bayesian approach. Particularly, a Gamma hyperprior is assigned to λ. For the implementation, we used a mode equal to 0.2 and a standard deviation equal to 0.4, as those are widely used as good-fit values when dealing with macroeconomic time series, following Giannone et al. (2015) and Miranda-Agrippino and Rey (2015).

$$p(\gamma \mid Y) \propto p(Y \mid \gamma)\, p(\gamma), \qquad \lambda^\star = \arg\max_{\lambda}\ p(\gamma \mid Y) \tag{16}$$

Then, the optimal value of λ is obtained by maximizing its log-posterior, defined as the sum of the log marginal likelihood of the data and the log-density of the Gamma hyperprior.

$$\log p(Y \mid \lambda) + \log p(\lambda), \tag{17}$$

In the specification, we assess a grid of possible values of λ to identify potential areas where the maximum could be located, and then refine the search in the identified regions to obtain the optimal $\lambda^{\star}$.

Figure 2 presents the results for the optimization process previously referred, for each model:

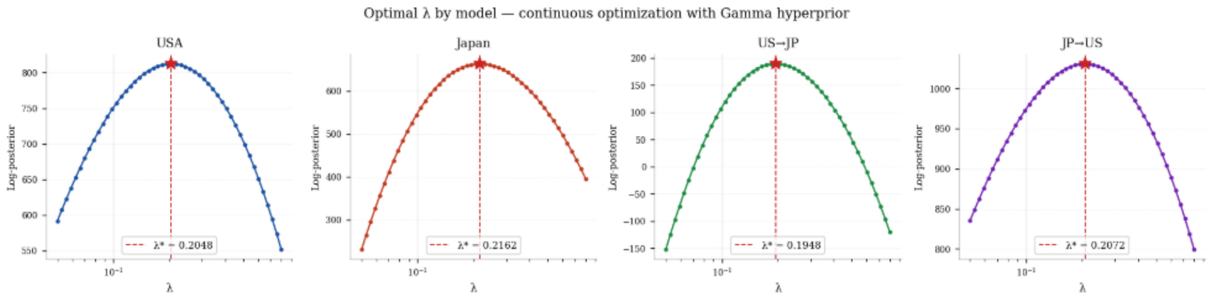

Figure 2: Optimal λ by model — continuous optimization with Gamma hyperprior

The resulting optimal values of the shrinkage parameter $\lambda^{\star}$ are 0.204827 for the US model, 0.216205 for the Japan model, 0.194809 for the US Japan model, and 0.207231 for the Japan US model. These values are, therefore, used for each BSVAR-IV specification.

4 Results

We run the four BSVAR-IV specifications for the period January 1997 to December 2019 for the United States' models and, with the period January 1999 to December 2019, for the Japanese domestic and cross-border models. All the models were estimated with 12 lags as customary.

In all the specifications, the monetary policy shock is normalized to a 25-basis-point increase in the 1-year monetary policy indicator, while the responses of the remaining variables of each model are expressed in standard deviation units.

The transmission channel of US monetary policy has been widely documented. A contractionary monetary policy shock of 25-bp tightens the financial conditions, with increases in the mortgage and corporate spreads of 0.15 and 0.18 standard deviations, respectively. In addition, a negative short- to medium-term impact on the inflation rate and industrial production aligns with the literature and the traditional effects of a contractionary monetary policy. The on-impact response of the US dollar–yen exchange rate seems to reflect an appreciation not persistently significant, while the stock market shows a negative short-term impact of about 0.08 standard deviations in the S&P 500. These results are aligned with the main literature findings, such as Gerko and Rey (2017), where the authors place special emphasis on the role of capital market friction as spreads go up, for the domestic results in the United States.

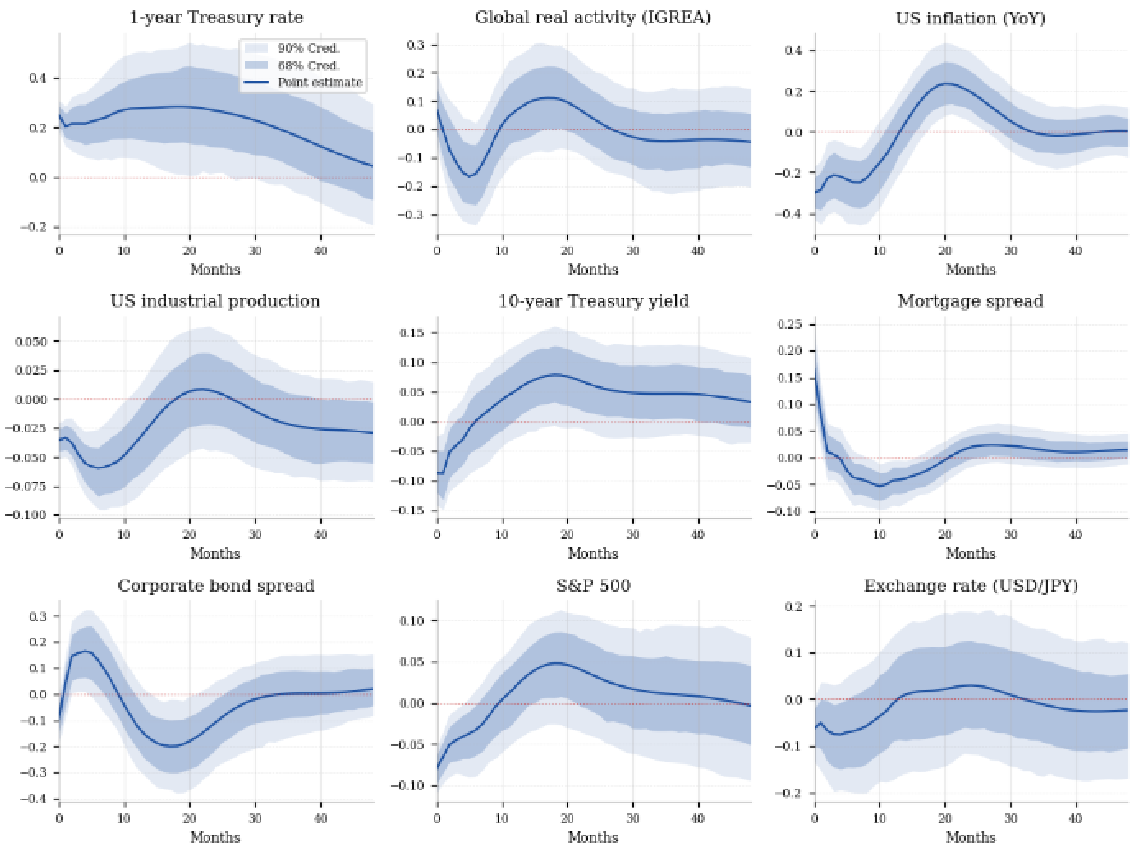

Figure 3: Impulse responses — United States local model (BSVAR-IV, Gertler–Karadi instrument)

Following the Fed's movements, when assessing the spillovers on Japanese economic conditions, the IRFs show, mainly, sharp negative effects on the financial variables, on-impact responses of approximately −0.15 and −0.09 standard deviations in the credit spread and interest rate spread, respectively. It is also worth noting that those effects seem to be persistent during the first six to ten months of the response horizon. In this line, negative responses are also observed in the Nikkei index and in the 10-year government bond yield, with impacts of approximately −0.11 and −0.02 standard deviations, respectively. Regarding the first, the movement is consistent with the literature as stated by Wongswan (2009), about the way that FOMC announcements affect foreign countries through equity markets, who finds that US contractionary monetary policy surprises are generally associated with declines in foreign equity prices. Concerning the latter, it should be taken into account that the Bank of Japan intervention on the yield curve could have softened the natural transmission and that a potential increase in demand for safe assets following Fed tightening could increase the price of the bonds and, therefore, reduce their yield, at least during the first period after the innovation, as the effect shows, and in line with Lam and Tokuoka (2011), who mention European turmoil and associated 'safe-haven' flows as a cause of the decline in JGB yields during the beginning of the last decade.

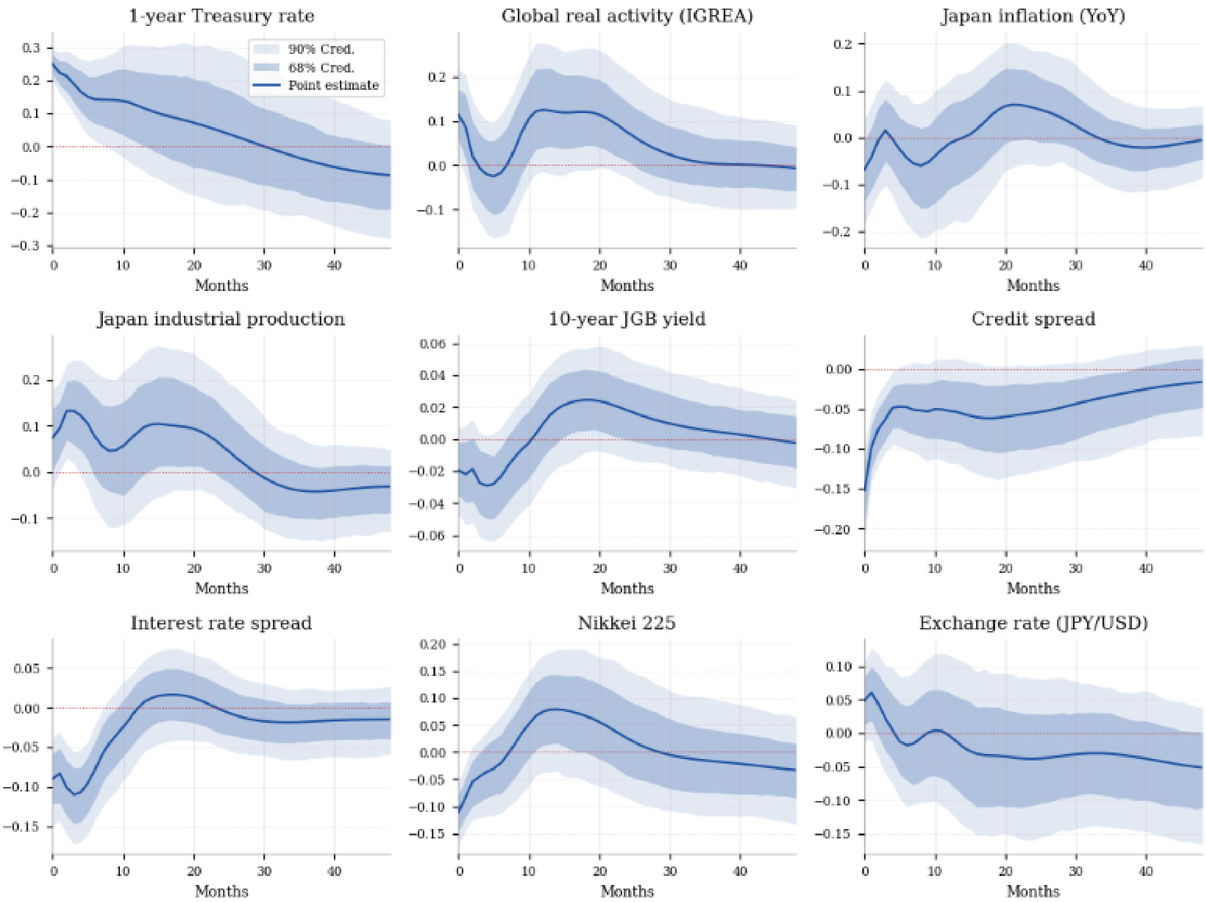

Figure 4: Impulse responses — US → Japan spillover model (BSVAR-IV, Gertler–Karadi instrument)

Focusing on the effects of the Bank of Japan, in the domestic scenario the point estimates indicate mixed effects. First, and in line with the literature, a negative on-impact response of approximately -0.05 standard deviations is observed in the inflation rate, which vanishes shortly after. Secondly, the point estimate suggests that the monetary tightening is followed by a positive and lasting impact on the long-term yield curve, and a first positive and significant effect on the asset prices characterized by the Nikkei 225 index, but with a sharp drop before settling in negative territory towards the end of the horizon. These dynamics are consistent with the findings reported by Kubota and Shintani (2022), where the authors point out positive effects on government bond yields even though there are negative outcomes for stock prices. Similar to the United States case, the financial spreads tend to oscillate in positive territory; however, the effect seems to be strong only at longer horizons.

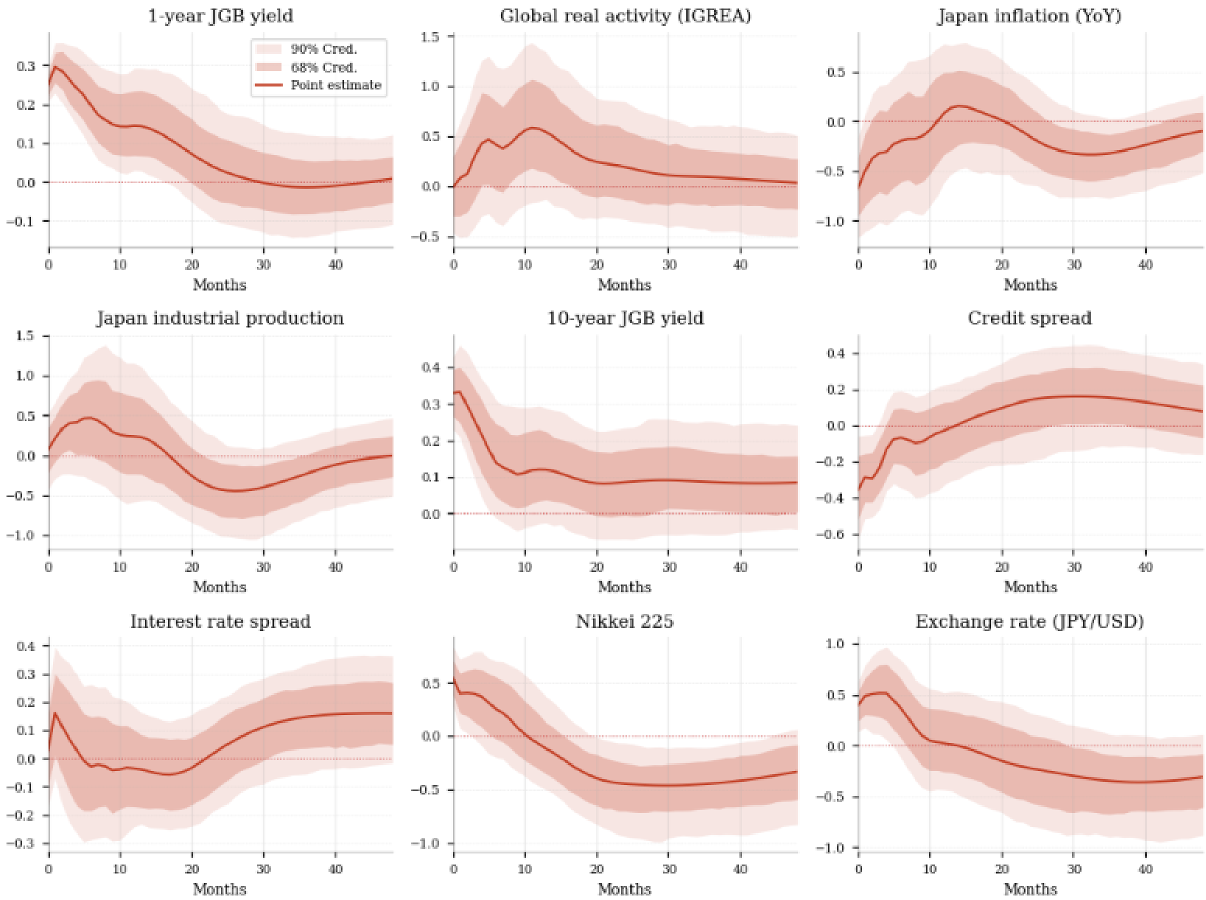

Figure 5: Impulse responses — Japan local model (BSVAR-IV, Euroyen futures instrument)

Last in order, the international effects of the Bank of Japan on the United States economic and financial conditions, following a contractionary Japanese monetary policy shock of 25 bp, seem to be mainly in the financial channel, as there are increases in the mortgage and corporate spreads in the medium-term. Nevertheless, the effect on the mortgage spread is relatively small, in addition to an on-impact response of approximately 0.29 standard deviations in the 10-year Treasury yield. This partially corroborates some literature findings in the sense that the effects of other powers on the United States economy are small and short-lived, as referred to, for example, by Ca' Zorzi et al. (2020) finding a statistically significant effect of ECB on US unemployment, yet not beyond one quarter.

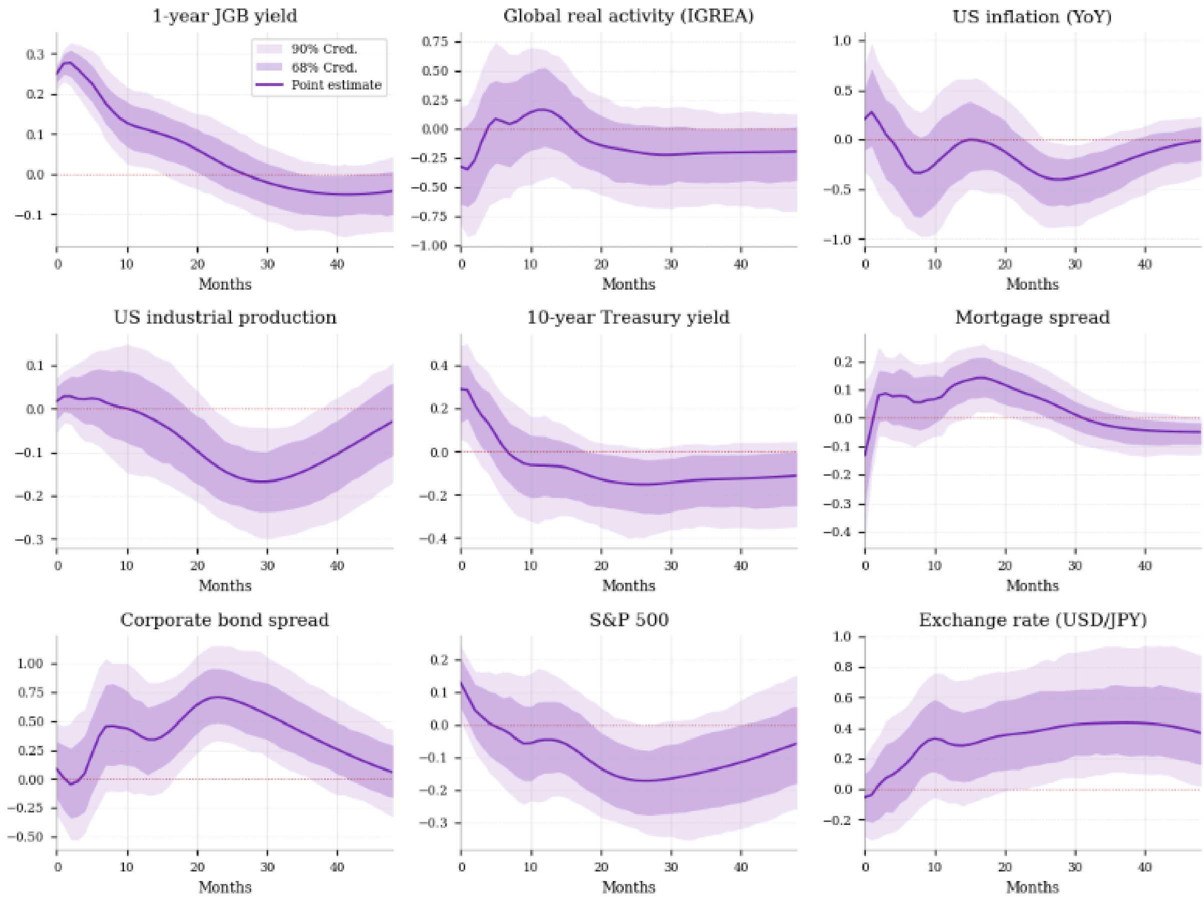

Figure 6: Impulse responses — Japan → US spillover model (BSVAR-IV, Euroyen futures instrument)

As an additional robustness exercise, the four specifications were also estimated using a frequentist SVAR-IV framework. These estimations provide a useful benchmark for assessing the sensitivity of the results to the Bayesian specification and are reported in Appendix B.

After viewing the dynamics of the impulse response functions over the 48-month horizon, it is also useful to complement these results with a description and measurement of their cumulative effects. For this, the next table includes the metrics ‘impact’, as the response on $h = 0$ following the monetary policy shock; ‘Cumulative 12m’ as the cumulative response through 12 months following the shock ($h = 0, \ldots, 12$), and ‘P(sign Cumulative 12m)’ as the posterior probability that the cumulative response over $h = 0, \ldots, 12$ has the same sign as its point estimate.

Table 3: Spillover asymmetry: responses to a +25 bp policy shock, US → JP versus JP → US (Gertler–Karadi instrument)

	US–JP			JP–US		
Category	Impact (SD)	Cumulative 12m (SD)	P(cumulative12)	Impact (SD)	Cumulative 12m (SD)	P(cumulative12)
Policy rate (shock)	25 bp	2.1492	**0.9847**	25 bp	2.5741	**1.0000**
Global real activity	0.1137	0.6170	0.7677	−0.3242	−0.1815	0.5226
Inflation (YoY)	−0.0675	−0.4197	0.6773	0.2106	−1.2095	0.6022
Industrial production	0.0738	1.1013	**0.9082**	0.0170	0.1751	0.5613
10-year government yield	−0.0193	−0.1905	**0.8484**	0.2905	0.9045	0.6731
Credit / mortgage spread	−0.1519	−0.8406	**0.9930**	−0.1307	0.6612	0.8280
Term / corporate spread	−0.0903	−0.8469	**0.9972**	0.0862	3.2155	0.8387
Equity index	−0.1111	−0.1389	0.6106	0.1277	−0.0197	0.4903
Exchange rate	0.0487	0.1301	0.5688	−0.0547	2.1583	0.8172

Note: Monetary policy shocks are normalized to a 25-basis-point increase in the corresponding 1-year policy indicator. All other responses are reported in standard deviation units.

In line with the graphical analysis presented above, we seek to compare the magnitude and direction of the monetary policy spillovers between the two economies by combining the immediate response with their cumulative effect over the first 12 months and its posterior sign probability.

There are some remarks worth considering regarding the quantitative summary. In the first place, in line with the extensive literature, the main spillover channel of the United States appears to be the financial mechanism; the responses of the Japanese credit and term spreads are negative on impact and cumulatively over the first year, with a posterior probability over 90%. In this sense, a similar effect is also perceived in the 10-year Japanese government bond yield, while industrial production exhibits a positive dynamic during the period referred to, with an important probability of 91%.

Second, analyzing the Japanese effects, we found a feature that differs from what the literature usually points out, regarding the spillovers on the United States. In particular, there is a considerable positive effect of Japan on the 10-year Treasury yield and the corporate bond spread, which is consistent with the fact that Japan is the largest foreign holder of Treasury securities and, consequently, tightening by the Bank of Japan could trigger rebalancing in Japanese portfolios, placing those bonds on the market, pushing down their prices and up their yields, in addition to the distinctive feature that Japanese portfolios are largely held by life insurers and pension funds, which often hold long-term assets. However, this mechanism remains a hypothesis that requires further empirical validation, as the present specification does not include capital-flow variables that would allow it to be directly identified.

For completeness, the full impulse-response results for the baseline Gertler-Karadi and the two alternative Jarociński-Karadi instruments are reported in Appendix A.

5 Conclusions

Through this quantitative analysis, we seek to comprehensively characterize the transmission and effects of monetary policy between two of the largest and most influential economies on the international stage. To this end, we developed a strategy that sought to combine the set of tools available in the econometric literature—which have been widely used over the past decade, such as the BSVAR-IV model—with publicly available economic and financial data that is easily accessible to anyone wishing to replicate this analysis.

Among the advantages offered by the Bayesian methodology, the one that proved most beneficial for this study is the ability to allocate a larger information set than is typically feasible in frequentist VARs, for typical macroeconomic time series with a relatively short sample horizon—rarely exceeding 30 or 40 years—using monthly data. In this way, we made full use of the variability and information offered by 9-variable models, where the objective was to integrate the behavior of the real sector, the financial sector, and the international sector.

Therefore, the main findings suggest that, in both economies at the domestic level, the monetary policy contractions widen financial spreads. Likewise, the spillovers of the United States, very in line with the literature, appear to operate mainly through financial conditions, particularly through a reduction in foreign financial spreads, while the main international effects of Japan appear to be linked to the large Japanese holdings of long-term US Treasury securities.

The comparison of those four specifications within a common empirical framework aims to gradually fill the gaps in the study and characterization of the transmission channels, the effects, and the hierarchical role of the different types of economies and their monetary policy globally.

Nevertheless, we are fully conscious of the limitations of this research, with aspects such as the complete implementation of the refined monetary policy surprises, considering the asset prices and the bank information effects together with a broader factor of interest-rate surprises, especially for the Japanese case. Another step in future research is associated with the more direct examination of the portfolio-rebalancing channel, particularly in the effects transmitted from the Bank of Japan to the US long-term yields, incorporating bilateral portfolio holdings or capital flows data.

A Alternative external instruments

Appendix A: Full BSVAR-IV Results

The following tables report the complete quantitative results for the baseline Gertler–Karadi (GK) instrument and the two alternative Jarociński–Karadi specifications. All impulse responses are normalized to a +25 bp monetary policy shock. *Impact* denotes the response at $h = 0$; *Peak* is the largest response in absolute value and h the horizon at which it occurs; *P(peak)* denotes the share of the posterior on the same side of zero as the point estimate at that horizon; *Cum. 12m* is the cumulative response over $h = 0, \dots, 12$ and *P(cum)* its posterior sign probability; *Months* denotes the number of horizons for which the 68% credible band excludes zero. The

JP$\rightarrow$US block uses the Euroyen futures instrument throughout and is therefore common to the three tables.

Table A.1: Full BSVAR-IV Results – Gertler–Karadi (GK) Instrument

	US → JP (GK)							JP → US (Euroyen)						
Category	Impact	Peak	h	P(peak)	Cum. 12m	P(cum)	Months	Impact	Peak	h	P(peak)	Cum. 12m	P(cum)	Months
Policy rate (shock)	25bp	0.2500	0	1.0000	2.1492	0.9847	13	25bp	0.2778	2	1.0000	2.5741	1.0000	20
Global real activity	0.1137	0.1248	12	0.9179	0.6170	0.7677	17	-0.3242	-0.3471	1	0.8237	-0.1815	0.5226	3
Inflation (YoY)	-0.0675	0.0702	21	0.8373	-0.4197	0.6773	5	0.2106	-0.4017	28	0.9591	-1.2095	0.6022	15
Industrial production	0.0738	0.1325	3	0.9764	1.1013	0.9082	14	0.0170	-0.1681	29	0.9849	0.1751	0.5613	24
10-year government yield	-0.0193	-0.0290	4	0.9611	-0.1905	0.8484	14	0.2905	0.2905	0	0.9785	0.9045	0.6731	25
Credit / mortgage spread	-0.1519	-0.1519	0	1.0000	-0.8406	0.9930	39	-0.1307	0.1423	17	0.9806	0.6612	0.8280	24
Term / corporate spread	-0.0903	-0.1102	3	1.0000	-0.8469	0.9972	10	0.0862	0.7078	23	0.9914	3.2155	0.8387	35
Equity index	-0.1111	-0.1111	0	1.0000	-0.1389	0.6106	10	0.1277	-0.1733	26	0.9462	-0.0197	0.4903	24
Exchange rate	0.0487	0.0605	1	0.9374	0.1301	0.5688	2	-0.0547	0.4346	37	0.9527	2.1583	0.8172	42

Table A.2: Full BSVAR-IV Results – Jarociński–Karadi (JK) Instrument

	US → JP (JK)							JP → US (Euroyen)						
Category	Impact	Peak	h	P(peak)	Cum. 12m	P(cum)	Months	Impact	Peak	h	P(peak)	Cum. 12m	P(cum)	Months
Policy rate (shock)	25bp	0.2500	0	1.0000	1.0874	0.7881	4	25bp	0.2778	2	1.0000	2.5741	1.0000	20
Global real activity	0.0263	-0.1452	4	0.8947	-0.5103	0.6671	9	-0.3242	-0.3471	1	0.8237	-0.1815	0.5226	3
Inflation (YoY)	-0.0535	0.1149	23	0.8563	-0.6545	0.6814	6	0.2106	-0.4017	28	0.9591	-1.2095	0.6022	15
Industrial production	0.1669	0.1669	0	0.9545	0.6254	0.6828	4	0.0170	-0.1681	29	0.9849	0.1751	0.5613	24
10-year government yield	-0.0591	-0.0703	3	0.9957	-0.6069	0.9787	10	0.2905	0.2905	0	0.9785	0.9045	0.6731	25
Credit / mortgage spread	-0.2569	-0.2569	0	1.0000	-1.0767	0.9858	38	-0.1307	0.1423	17	0.9806	0.6612	0.8280	24
Term / corporate spread	-0.1398	-0.1875	3	1.0000	-1.4966	0.9986	11	0.0862	0.7078	23	0.9914	3.2155	0.8387	35
Equity index	-0.2542	-0.2542	0	1.0000	-1.2081	0.9360	7	0.1277	-0.1733	26	0.9462	-0.0197	0.4903	24
Exchange rate	0.0708	0.0708	0	0.9275	0.3255	0.6358	2	-0.0547	0.4346	37	0.9527	2.1583	0.8172	42

Table A.3: Full BSVAR-IV Results – Jarociński–Karadi Recent Extension

	US → JP (JK-New)							JP → US (Euroyen)						
Category	Impact	Peak	h	P(peak)	Cum. 12m	P(cum)	Months	Impact	Peak	h	P(peak)	Cum. 12m	P(cum)	Months
Policy rate (shock)	25bp	0.2500	0	1.0000	0.2421	0.5445	3	25bp	0.2778	2	1.0000	2.5741	1.0000	20
Global real activity	0.0977	0.1829	19	0.9111	-0.3905	0.5910	13	-0.3242	-0.3471	1	0.8237	-0.1815	0.5226	3
Inflation (YoY)	-0.1026	-0.1284	8	0.7579	-1.0145	0.7264	4	0.2106	-0.4017	28	0.9591	-1.2095	0.6022	15
Industrial production	0.2001	0.2001	0	0.9562	0.5911	0.6375	4	0.0170	-0.1681	29	0.9849	0.1751	0.5613	24
10-year government yield	-0.0730	-0.1008	3	1.0000	-0.8656	0.9932	12	0.2905	0.2905	0	0.9785	0.9045	0.6731	25
Credit / mortgage spread	-0.2133	-0.2133	0	0.9986	-0.7606	0.8577	4	-0.1307	0.1423	17	0.9806	0.6612	0.8280	24
Term / corporate spread	-0.1459	-0.2310	3	1.0000	-1.8047	1.0000	11	0.0862	0.7078	23	0.9914	3.2155	0.8387	35
Equity index	-0.3178	-0.3178	0	1.0000	-1.8192	0.9562	8	0.1277	-0.1733	26	0.9462	-0.0197	0.4903	24
Exchange rate	0.1560	0.1560	0	0.9959	1.1560	0.8454	3	-0.0547	0.4346	37	0.9527	2.1583	0.8172	42

B Frequentist SVAR-IV estimates

The following figures report the impulse-response functions obtained from the frequentist SVAR-IV specifications. Unlike the baseline BSVAR-IV estimates, these responses are reported under their original normalization and are not rescaled to a 25-basis-point policy shock. They are therefore used as a qualitative robustness exercise regarding the direction and dynamics of the responses, rather than for a direct comparison of magnitudes.

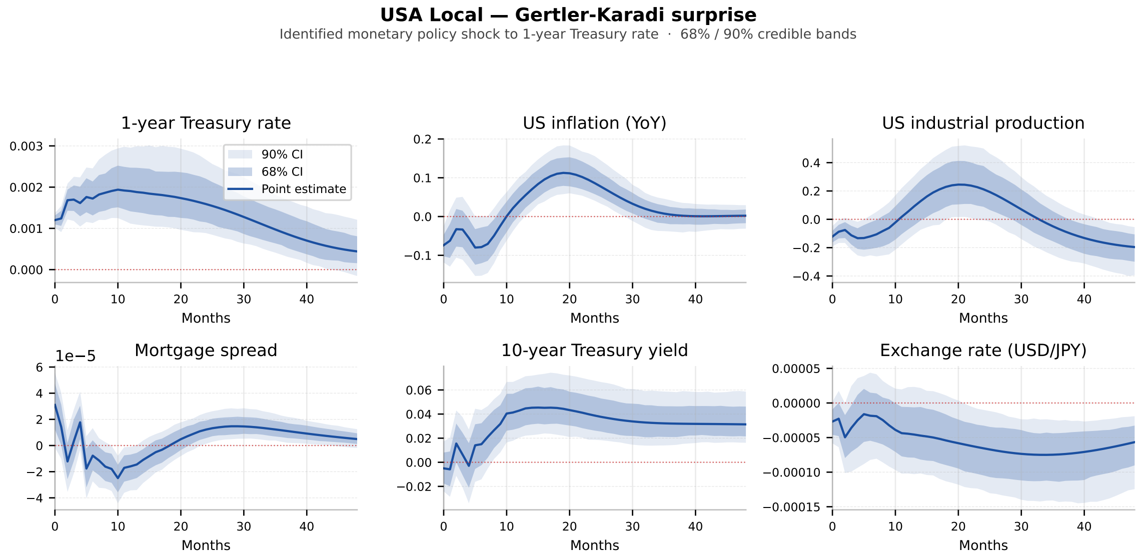

Figure 7: Frequentist SVAR-IV impulse responses: United States local model, using the Gertler–Karadi monetary policy surprise.

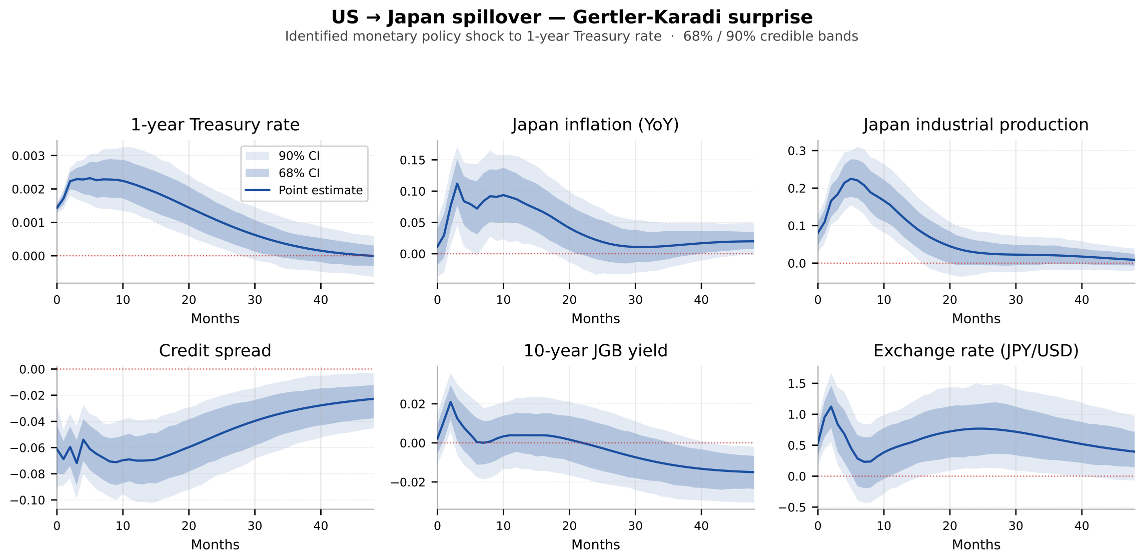

Figure 8: Frequentist SVAR-IV impulse responses: United States to Japan spillover model, using the Gertler–Karadi monetary policy surprise.

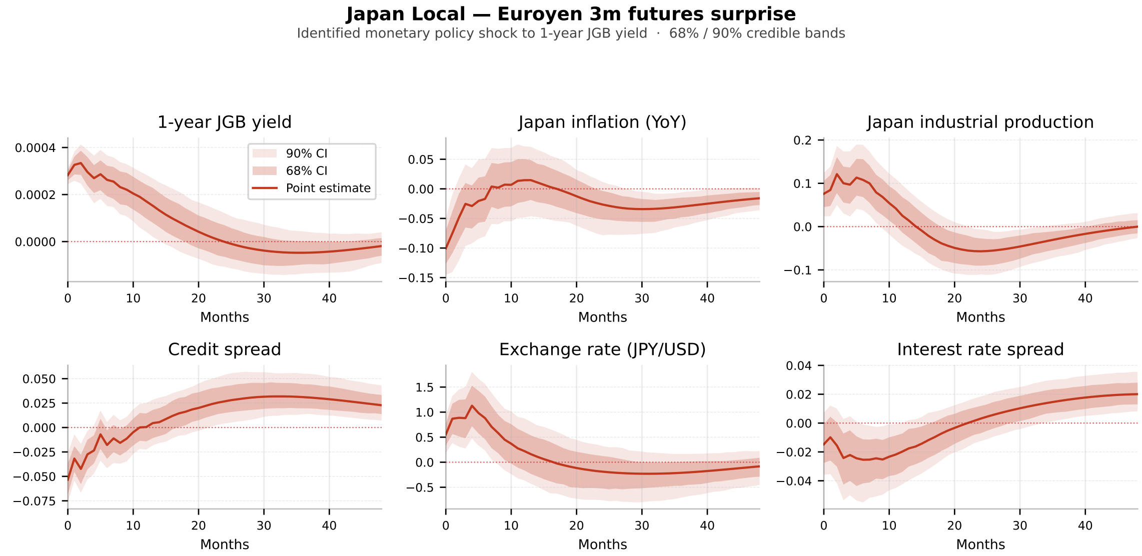

Figure 9: Frequentist SVAR-IV impulse responses: Japan local model, using the Euroyen three-month futures surprise.

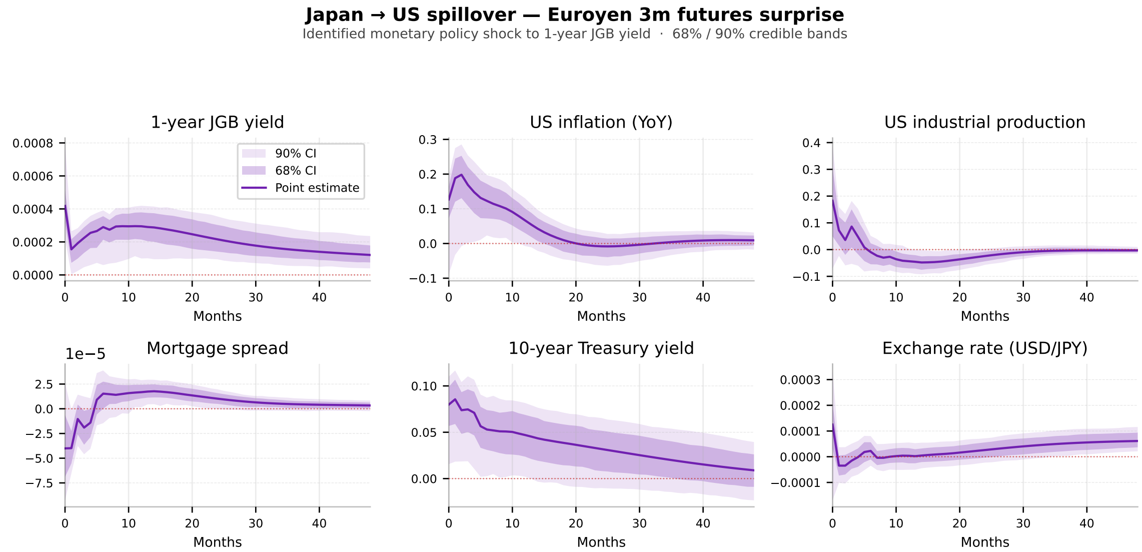

Figure 10: Frequentist SVAR-IV impulse responses: Japan to United States spillover model, using the Euroyen three-month futures surprise.

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