

What Drives Euro-Area Financial Markets? The Role of U.S. Spillovers and Global Risk*

Lennart Brandt,^a Arthur Saint Guilhem,^b
Maximilian Schröder,^c and Ine Van Robays^a

^aBank of England

^bBanque de France

^cEuropean Central Bank

Understanding euro-area financial market dynamics requires looking beyond borders. We introduce a novel Bayesian structural VAR model designed to jointly estimate the main drivers of euro-area financial asset prices on a daily basis. The model explicitly accounts for transatlantic spillovers and the distinctive influence of the United States, particularly through its monetary policy and its role as a safe haven during periods of heightened risk aversion. The results show that euro-area financial markets are influenced by a complex interplay of domestic factors, U.S. influences, and global risk shocks, which can either amplify or mitigate financial dynamics at home. These significant spillovers can pose substantial challenges for monetary policy, particularly amidst economic and monetary policy divergence.

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1. Introduction

Monetary policymakers closely monitor daily fluctuations in financial asset prices such as bond yields, stock prices, and exchange rates in search for signals on the underlying expected dynamics of

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the economy. Asset prices contain a rich set of information; they react in real time to economic news and hint at how markets assess the effect of recent news or policy decisions on growth and inflation.

At the same time, extracting information from asset prices in real time is challenging; economic shocks do not occur in isolation and can steer asset prices in different directions, blurring their signaling content. Euro-area financial markets are also largely driven by international factors, which adds to the complexity. Two particularly important sources of global impulses have been documented in the literature.

First, many studies have documented the importance of U.S. monetary policy spillovers (Bruno and Shin 2015; Dedola, Rivolta, and Stracca 2017; Buch et al. 2019; Jarociński 2022; Ca’Zorzi et al. 2023), reflecting the central role of U.S. monetary policy in steering the global financial cycle (Miranda-Agrippino and Rey 2020; Gourinchas and Rey 2022) and the dominant role of the U.S. dollar in the international monetary system (Ilzetzki, Reinhart, and Rogoff 2019; Maggiori, Neiman, and Schreger 2019; Boz et al. 2022). U.S. developments affect economic conditions abroad through various channels, including demand, the exchange rate, and financial linkages. As a result, not only U.S. monetary policy shocks but also news about the U.S. economy can influence global financial markets (Albuquerque and Vega 2009; Pinchetti and Szczepaniak 2024).

Second, global financial markets are vulnerable to sudden shifts in global risk sentiment, as shown by the Global Financial Crisis of 2008 and the outbreak of the COVID-19 pandemic in 2020. During such episodes, global investors typically rotate from risky into safe assets amid heightened global risk aversion, which affects the pricing of financial assets globally (Baele et al. 2020; Ahmed 2023). The safe-haven status of U.S. dollar-denominated assets implies that the U.S. dollar and U.S. Treasury yields are particularly susceptible to shifts in global risk sentiment (Habib and Stracca 2012; Fatum and Yamamoto 2016; Bodenstein et al. 2023; Georgiadis, Müller, and Schumann 2024), which in turn can affect asset pricing in the euro area.

To gauge the driving forces behind euro-area financial markets, it is important to jointly account for the effects of these two types of shocks—U.S.-specific shocks and global risk shocks. The academic literature so far has mostly evaluated these in isolation. This

leaves open the question of their relative importance, which is key to understanding the policy implications of a given change in financial conditions. For instance, a decline in euro-area interest rates is likely to exert very different effects depending on whether it reflects a domestic monetary policy easing, negative macroeconomic news, spillovers from U.S. monetary policy accommodation, or heightened global risk aversion.¹ Disentangling these different drivers of financial market movements in a simultaneous way is therefore an important endeavor for monetary policymakers and central bankers at large.

To address this challenge, this paper proposes a parsimonious unified framework that allows separating daily movements of key euro-area financial variables into their underlying drivers, while accounting for the unique role of the U.S. in shaping global financial market dynamics. The primary goal of the model is to provide a real-time evaluation of what steers key euro-area asset prices on a daily basis. We stand out from prior research by explicitly considering international channels² and integrating various driving factors in one common framework,³ which allows us to untangle their relative importance. In addition, our approach departs from the high-frequency literature identifying monetary policy shocks in a narrow time interval around monetary policy announcements (e.g., Jarociński and Karadi 2020), in that we identify euro-area and U.S.

¹The fact that shock dependence matters for the interpretation of changes in asset prices has been documented in the literature on exchange rate pass-through (Forbes, Hjortsoe, and Nenova 2018), for instance, but it applies to financial asset prices more generally.

²For example, Matheson and Stavrev (2014) estimate a daily BVAR model for U.S. yields and stock prices based on sign restrictions exploiting cross-asset price movements. Compared to them, we extend the model to a two-country euro-area/U.S. framework including not only bond yields and equity prices but also the bilateral USD/EUR exchange rate. Additionally, we build on the role of U.S. dollar-denominated assets as safe-haven assets for global investors to identify a new important source of daily market movements, the so-called global risk factor.

³For example, Ca'Zorzi et al. (2023) compare the international transmission of euro-area and U.S. monetary policy shocks relying on “pure” monetary policy shocks which are identified in a narrow time window and purged for central bank information effects following Jarociński and Karadi (2020). Our paper differs by simultaneously identifying macro, monetary policy, and global risk shocks, which provide a more comprehensive picture of the relative importance of monetary policy shocks in driving financial markets.

shocks on a continuous, daily basis, aligning with the frequency at which market participants adjust their perception of the macroeconomic and policy outlook. This broader approach has the benefit of capturing anticipation effects of monetary policy, which play a pivotal role in the transmission of monetary policy to financial conditions (Cao and Foerster 2013). It also allows capturing changes in the perception of market investors on the monetary policy stance which happen on non-meeting days (Jayawickrema and Swanson 2021; Bauer and Swanson 2023). Our identification leads to an interpretation of monetary policy shocks that is broader and more general than in the standard high-frequency literature, in essence capturing the continuous repricing by markets of monetary policy expectations, similar to Cieslak and Pang (2021). Despite these differences, however, we find that our estimated monetary policy shocks comove significantly with estimates from the high-frequency literature on the days when a monetary policy announcement takes place. We also find that realizations of our monetary policy shocks are significantly larger on monetary policy meeting days than on non-meeting days.

In a first step, we set up a Bayesian vector autoregression (BVAR) model at daily frequency that identifies five different drivers of asset price fluctuations: euro-area and U.S. monetary policy, euro-area and U.S. domestic macro news, and global risk. We rely on an identification approach based on sign and magnitude restrictions following Arias, Rubio-Ramírez, and Waggoner (2018), exploiting the information content of daily comovements in risk-free yields, equity prices, and the U.S. dollar-euro exchange rate. The key novelty is that we explicitly allow for simultaneous spillovers between the euro area and the U.S. and account for the potential importance of global risk in driving financial markets on both sides of the Atlantic. This contrasts our approach from the literature on international spillovers of monetary policy shocks that leverages high-frequency information in proxy SVARs (Miranda-Agrippino and Nenova 2022; Degasperri, Hong, and Ricco 2024) or by a combination of high-frequency policy proxies and traditional sign restrictions (Cesa-Bianchi and Sokol 2022). In particular, Cesa-Bianchi and Sokol (2022) disentangle domestic and foreign dynamics by ruling out spillovers from the domestic to the foreign economy with zero restrictions, whereas we allow for simultaneous

international spillovers by imposing softer magnitude restrictions. This offers a complementary perspective on the identification of international spillovers and cross-country shocks. We extensively test the performance of our model by benchmarking its interpretation of daily financial market movements against our knowledge of clear narrative events, and by comparing the estimated structural shocks with other established standards from the literature. In a second step, we use our set of daily shocks as econometric instruments in a monthly proxy structural VAR model, following Stock and Watson (2012), Mertens and Ravn (2013), Gertler and Karadi (2015), and particularly Caldara and Herbst (2019). We use this monthly model to assess how daily financial dynamics carry over to the real economy, and to illustrate why it matters to differentiate between different drivers of financial variables in the first place.

Two sets of results are worth highlighting. First, to grasp the daily shifts in the set of key financial variables that we consider, it is essential to account for the U.S. influence and the impact of global risk. Our results show that spillovers from the U.S. and changes in global risk aversion can explain close to half of the average variation in selected asset prices in the euro area. This large effect of foreign forces might pose challenges for domestic policymakers. At times, these spillover effects might align with the intended direction set by domestic monetary policy. But there might be instances when these spillovers push asset prices in the opposite direction, and policymakers are faced with the decision to counteract these or not. While U.S. spillovers explain a large part of dynamics in euro-area financial markets, euro-area shocks are found less relevant for U.S. financial markets. Instead, shifts in global risk sentiment determine a larger part of the U.S. financial market dynamics, consistent with its safe-haven role.

The second key finding is that daily movements in financial markets provide valuable information about broader, longer-term expectations for economic growth and inflation. Our proxy VAR results show that the way financial markets affect the overall economy can vary significantly based on the combination of factors driving their developments. This implies that for policymakers, breaking down signals from daily financial market indicators is particularly relevant; it provides a crucial signal on expected core economic trends

and insights into how monetary policy is being transmitted to the real economy.

The remainder of the paper proceeds as follows. The next section explains the setup of the daily Bayesian VAR model, the data, and the sign restriction identification scheme, while Subsection 2.5 empirically evaluates the validity of the model setup. Section 3 reviews the main empirical results, focusing on the factors driving euro-area financial markets since the inception of the euro, with particular attention to cross-Atlantic spillovers and global risk shocks. It then assesses the transmission of the identified shocks to the real economy using a proxy VAR model which is described in Section 4. Section 5 concludes.

2. Identifying Daily Drivers of Euro-Area Asset Prices

2.1 *A Daily Two-Country Structural VAR Model*

In order to analyze the drivers of euro-area financial markets, we set up a two-country structural vector autoregression model (SVAR) containing key asset price data for the euro area and the U.S., which we estimate using Bayesian methods. The underlying drivers of daily changes in these euro-area and U.S. asset prices are identified using sign restrictions exploiting cross-asset price movements on the day of the shock. Using these models to analyze interactions at daily frequency offers a number of benefits to circumvent some of the well-documented limitations of shock identification with low-frequency macroeconomic data. In particular, due to the rich data environment, the estimation can rely on rather minimalistic prior assumptions.

Following the notation of Rubio-Ramírez, Waggoner, and Zha (2010), the structural form of the VAR is given by

$$y_t' A_0 = x_t' A_+ + \varepsilon_t'. \quad (1)$$

Here, y_t is an $n \times 1$ vector of endogenous variables and x_t is an $(np+k) \times 1$ vector which collects all predetermined variables, that is, p lags of the endogenous variables and k exogenous and deterministic variables. The conformable matrices A_0 and A_+ capture the contemporaneous comovement between endogenous variables and the

VAR parameters of the predetermined variables, respectively. The corresponding reduced form is given by

$$y'_t = x'_t B + u'_t, \quad (2)$$

where $B = A_+ A_0^{-1}$ and $u_t = \varepsilon'_t A_0^{-1}$ with $E[u_t u'_t] = \Sigma = (A'_0 A_0)^{-1}$. For an orthonormal $n \times n$ rotation matrix, Q , (A_0, A_+) can alternatively be expressed as the observationally equivalent $(A_0 Q, A_+ Q)$. Since the set of possible orthogonal matrices is infinite, there exists an infinite number of structural models that give rise to the same observable data.⁴ However, given a specific Q , there exists a one-to-one mapping between reduced and structural form. Given the Cholesky factorization⁵ of the covariance matrix of the residuals, we can write the reduced form in terms of the underlying structural shocks and the rotation matrix Q (Arias, Rubio-Ramírez, and Waggoner 2018):

$$y'_t = x'_t B + \varepsilon'_t Q' \text{chol}(\Sigma). \quad (3)$$

Since B and Σ are exactly identified and Q uniquely links these to a valid structural model, Q can be used as a parsimonious way to carry theoretical restrictions on the structural parameters that are independent of the reduced form. In particular, these restrictions can be expressed as a Bayesian prior over Q that assigns zero probability mass to parts of the parameter space where the restrictions do not hold. This forms the basis for identification. Statistics, such as impulse response functions or historical decompositions, can be computed in a standard way. In general, however, this identification will not be unique and the imposed sign restrictions will yield a set of models that is plausible under these sign restrictions.

2.2 Priors and Estimation

In the empirical exercises, we follow Arias, Rubio-Ramírez, and Waggoner (2018) and impose a conjugate normal-inverse-Wishart

⁴Because $B = A_+ A_0^{-1} = A_+ Q \cdot Q^{-1} A_0^{-1}$ and $\Sigma = A_0 Q \cdot Q^{-1} A_0^{-1} \forall Q \in \mathcal{O}_n$.

⁵Or any other decomposition h for which it holds that $h(\Sigma)' h(\Sigma) = \Sigma$ (Arias, Rubio-Ramírez, and Waggoner 2018).

prior on the reduced-form parameters as well as a uniform prior on the rotation matrix, Q . The joint prior is hence given by

$$p(B, \Sigma, Q) = P(B, \Sigma) \cdot P(Q). \quad (4)$$

Together with a normal likelihood, this parameterization gives rise to a so-called normal-generalized-normal posterior distribution over the structural parameters (A_0, A_+) conditional on the restrictions imposed. Because $p(B, \Sigma | Y_T)$ is itself a proper posterior density—i.e., $p(B, \Sigma | Y_T) \propto p(B, \Sigma) \cdot p(Y_T | B, \Sigma)$ —and because Q is not informative about the reduced form—i.e., the reduced form is unaffected by the choice of restrictions—this posterior is given by

$$p(B, \Sigma, Q | Y_T) \propto p(Q) \cdot p(B, \Sigma) \cdot p(Y_T | B, \Sigma). \quad (5)$$

In the empirical application, estimation is implemented with Algorithm 1 of Arias, Rubio-Ramírez, and Waggoner (2018), which yields i.i.d. draws from the normal-generalized-normal posterior conditional on the set of sign restrictions. In doing so, we do not restrict the set of (A_0, A_+) itself but the contemporaneous impulse response functions. Each iteration, we draw a naive candidate for the impulse response function which we repeatedly rotate with draws of Q . If the rotated impulse response function conforms to our sign restrictions, we retain the draw; otherwise, we discard it.

2.3 Data

Our set of variables comprises the 10-year euro-area overnight index swap (OIS), the EURO STOXX price index, the U.S. S&P 500, and the bilateral euro-U.S. dollar exchange rate, as well as the spread between the 10-year euro OIS rate and 10-year U.S. Treasury yield.⁶ We use the 10-year euro-area (EA) OIS rate and U.S. Treasury yield, as they are the main references for long-term risk-free rates in both

⁶The yield and spread variables enter the model in first difference, while stock prices and the exchange rate are in log-difference. All variables are at business-day frequency.

jurisdictions.^{7,8} Including long-term rates in the model, as opposed to short-term rates, allows for a broader definition of monetary policy shocks and might better capture shifts in risk sentiment. Regarding monetary policy shocks, using the 10-year yield allows capturing not only conventional monetary policy—which mostly affects the yield curve at short to medium maturities—but also unconventional measures such as those deployed by the Federal Reserve (the Fed) following the Global Financial Crisis. Large-scale asset purchases (LSAPs) have been shown to indeed exert a larger impact at longer maturities by compressing term premia.⁹ In addition, focusing on longer-term risk-free rates is instrumental to identify the global risk shock, as flight-to-safety episodes primarily affect investors' appetite for risk-free bonds against riskier assets, and the U.S. Treasury market is the largest provider of safe, U.S. dollar-denominated assets globally. Cieslak and Povala (2015) and Cieslak and Pang (2021) have shown that risk premium shocks more strongly affect longer maturities of U.S. Treasury bonds, moving 10-year yields more than twice as strongly as 2-year yields. The model is estimated over the period January 1999–December 2023, including four lags of the dependent variables.¹⁰

2.4 Shock Identification

Shock identification is achieved by way of imposing sign restrictions as in Arias, Rubio-Ramírez, and Waggoner (2018). Our approach

⁷The swap rate is the fixed rate which banks engaging in swap contracts agree to pay in exchange for receiving the average overnight interest rate for the duration of the swap. Unlike an unsecured interbank loan, in which the lender is exposed to the full credit risk of the borrower, a swap contract is settled in notional amounts, namely without involving a physical exchange of principals, and thus it is considered near risk-free.

⁸An alternative would be to use the 10-year German bund as a measure of the long-term risk-free rate. However, given that the 10-year OIS and 10-year German bund are tightly correlated over time, estimating the model with the 10-year German bund instead of the 10-year OIS leaves the results largely unaffected.

⁹The downward pressures on the term premium stem from the central bank extracting duration risk from the market, which is the well-documented duration channel of asset purchases. For an empirical assessment of the duration channel of European Central Bank (ECB) asset purchases based on a term structure model, see Eser et al. (2023).

¹⁰While our main interest is on the most recent years, we include the pre-crisis sample as a way to benchmark post-crisis developments vis-à-vis “normal” times.

consists of imposing sign restrictions on daily cross-asset price movements, motivated by the intuition often portrayed in market commentaries that these comovements reveal information about the underlying drivers of financial markets. For instance, bond yields and stock prices typically comove positively in response to news about the economy and negatively in response to news related to monetary policy. This intuition finds strong empirical support (Rigobon and Sack 2003, 2004; Matheson and Stavrev 2014), and has been formalized in several papers that identify the contribution of monetary policy or growth shocks to yield and stock price reactions around monetary policy announcements.¹¹ The imposed sign restrictions are also in line with well-established closed- and open-economy structural model dynamics, such as those described in Bernanke, Gertler, and Gilchrist (1999) and Christiano, Motto, and Rostagno (2014) for the domestic shocks, and Galí and Monacelli (2005), Dedola and Lombardo (2012), and Dedola, Karadi, and Lombardo (2013) for the cross-country spillovers.

A crucial departure from the literature using higher-frequency asset price dynamics for shock identification lies in our broader framework, and this along two dimensions. First, we do not confine the estimates to a specific narrow time window surrounding particular announcements, but instead allow shock identification in “continuous time.” This is consistent with the observation that market-moving news, which influences perceptions on monetary policy or the growth outlook, unfolds virtually every day. Nuances in monetary policy communication which move financial markets often occur outside of these narrow time frames (Jayawickrema and Swanson 2021; Bauer and Swanson 2023), for example. A second departure from this literature is that we identify multiple shocks jointly, which is a key contribution, as it allows us to compare

¹¹For example, Jarociński and Karadi (2020) use high-frequency comovement of interest rates and stock prices around policy announcements to disentangle monetary policy surprises from central bank information shocks. Andrade and Ferroni (2021) use comovements between yields and inflation expectations to disentangle “Odyssean” monetary policy signals from “Delphic” monetary policy surprises (Campbell et al. 2012). Cieslak and Schrimpf (2019) use comovements between stock prices and bond yields at different maturities to decompose asset price fluctuations into monetary policy surprises, information (or growth) surprises, and risk shocks.

Table 1. Sign Restriction Table

	EA Monetary Policy	EA Macro News	U.S Monetary Policy	U.S. Macro News	Global Risk
EA Long-Term Yields	+	+	+	+	−
EA Equity	−	+			−
U.S. Equity			−	+	−
USD/EUR	+	+	−	−	−
EA-U.S. Yield Spread	+	+	−	−	+
Note: Empty fields leave that parameter unrestricted, “+” and “−” denote an increase or a decrease in the respective variable on impact. A “+” (−) for the USD/EUR denotes an appreciation (a depreciation) of the euro vis-à-vis the U.S. dollar. The global risk shock displays a worsening of global risk sentiment.					

the relative importance of the key driving factors, while taking a consistent approach to identification.¹²

Table 1 summarizes the structural shock identification scheme via sign restrictions on the contemporaneous impulse response functions. A “+” and “−” denote an increase or decrease, respectively, in the variable following a specific shock, while empty fields leave that response unrestricted. All restrictions are imposed on impact, reflecting the fact that markets typically react to news within the same day.

As shown in Table 1, monetary policy shocks differ from macro shocks through the implied comovement between yields and stock prices; a restrictive monetary policy shock drives yields up and equity prices down, while a positive macro shock increases yields and equity prices (Matheson and Stavrev 2014; Altavilla et al. 2019; Cieslak and Schrimpf 2019; Jarociński and Karadi 2020). Both shocks are assumed to affect the exchange rate similarly, with higher domestic interest rates leading, *ceteris paribus*, to an appreciation of the domestic currency (Engel 2014; Ca’Zorzi et al. 2023). We leave the

¹²For shocks other than the monetary policy shocks, such as the global risk or macro shocks, defining a narrow window around a specific event for identification is more challenging and arguably more arbitrary.

effect of a domestic shock on foreign equity prices unrestricted, as the effect is *a priori* ambiguous.¹³

Second, we allow for instantaneous spillovers between the euro area and the U.S., which requires us to properly control for the country of origin. We address this issue by assuming that a domestic shock has a larger effect on the domestic variable than on the foreign variable. In practice, we apply this magnitude restriction through the spread between euro-area and U.S. yields. For example, a monetary policy tightening in the U.S. might put upward pressures on U.S. and euro-area yields, but as the spread of euro-area over U.S. rates declines, U.S. yields will react more strongly. This contrasts our approach with that of Cesa-Bianchi and Sokol (2022), who rule out direct spillovers from the domestic to the foreign economy by means of stricter zero restrictions.

Finally, a global risk shock causes investors to reallocate their holdings of risky versus safe assets, which causes equity prices and bond yields to move in the same direction. For example, higher risk aversion will reduce appetite for risky assets (Baele et al. 2020) while causing inflows into safe assets. During episodes of heightened global risk, investors flee into U.S. dollar-denominated assets, as these are considered liquid and safe (Farhi and Gabaix 2016; Jiang, Krishnamurthy, and Lustig 2021), which holds in particular for U.S. Treasury bonds in that they embed a convenience yield (Krishnamurthy and Vissing-Jorgensen 2012; Du, Im, and Schreger 2018). Due to the higher liquidity and safety of U.S. Treasuries, we assume that Treasury rates will fall more strongly than euro-area yields upon a worsening in global risk sentiment, which causes the euro-area–U.S. rate spread to decline. In addition, the U.S. dollar is assumed to appreciate vis-à-vis the euro exchange rate, reflecting the role of the U.S. dollar as safe-haven currency (Georgiadis, Müller, and Schumann 2024), and the U.S. economy providing insurance in times of global stress (Gourinchas and Rey 2022).

¹³News about the domestic macroeconomic outlook may drive a reallocation from domestic risky assets into foreign risky assets, which all else equal would exert opposite effects on domestic and foreign equity prices. On the other hand, positive domestic news on the economy can lift foreign equity prices through the demand channel.

Interpretation of the Structural Shocks. Our choice to identify the structural shocks in “continuous time” by relying on comovements in asset prices has implications for the interpretation of the shocks. We identify the structural shocks through the lens of financial markets, with the shocks capturing changes in the interpretation of market participants of daily news on the macroeconomic outlook, global risk, and monetary policy, as captured by changes in asset pricing. This implies that we attain a wider definition of the structural shocks than part of the literature does. For example, compared to the studies using high-frequency monetary policy shock identification during narrow time windows (e.g., Jarociński and Karadi 2020), our monetary policy shocks capture changes in the *perception* of market participants of the monetary policy stance, similar to Cieslak and Pang (2021). These will include shifts in interest rates on days of monetary policy meetings and speeches, but also shifts caused by news that induce market participants to reprice their monetary policy expectations. This could happen following important data releases when monetary policy is data dependent, for example. As such, our monetary policy shocks encompass a broader range of innovations beyond those directly stemming from surprises in monetary policy decisions or communication, as we identify these shocks through asset price movements. Similarly, the global risk shock captures market reactions to events that cause investors to price in increased risk aversion, by shifting toward risk-free assets and safe U.S. dollar-denominated assets. For each day, typically a multitude of shocks is identified.

There are advantages to our identification approach. For example, compared to the literature exploiting market movements over narrow time windows around monetary policy events, there are two main differences. First, our approach is not restricted to days of monetary policy announcements, but we allow for monetary surprises to occur any day. This is consistent with the findings of Jayawickrema and Swanson (2021) and Bauer and Swanson (2023), who have underlined the importance of broadening the time window to a wider set of events in order to accurately pin down monetary policy surprises and central bank information effects. Particularly when monetary policy takes a data-driven approach, markets might reassess the expected stance of monetary policy more frequently. Second, because we do not restrict the time window to specific events, our approach

also allows us to capture in full anticipation effects that materialize ahead of the actual policy announcement through nuances in monetary policy communication on non-monetary policy meeting days such as in speeches. These anticipation effects are an important channel of monetary policy transmission, as shown by Cao and Foerster (2013) who use surveys, newspaper articles, and Internet searches to show that announcements for various rounds of LSAPs in the U.S. were largely expected. Our results, discussed below, confirm that monetary policy announcements are typically largely anticipated by market participants—and our framework effectively categorizes these as monetary policy shocks.¹⁴ Moreover, we find that realizations of monetary policy shocks are significantly larger on monetary policy meeting days than on non-meeting days, which reflects our broader definition of monetary policy shocks.¹⁵

Despite these conceptual differences, we find that our monetary policy shocks comove strongly with estimates from the high-frequency literature on announcement days. To illustrate the validity and information content of the shocks retrieved from our daily SVAR, we project onto them the high-frequency surprises in OIS rates across the term structure, using the changes in OIS rates around ECB announcements from the EA Monetary Policy Database of Altavilla et al. (2019).

For each high-frequency change hf in the OIS rate at maturity τ recorded on announcement day t , we run the following univariate regression, where $\varepsilon^{(i)}$ is the i 'th shock in the daily SVAR:

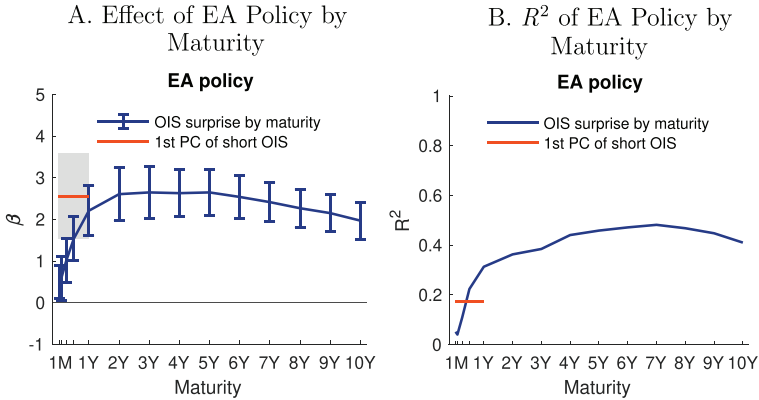
$$hf_{\tau,t} = \alpha^{(i)} + \beta_{\tau}^{(i)} \varepsilon_t^{(i)} + \nu_{\tau,t}^{(i)}. \quad (6)$$

Figure 1 shows that the shocks from the daily SVAR have significant explanatory power for high-frequency movements in financial market variables around policy announcements. We find that

¹⁴In particular, our results suggest that, once accounting for anticipation effects, there is no evidence that the marginal impact of LSAP programs on long-term interest rates has declined over time. This finding is in line with the evidence provided by Cahill et al. (2013), Cao and Foerster (2013), and Carlson et al. (2020). Cahill et al. (2013) show that, after controlling for pre-announcement market expectations, the yield impact of the Fed's asset purchases has not reduced over time.

¹⁵See Figure A.1 in Appendix A.

Figure 1. Explanatory Power of Euro-Area Shocks for High-Frequency Changes in OIS Rates around ECB Policy Announcements



Note: Panel A shows the term structure of regression coefficients from Equation (6). Error bars denote the 95 percent confidence interval. Panel B shows the associated share of variance explained. Orange lines and grey swathes additionally show the respective parameters of the regression with the first principal component of OIS with maturity up to one year on the left-hand side; as in, for example, Nakamura and Steinsson (2018) and Ca’Zorzi et al. (2023).

our monetary policy shock explains a significant share of the variation in OIS rates around policy announcements—around 40 percent beyond the four-year mark. Since our shocks are identified using a fairly long risk-free rate and estimated on a sample which includes a long period of unconventional monetary policy with short-term interest rates near the effective lower bound, it is expected that they comove most with surprises at medium- to long-term maturities. Point estimates of the parameter β are statistically significant (at the 5 percent level) and sizable with a one-standard-deviation monetary policy shock increasing OIS surprises by about 2.5 basis points (compared to a standard deviation of around 5 basis points for most OIS surprises).

Possible Extensions to Our Framework. While our baseline specification is rather parsimonious, it could be extended to capture additional drivers of euro-area financial conditions, such as sovereign or corporate credit risk. Additionally, one could consider

yields at other maturities as a way to capture different dimensions of monetary policy (e.g., negative interest rate policy versus rate forward guidance versus the ECB's asset purchase program).^{16,17} While changing the specification of the model may enrich the interpretation of monetary policy factors, the results remain largely unaffected.¹⁸ For our global risk shock, this implies that in essence, a simple framework that rests on two types of assets—risk-free bonds and equity—in combination with a safe-haven currency such as the U.S. dollar seems sufficient to pin down the “flight-to-safety” component.

2.5 *Model Interpretation and Validation*

We check the validity of our identification strategy in two ways. First, we inspect the estimated shocks and compare them to alternative empirical measures over time (Section 2.5.1). Second, we review the shock decomposition over a selection of significant market events for which we have a strong prior knowledge on the dominant factor driving market developments over that specific event (Section 2.5.2).

2.5.1 *Economic Interpretation of the Identified Drivers*

Monetary Policy Shocks. An inspection of the estimated euro-area and U.S. monetary policy shocks shows that over periods when the ECB and the Fed have been most active in deploying unconventional policy measures,¹⁹ large realizations of the shocks

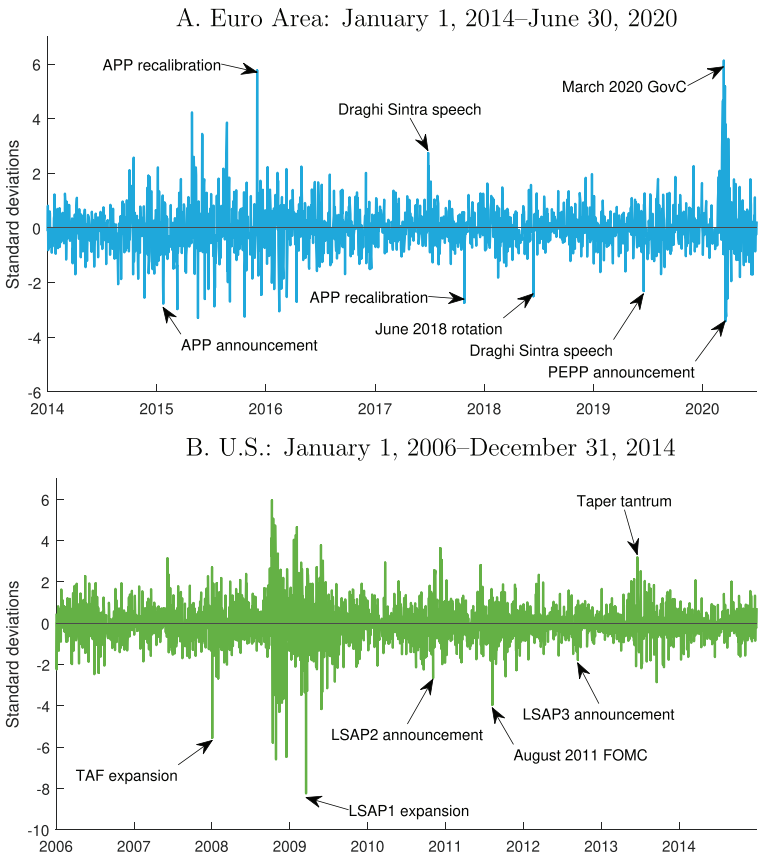
¹⁶In practice, empirically disentangling the different monetary policy instruments in one single framework proves challenging. Rostagno et al. (2021) propose an approach that overcomes this challenge based on combining yield curve identification with a large macro BVAR.

¹⁷One important implication of using long-term yields is that the estimated monetary policy shock spans multiple dimensions in line with the target, path, and quantitative easing (QE) factors from the literature. Appendix B provides a cross-check of our estimated monetary policy shock against the target, path, and QE instruments from Miranda-Agrippino and Nenova (2022). The results indicate that our monetary policy shock loads positively on all three factors and can therefore be interpreted as spanning multiple monetary policy dimensions. See Figures B.1–B.4.

¹⁸Appendix B provides robustness checks of alternative model specifications—for example, using sovereign yields.

¹⁹We focus on (i) 2014–20 for the euro area, covering the adoption of negative interest rate policy (NIRP) and the asset purchase program (APP) announcement and the measures taken in response to the COVID-19 pandemic such as the

Figure 2. Euro-Area and U.S. Monetary Policy Shocks during Periods of Unconventional Policy



Note: The charts show the respective posterior mean over all accepted draws from the BVAR.

coincide with important monetary policy announcements (Figure 2). For example, large shocks for the euro area come with the first asset purchase program (APP) announcement in early 2015, its

Pandemic Emergency Purchase Programme (PEPP); and (ii) the period 2008–12 for the U.S., during which the various large-scale asset purchase (LSAP) programs were announced. The choice to focus on this specific period is arbitrary; also beyond this time frame important monetary policy shocks are well captured.

subsequent recalibrations, and the announcement of the Pandemic Emergency Purchase Programme (PEPP) at the onset of the pandemic. For the U.S., the largest negative monetary policy shock during that time frame occurred on the day of the first large-scale asset purchase (LSAP) announcement in November 2008. We also inspect other policy announcements and find a significant contribution of monetary policy shocks in shaping financial conditions on these days. Overall, this indicates that our approach effectively captures key monetary policy announcements.²⁰

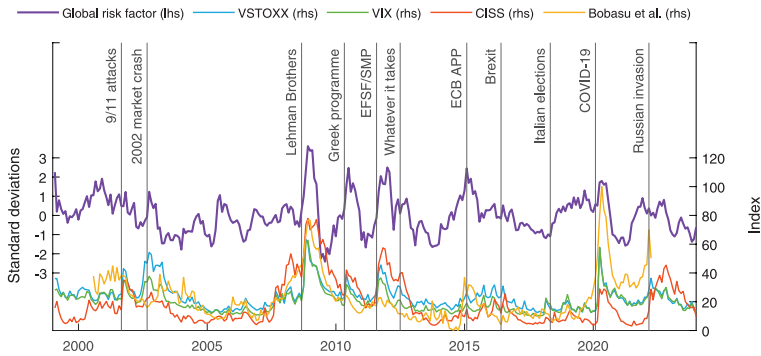
Macro Shocks. We assess the euro-area and U.S. macro shocks by comparing them with the Citigroup Economic Surprise Index (CESI), a measure of macroeconomic surprises commonly used by market analysts.²¹ As our identification of the macro shock aims at capturing news that affect the market perception of the macroeconomic outlook, the estimated macro shocks should exhibit some degree of comovement with actual macro surprises. In fact, the comparison shows that both measures strongly comove over the estimated sample for both the euro area and the U.S.²² It also shows that the correlation tends to vary over time. In particular, the identified macro factor disconnects at times from actual macro surprises with some persistence. There are two possible explanations for this. First, while the CESI is an aggregation of all different macro releases, market participants might be inclined to give more attention to specific news at specific periods of time. Second, the disconnect between actual macro surprises and the market perception of the macro outlook as estimated in our model is also consistent with the tendency of markets to over- or under-react to news about the state of the economy in bouts of optimism or pessimism, as in

²⁰These findings are consistent with the literature documenting a strong asset price reaction around large-scale asset purchase announcements. For the euro area, see Andrade et al. (2016) and Altavilla, Carboni, and Motto (2021). For the U.S., see Gagnon et al. (2011) and Vissing-Jorgensen and Krishnamurthy (2011).

²¹The CESI is defined as a weighted historical standard deviation of data surprises (actual releases versus the Bloomberg median survey) and is calculated daily in a rolling three-month window. The weights of the economic indicators are derived from relative high-frequency spot foreign exchange impacts of one-standard-deviation data surprises adjusted to include a time decay feature so as to replicate the contained memory of markets.

²²See Figure A.3 in Appendix A.

Figure 3. Comparison of the Global Risk Factor with Alternative Risk Indicators



Note: To align the volatility of our global risk measure to that of other measures for easier visual comparison, the global risk factor is the six-months moving average of the standardized posterior mean global risk shock from the daily BVAR, while financial market indicators are shown as monthly averages. The yellow line shows the Global Uncertainty Measure of Bobasu, Quaglietti, and Ricci (2024). To note, the measures are not fully comparable, because by construction the global risk shock takes positive and negative values (capturing risk-on and risk-off episodes), while financial market indicators measure volatility and only take positive values, hence the two distinct scales.

Benhabib, Liu, and Wang (2016). Alternatively, it might be that under imperfect information market investors take into account a wider set of economic indicators than pure data releases when forming their expectations about the state of the economy and the central bank's reaction to it, as suggested by Pastor and Veronesi (2009).

Global Risk Shock. To assess how well we capture shifts in global risk, we compare our estimated shock series to alternative risk measures: the U.S. and euro-area indices of stock market volatility (VIX and VSTOXX, respectively), the euro-area CISS (composite indicator of systemic stress) (Hollo, Kremer, and Lo Duca 2012), and the global economic uncertainty measure of Bobasu, Quaglietti, and Ricci (2024), as plotted in Figure 3. Our global risk factor, which aims at capturing episodes of shifting risk aversion and flight to quality, strongly comoves with these alternative risk measures, exhibiting spikes during episodes of market turmoil such as the 2008 Lehman collapse or at the start of the COVID-19 pandemic in early 2020. We also find evidence that the euro-area sovereign debt crisis was

accompanied by a surge in global risk aversion with investors moving out of euro-denominated assets toward U.S.-denominated assets in an attempt to reduce their exposure to redenomination risk.²³ Our global risk factor—being two-sided—tracks symmetrically both adverse and benign risk sentiment episodes. We find, for example, that at times when the euro-area economy was on a recovery track, such as in the mid-2000s or over 2015–18, the risk environment was especially favorable, which may have further supported the recovery.

2.6 *Event-Study Evidence*

As a second test of validation, we study the model performance more systematically over selected events that caused a market reaction following important news on euro-area monetary policy (such as announcements of APP or negative interest rate policy), U.S. monetary policy (such as the LSAP announcement), or relevant euro-area or U.S. macro releases. Table 2 lists the selected events and our prior expectation of the specific shock in our model that should dominate financial market movements on that day. Figure 4 plots the two-day reaction of euro-area long-term rates for each of the selected events, together with the contributions of the underlying drivers.²⁴ The results for U.S. yields, euro-area stock prices, and the exchange rate are reported in Appendix A.

Two findings are worth highlighting. First, the results show that the model identification is successful at capturing the specific nature of each event. For events that are caused by an important monetary policy announcement, the model tends to identify the monetary policy shock as the dominant driver of the change in euro-area long-term rates over the two-day window around the event (see left

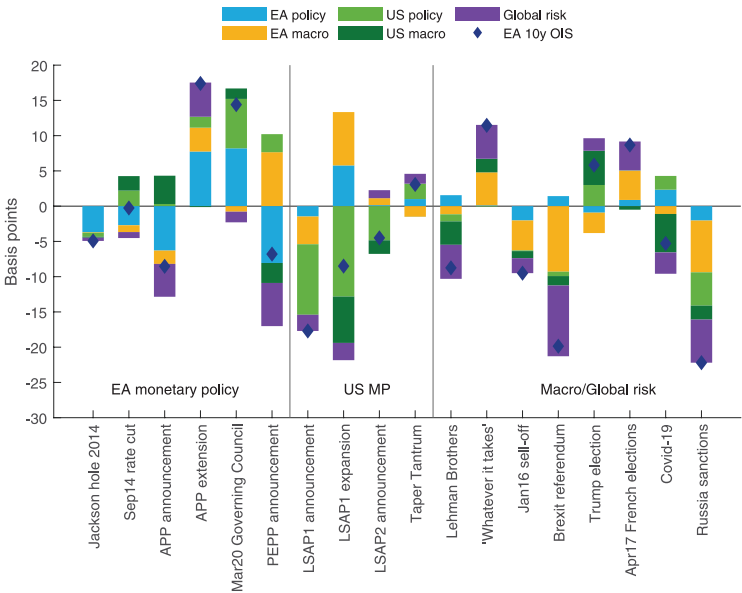
²³This is consistent with evidence of investors' fears of a euro-area breakdown, as captured by rising redenomination risk (De Santis 2019).

²⁴On any given day, releases of macroeconomic data, monetary policy announcements, or any other type of event can generally coincide. The daily VAR decomposes the reduced-form residuals of the system into orthogonal structural shocks, conditional on our set of identifying sign restrictions. The historical decompositions that form the basis for our event study utilize the identified VAR to express all variables and hence daily movements as a sum of current and past shocks, conditional on the dynamics of the system. This is why the contributions are generally nonzero anywhere, even though the underlying shocks are orthogonal.

Table 2. List of Selected Events

Date	Announcement	Type of Shock
Sep. 15, 2008	Lehman Brothers Collapse	Global Risk/Macro
Nov. 25, 2008	LSAP1 Ann.	U.S. Monetary Policy
Mar. 18, 2009	LSAP1 Expansion	U.S. Monetary Policy
May 10, 2010	Greek Program + EFSF + SMP Ann.	EA Monetary Policy/Macro
Nov. 3, 2010	LSAP2 Ann.	U.S. Monetary policy
Jul. 26, 2012	Draghi London Speech: “Whatever It Takes”	EA Monetary Policy/Risk
Jun. 19, 2013	FOMC Meeting; Fed Taper Tantrum	U.S. Monetary Policy
Aug. 22, 2014	Draghi Jackson Hole Speech	EA Monetary Policy
Sep. 4, 2014	10 bps DFR Cut and ABSPP/CBPP Ann.	EA Monetary Policy
Jan. 22, 2015	APP Ann.	EA Monetary Policy
Dec. 3, 2015	10 bps DFR Cut and APP Extension	EA Macro/Global Risk
Jan. 4, 2016	Stock Market Sell-Off	EA Macro/Global Risk
Jun. 23, 2016	Brexit Referendum	EA Macro/Global Risk
Nov. 8, 2016	U.S. Presidential Elections	U.S. Macro/Global Risk
Apr. 23, 2017	First Round French Presidential Elections	EA Macro/Global Risk
Feb. 25, 2020	Intensification COVID-19 Crisis	EA Macro/Global Risk
Mar. 12, 2020	March 2020 Governing Council	Global Risk/Macro
Mar. 18, 2020	PEPP Ann.	EA Monetary Policy
Note: “Ann.” Stands for announcement, “DFR” for deposit facility rate.		

Figure 4. Drivers of the Euro-Area 10-Year
OIS Rate around Selected Events



Note: The chart shows the decomposition of the change on the day of the event and the day after. The results for the variables not shown can be found in Appendix A; see Figures A.4–A.7.

panel in Figure 4). Similar conclusions apply to spillovers around U.S. monetary policy events; U.S. monetary policy shocks tend to be the dominant driver of euro-area long-term rates on these days (see middle panel in Figure 4). Finally, also global risk and macro events are well captured (see right panel). For example, the Brexit referendum is associated with a large decline in the 10-year OIS in the euro area (–20 basis points), which is equally split between two factors—global risk and euro-area macro. This decomposition sheds light on the market perception of the implications of Brexit: increased risk aversion leading to investment flows into safe dollar-denominated assets, combined with a sudden negative reappraisal of the euro-area macro landscape through close trade and financial linkages with the U.K.

Second, the exercise also underlines that—while one shock might dominate developments on a given day—other shocks also matter.

This may reflect two elements. First, news typically encompasses diverse topics. Some of these updates are focused on monetary policy, while others revolve around macro information. For example, the ECB Governing Council meetings tend to coincide with the release of important U.S. macro news such as the preliminary release of U.S. non-farm payroll data. This might blur the signal associated to the specific event that one tries to isolate. Second, the announcement may give rise to a reappraisal along dimensions that are not directly related to the original signal. For instance, euro-area monetary policy events tend to be associated not only with a monetary policy shock but also with a reappraisal of the euro-area macro factor. This result is consistent with the well-documented finding that ECB monetary policy events give rise to two types of monetary policy signals, namely a classic “Delphic” component (signal about a turn in the monetary policy stance) as well as an “Odyssean” component (signal on the central bank’s assessment of the economic outlook); see also Jarociński and Karadi (2020) and Andrade and Ferroni (2021). Our approach allows us to effectively isolate the Delphic component of monetary news. At the same time, our results also suggest an important role of non-monetary news—shifts in macro and global risk—in explaining the daily reaction of asset prices around monetary policy events, which is consistent with the findings from the literature (Nakamura and Steinsson 2018; Cieslak and Schrimpf 2019).

3. Empirical Results

3.1 *What Drives Euro-Area and U.S. Financial Markets?*

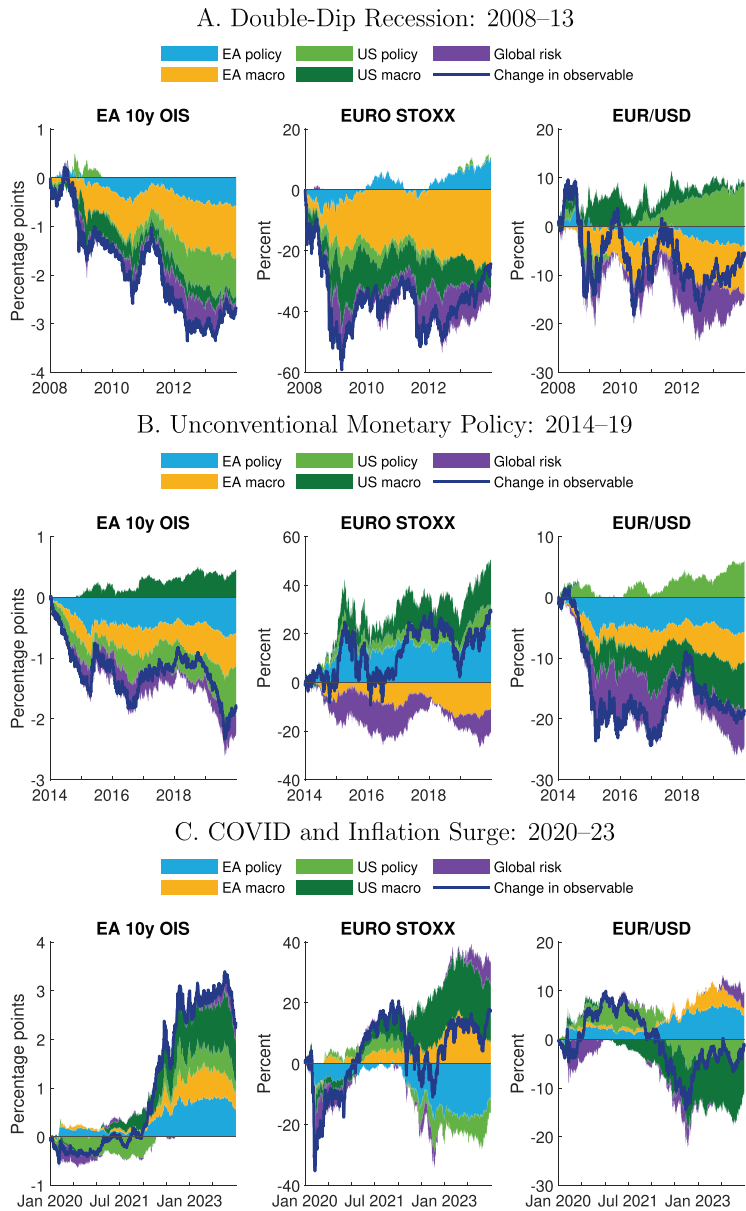
To get a broader overview of the drivers of euro-area asset prices, we present the historical decomposition of euro-area long-term rates, equity prices, and the euro-dollar exchange rate over three subperiods: (i) January 2008–December 2013, dominated by the Global Financial Crisis and the euro-area sovereign debt crisis (“double-dip recession”), (ii) January 2014–December 2019, containing the shift of the ECB’s monetary policy into unconventional domain, and (iii) the COVID-19 pandemic and the inflation surge of 2022.²⁵

²⁵The corresponding results for the U.S. are shown in Appendix A; see Figure A.8.

Double-Dip Recession. During the Global Financial Crisis, the deterioration of the euro-area domestic macro outlook explained about half of the decline in euro-area risk-free rates and caused close to 20 percent fall in euro-area equity prices compared to early 2008; see the top panel in Figure 5. The ECB's monetary policy response (as captured in the euro-area policy factor) lowered long-term yields while supporting domestic equity markets. The euro fell substantially against the U.S. dollar in the first months of the crisis, reflecting safe-haven flows into dollar-denominated assets (as captured by the global risk shock). As the macroeconomic outlook deteriorated on both sides of the Atlantic, macro shocks did not steer the bilateral exchange rate in a specific direction. That changed in the years thereafter, however, when the U.S. economy recovered from the Global Financial Crisis while adverse macro shocks continued to weigh on financial markets in the euro area as the sovereign debt crisis intensified, lowering long-term yields and equity prices further. The euro exchange rate weakened substantially as investors questioned the robustness of the common currency (captured by a combination of euro-area macro and global risk shocks). These factors more than offset upward pressures on the euro from the Fed's unconventional policy measures in 2011–12 that depreciated the U.S. dollar. The persistent drag of adverse macro risk shocks on the outlook for economic activity and inflation in the euro area triggered the ECB to resort to unconventional monetary policy in the months thereafter.

Unconventional Monetary Policy. Over the period 2014–19, the ECB widened its toolkit to include unconventional measures such as negative interest rates, rate forward guidance, and asset purchases, with the objective to bring inflation back to target in the face of persistent deflationary pressures. Model results show that these measures left a significant footprint on euro-area financial markets. This is particularly visible in the contribution of the policy factor, which lowered euro-area long-term yields by about 60 basis points in cumulated terms over 2014–19. This supported domestic equity markets and significantly depreciated the euro exchange rate throughout the review period; see panel B in Figure 5. The deterioration in the euro-area macro outlook added to the downward pressure on long-term yields and the euro exchange rate. By contrast, the improvement in the U.S. macroeconomic outlook pushed up euro-area long-term yields and stock prices, while adding

Figure 5. Historical Decomposition of Euro-Area Asset Prices



Note: Contributions are rebased to zero at the beginning of the review period. For equity prices and the exchange rate they are rescaled to match cumulative growth in the observable variable in percent instead of log-differences. The corresponding decomposition of the U.S. variables can be found in Appendix A ; see Figure A.8.

downward pressures on the euro exchange rate. Although the Fed started to raise policy rates in December 2015, the U.S. policy factor continued to exert downward pressures on U.S. and euro-area yields, indicating a persistently accommodative stance.

COVID-19 Pandemic and the Inflation Surge. The outbreak of the COVID-19 pandemic in early 2020 affected euro-area financial markets differently. The shock mainly affected markets through inflows into safe assets, lowering euro-area long-term yields further and explaining a substantial part of the fall in equity prices in the first months of 2020. Shifts in global risk sentiment were even more impactful in the U.S.—aligning with its recognized status as a safe haven—and accounted for a significant portion of the strengthening of the U.S. dollar in the early part of the pandemic; see panel C in Figure 5. Domestic macro and monetary policy factors did not point to a clear direction initially, which might be consistent with the highly accommodative ECB monetary policy stance before the pandemic hit.²⁶ Central bank communication might have also played a role. Model results suggest that initial ECB communication failed to fully reassure markets, as visible in the large tightening shock at the early March press conference. This was, however, soon followed by a sharp reversal in the accommodative direction after the March 18 decision to launch PEPP.

In the years thereafter, yields and equity prices increased again as the global economy recovered from the pandemic slump. Between 2021 and 2023, the model attributes a sizable part of the recovery in yields and equity prices to improving expectations on the macro outlook on both sides of the Atlantic. As macro dynamics were stronger in the U.S., however, the euro depreciated against the dollar. At the same time, monetary policy started to tighten at an unprecedented pace as inflation hit record high levels due to the recovery in demand and surging energy prices after Russia invaded Ukraine.²⁷

²⁶With policy rates in negative territory and a sizable balance sheet, markets might have anticipated that room for monetary policy to maneuver was limited, at least regarding the ability to further lower the risk-free yield curve.

²⁷This additional tightening impulse—over and above the reaction to an improving macro outlook—might in part reflect the resurgence of adverse supply factors. In theory, the impact of a supply shock on asset prices is ambiguous and depends on how markets expect the central bank to react. If the shock is perceived to be temporary, markets may expect the central bank to look through,

The simultaneous economic rebound in both the euro area and the U.S., accompanied by a synchronous tightening of monetary policies, largely accounted for the sharp rise in yields in the euro area, while intensifying fluctuations in euro-area equities; see panel C in Figure 5. By contrast, because both euro-area and U.S. factors were of similar nature but tended to offset each other in terms of their exchange rate impact, movements in the euro-U.S. dollar pair were relatively more contained.

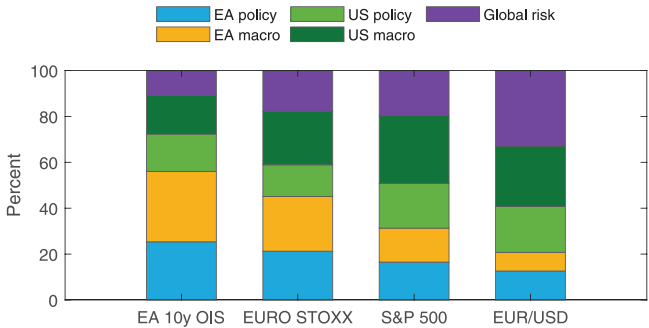
Overall, these events illustrate that financial markets in the euro area are influenced by a complex interplay of shocks that do not occur in isolation and can amplify, or suppress, financial dynamics. This is particularly the case for U.S. spillovers to euro-area markets, as illustrated next.

3.2 Cross-Atlantic Financial Spillovers

Financial market dynamics—particularly in the euro area—are significantly determined by cross-Atlantic spillovers. The forecast error variance decomposition indicates that U.S. shocks are found to explain close to 40 percent of variability in euro-area yields and equity prices over the full sample; see Figure 6. Shocks originating in the euro area, while relatively less important, still exert sizable influence on U.S. financial markets, and account for about 30 percent of the dynamics in U.S. equity prices on average. Interestingly, our finding that spillovers might run both ways is similar to Kearns, Schrimpf, and Xia (2023), who focus on monetary policy shocks and find that Fed spillovers tend to dominate ECB spillovers but that ECB spillovers to U.S. financial conditions remain tangible. Euro-area financial markets are also affected by shifts in global risk sentiment, although these types of shocks play a larger role for U.S. financial markets given the safe-haven status of U.S. dollar-denominated assets. Taken together, spillovers from U.S. shocks and

leaving financial variables unaffected. On the other hand, the types of supply shocks observed during the pandemic recovery—especially the sharp increase in energy prices—are likely to have contributed to a more forceful monetary policy response than during “normal” times, hence leading the central bank to deviate from its standard reaction function and adding upward pressures on yields as shown by the model results.

Figure 6. Forecast Error Variance Decomposition



Note: The figure shows the one-step-ahead forecast error variance decomposition, averaged over all accepted draws from the daily BVAR.

changes in global risk aversion can explain close to half of the average variation in selected asset prices in the euro area.

Interestingly, the extent to which foreign shocks drive euro-area financial markets differs across assets. Foreign forces explain more than half of euro-area equity prices over our sample, while this share is less for euro-area yields, possibly reflecting the role of ECB’s rate forward guidance in shielding euro-area shorter-term rate expectations from foreign influence. For the euro-U.S. dollar exchange rate, euro-area-specific shocks only account for about 20 percent of the variability, with U.S. shocks explaining about double that amount. Variation in global risk sentiment is, however, the dominant driver of the bilateral euro-U.S. dollar pair, which is in line with the literature that underscores the importance of risk premia in driving exchange rates (Engel 2014), as well as the safe-haven role of the U.S. dollar (Georgiadis, Müller, and Schumann 2024).

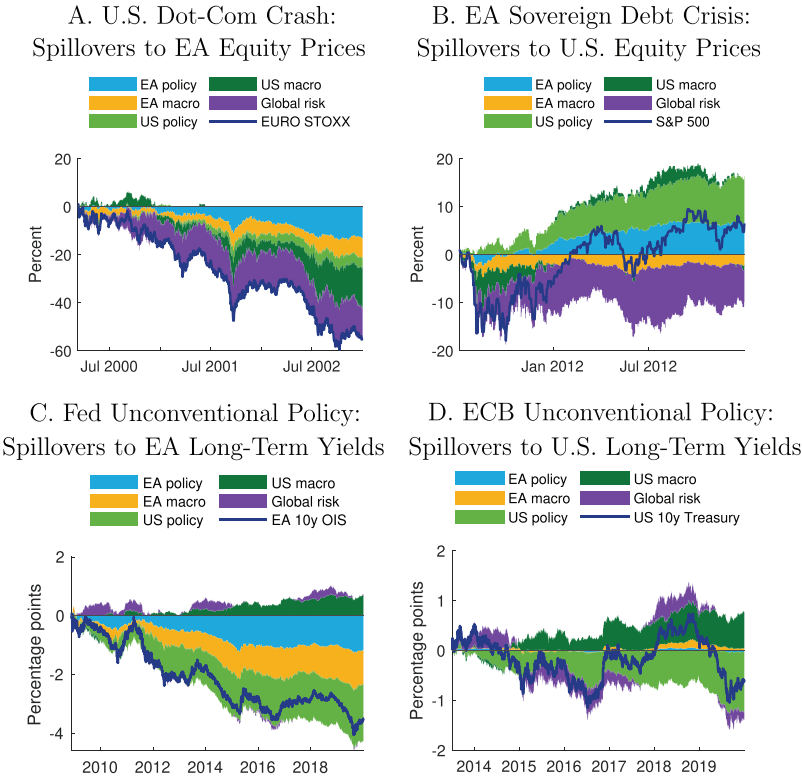
To illustrate the importance of cross-Atlantic financial spillovers, it is useful to focus on periods that brought about major shifts in financial markets. As the extent of spillovers depends on the underlying dominant shock, we study the spillovers during (i) the U.S. dot-com bubble (U.S. macro shock), (ii) the euro-area sovereign debt crisis (euro-area macro shock), (iii) the aftermath of the first round of LSAPs by the Fed (U.S. monetary policy shock), and (iv) the period since the ECB started using unconventional monetary policy (euro-area monetary policy shocks).

The U.S. dot-com bubble period illustrates that U.S.-driven macro shocks can significantly steer euro-area financial markets. After a prolonged period of optimistic macro prospects, the burst of the dot-com bubble in early March 2000 triggered a sharp sell-off in equity markets in the U.S. that largely transmitted to EA equity prices. Adverse U.S. macro shocks caused EA equity prices to decline by about 20 percent over a period of almost two years, which is close to the magnitude of the domestic U.S. equity price reaction. The burst of the bubble also motivated investors to shift their portfolios from equities to bonds—as captured by the global risk shock—which further weighed on euro-area equity prices. The negative U.S. shock came at a time when the ECB was tightening its policy, causing the overall decline in equity prices in the euro area to be much more pronounced than the one observed in the U.S. over that period.

In comparison, the spillovers of euro-area macro shocks to U.S. financial markets are found to be noticeably smaller. Whereas the transmission following the U.S. dot-com bubble across equity markets was close to full, only less than half of the drop in euro-area equity prices caused by adverse macro shocks spilled over to U.S. equity markets following the sovereign debt crisis (see panel B in Figure 7). However, as the debt crisis also triggered flows into safer assets such as bonds, particularly dollar-denominated ones, U.S. equity prices and long-term yields were importantly affected through the global risk channel instead.

Regarding monetary policy spillovers, it is also the case that U.S. monetary policy shocks spill over more significantly to euro-area financial markets than the other way around, which is in line with the literature that underlines the dominant role of U.S. monetary policy in steering the global financial cycle (Miranda-Agrippino and Rey 2020; Ca’Zorzi et al. 2023). After the Fed embarked upon quantitative easing policies in late 2008, accommodative U.S. monetary policy shocks are found to have considerably lowered euro-area long-term yields; see panel C in Figure 7. Overall, as the ECB was loosening its policy stance as well over most of that period, the spillovers from the Fed supported domestic efforts to ease financial conditions. In contrast, the spillovers of the ECB’s unconventional policies since mid-2013—comprising forward guidance, negative short-term rates, and asset purchases—are hardly registered in U.S. long-term yields,

Figure 7. Cross-Atlantic Spillovers in Financial Markets



Note: Panel A shows cumulative changes in EA equity prices from March 10, 2000 to December 31, 2002 and panel B shows cumulative changes in U.S. equity prices from July 7, 2011 to December 31, 2012. Panel C shows cumulative changes in EA 10-year OIS from November 24, 2008 to December 31, 2019, and panel D shows cumulative changes in 10-year U.S. Treasury yields from July 4, 2013 to December 31, 2019. All shock contributions are normalized to zero at the beginning of the review period. The corresponding decomposition of variables not shown here can be found in Appendix A; see Figures A.9–A.12.

as shown in panel D. At that time, rates in the U.S. were partly anchored by rate forward guidance, which might have been a reason why euro-area-to-U.S. spillovers were smaller than those of the Fed's policies to euro-area yields before 2013 when the ECB introduced rate forward guidance as well.

In sum, these findings underscore the necessity of considering external influences when dissecting financial conditions. For the euro area, changes in U.S. monetary policy as well as global risk perceptions play important roles, affecting yields and equity prices, and determining the strength of the euro exchange rate. For U.S. financial markets, by contrast, euro-area-specific dynamics can matter but are typically less relevant than domestic or global risk factors. Overall, looking beyond borders appears key for a proper understanding of financial market dynamics in real time.

4. Transmission to the Macroeconomy: Proxy SVAR

As a final exercise, this section analyzes the response of macroeconomic variables to the shocks extracted in the previous section. In doing so, we draw on the proxy-SVAR literature (see, e.g., Stock and Watson 2012; Mertens and Ravn 2013; Gertler and Karadi 2015) and employ the Bayesian proxy-SVAR algorithm proposed by Caldara and Herbst (2019). The starting point is a VAR at monthly frequency that includes the financial variables contained in the daily model as well as industrial production, inflation, and the unemployment rate for both the euro area and the U.S. Stacking these variables in a vector denoted by Y_t yields the structural form VAR

$$B_0 Y_t = B_+ Y_{t-1} + \varepsilon_t, \quad (7)$$

where B_0 and B_+ contain the structural parameters, and $\varepsilon_t \sim N(0, I)$ is the vector of structural shocks. The reduced-form residuals $u_t \sim N(0, \Sigma)$ are hence given by $u_t = B_0^{-1} \varepsilon_t$, with $\Sigma = (B_0' B_0)^{-1}$ and the reduced-form VAR coefficients by $\bar{B}_+ = B_0^{-1} B_+$, where without loss of generality $\bar{B}_+$ and B_+ collect constants and coefficients on lags.

As with any standard VAR, this model requires additional restrictions for identification due to the many combinations of structural parameters that yield the same reduced-form parameters and hence likelihood function. We leverage this identification challenge to connect high-frequency shocks derived from our daily financial VAR to the set of monthly macroeconomic variables.

In doing so, we draw from the proxy-SVAR literature (see, e.g., Stock and Watson 2012; Mertens and Ravn 2013; Gertler and Karadi

2015) and identify the structural shocks in the monthly VAR one at a time using a single instrument, Z_t , for each economic shock of interest, ε_t^p , and its corresponding row in the inverse impact matrix, B_0^p . In our setup, the natural choice for the instruments are then the structural shocks from our daily BVAR. Formally, we follow Caldara and Herbst (2019) and establish a link between the structural shock, ε_t^p , and the instrument, Z_t , through

$$Z_t = \beta \varepsilon_t^p + \sigma_\nu \nu_t, \quad \text{with } \nu_t \sim N(0, 1) \text{ and } \nu_t \perp \varepsilon_t. \quad (8)$$

Two critical assumptions in the proxy-SVAR literature are directly implied by this mapping:

$$E[Z_t \varepsilon_t^{p'}] = \theta \quad (9)$$

$$E[Z_t \varepsilon_t^{q'}] = 0. \quad (10)$$

Assumption (9) requires that the instrument is correlated with the policy shock of interest, ε_t^p . The relevance of the proxy is directly related to the signal-to-noise ratio β/σ_ν . The higher this ratio, the more information the proxy contains on the structural shock and the closer the time series of the structural shock to the time series of the proxy. Conversely, when $\beta/\sigma_\nu = 0$, then the proxy is driven by noise entirely and does not contain information on ε_t . Weak identification results when β/σ_ν is close to zero. Because the structural shocks extracted from the daily VAR are identified using sign restrictions that embody the economic interpretation of ε_t^p , condition (9) is by construction fulfilled. In addition, prior beliefs about the relationship between the proxy and the structural shock of interest can be directly introduced through the tightness of the prior on σ_ν (Caldara and Herbst 2019). In this exercise, we focus on macro-level responses to our daily financial shocks. Therefore, we favor structural shocks that closely align with the proxy by adopting the high-relevance prior outlined in Caldara and Herbst (2019). This prior suggests that only half of the variation in the proxy can be attributed to measurement error, although our empirical results remain robust even when imposing an uninformative prior.

Assumption (10) requires that the instrument is orthogonal to the other structural shocks, ε_t^q , in the macro VAR. To ensure that this condition continues to hold once we aggregate the daily

structural shocks to monthly frequency, we control for possible correlations during the aggregation process.²⁸

4.1 Proxy SVAR Methodology and Estimation

To estimate the proxy SVAR described above, we employ the algorithm in Caldara and Herbst (2019) throughout, which has key advantages over other algorithms in the literature. Taking the proxy into account, the structural VAR can be augmented such that

$$\tilde{B}_0 \tilde{Y}_t = \tilde{B}_j \tilde{Y}_{t-1} + \tilde{\varepsilon}_t, \quad (11)$$

where $\tilde{Y}_t = [Y_t' Z_t']'$ and $\tilde{\varepsilon}_t = [\varepsilon_t' \nu_t']'$. $\tilde{B}_0$ and $\tilde{B}_j$ contain the SVAR parameters as well as the parameters from proxy equation (8) with

$$\tilde{B}_0 = \begin{bmatrix} B_0 & \mathbf{0} \\ -\frac{\beta}{\sigma_\nu} B_0^p & \frac{1}{\sigma_\nu} \end{bmatrix} \text{ and } \tilde{B}_+ = \begin{bmatrix} B_+ \\ -\frac{\beta}{\sigma_\nu} B_+^p \end{bmatrix}. \quad (12)$$

This gives rise to the likelihood function

$$p(Y_{1:T}, Z_{1:T} | \tilde{B}_0, \tilde{B}_+) = p(Y_{1:T} | \Sigma, \tilde{B}_+) p(Z_{1:T} | Y_{1:T}, B_0, B_+, \beta, \sigma_\nu), \quad (13)$$

which contains not only the likelihood function of the reduced-form VAR but also the likelihood of the proxy given the macroeconomic data and structural parameters. This allows for efficient use of information contained in the proxy, as it is utilized during the estimation of both the structural and reduced-form parameters, while also allowing for the joint modeling of all sources of uncertainty (Caldara and Herbst 2019). In contrast, traditional proxy-SVAR approaches rely on a two-step procedure which does not leverage proxy information during the estimation of the reduced-form VAR.²⁹

²⁸To obtain the monthly instruments, we aggregate the daily structural shock series from the BVAR model over the number of successful draws and over time, which introduces some correlation between the instruments in monthly frequency—even though shocks from each draw are uncorrelated at the daily frequency. To address this issue, we purge the instruments by sequentially regressing these on the other shock series to ensure the shock instruments are uncorrelated.

²⁹The first-stage regression isolates the variation of the reduced-form residual, u_t^p , that can be explained by the proxy. In the second-stage regression, the reduced-form residuals of the other variables in the VAR are regressed on the fitted values, which then allows to compute B_0^p based on the restrictions implied by these regression estimates.

For comprehensive explanations and detailed derivations of the algorithm, readers are directed to Caldara and Herbst (2019).

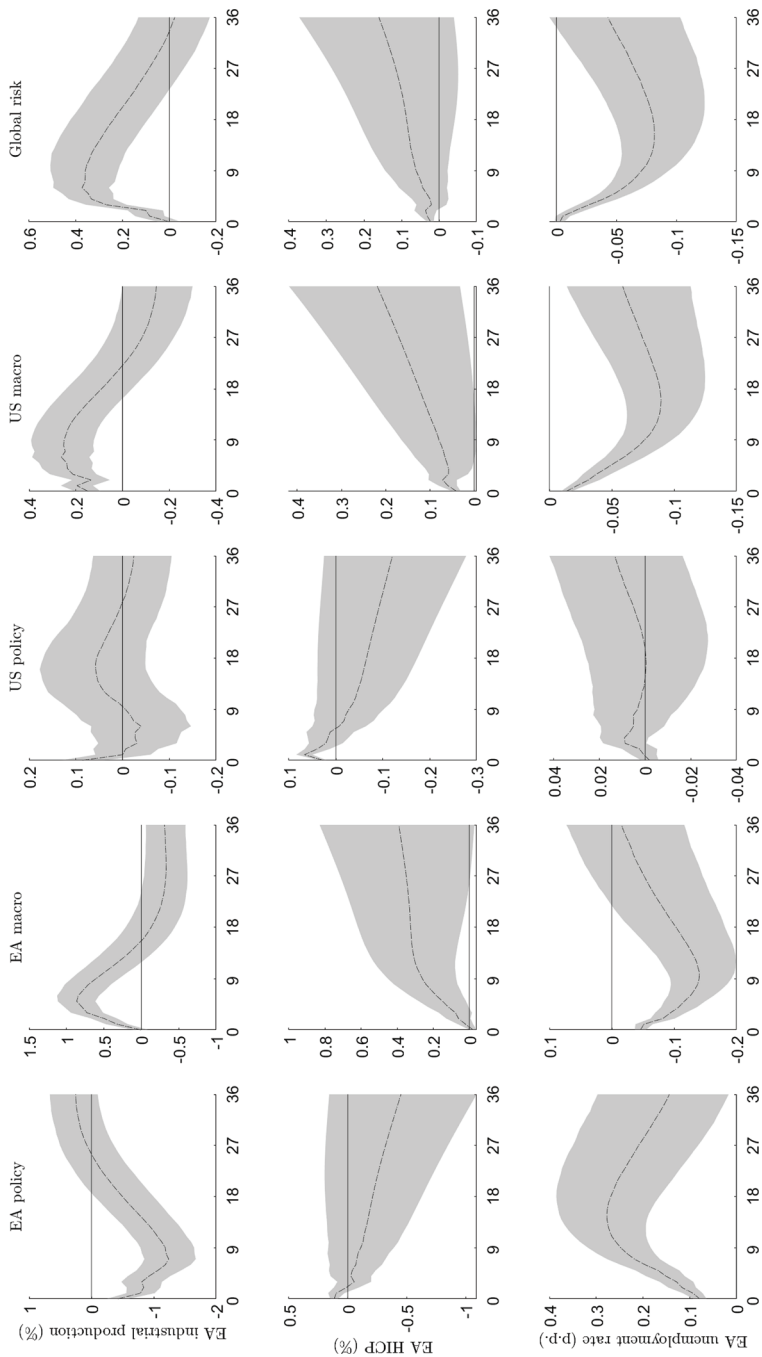
4.2 Empirical Results: Shock Dependence Matters

Figure 8 shows the estimated macroeconomic effects of an impact increase in long-term rates in the euro area by 10 basis points depending on the shock causing higher yields: (i) a euro-area monetary policy shock, (ii) a U.S. monetary policy shock, (iii) a euro-area macro shock, (iv) a U.S. macro shock, or (v) a global risk shock. Here we report results using the euro-area yields to normalize the impact of the shocks, but the macro implications are the same when another endogenous variable is used to normalize, such as the exchange rate.

The results show that, indeed, the implications of higher yields for euro-area industrial production, inflation, and unemployment differ depending on the underlying driver. For example, a monetary policy shock originating within the euro area leads to higher unemployment and lower output, whereas the same shock originating in the U.S. has largely insignificant effects. Likewise, euro-area inflation responds less strongly to a U.S. monetary policy tightening, likely due to the conflicting effect of the euro depreciation. However, in both cases, the responses are generally insignificant and accompanied by wide confidence bounds. In contrast, when long-term euro-area yields rise due to an improving domestic macroeconomic outlook, industrial production and inflation tend to benefit from stronger demand rather than being dampened by higher yields and an appreciating euro. Similarly, when euro-area yields increase in response to positive U.S. macroeconomic news that spills over into euro-area financial markets, domestic industrial production and inflation increase. Finally, when euro-area risk-free rates are higher because of improving global risk sentiment—in the recovery phase from the Global Financial Crisis or the COVID-19 pandemic, for example—higher yields will also be associated with strengthening growth and rising inflationary pressures.

These findings confirm that looking at daily financial market dynamics is useful for policymakers; their comovements convey valuable information on how changes in financial assets will transmit to the real economy and inflation. Depending on the dominant driver, the implications can differ greatly. This underscores the need

Figure 8. PSVAR Impulse Response Functions for Euro-Area Macrovariables



Note: Responses to the policy and macro shocks are normalized to a shock which increases the respective long-term interest rate by 10 basis points on impact. Responses to the global risk shock are normalized to a shock which causes an appreciation of the bilateral euro-dollar exchange rate by 1 percent on impact. The responses in the U.S. and the financial block are shown in Appendix Figures A.13 and A.14, respectively.

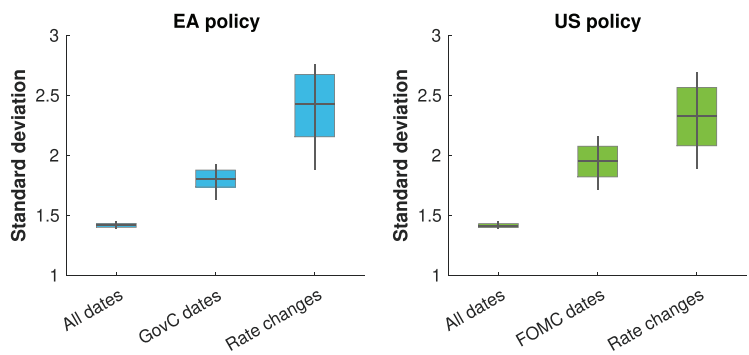
to understand the drivers of financial market dynamics in the first place.

5. Conclusions

Understanding financial market dynamics in the euro area requires looking beyond borders. In this paper, we provide a novel, parsimonious model which jointly estimates key drivers of euro-area financial asset prices. The model explicitly accounts for the unique role of the U.S. in shaping global financial market dynamics and cross-Atlantic spillovers. The results show that euro-area financial markets are driven by a complex interplay of domestic and foreign shocks that can amplify or suppress financial dynamics at home. Spillovers from the U.S. and changes in global risk aversion account for close to half of the average variation in selected asset prices in the euro area. This high degree of spillovers can pose challenges for monetary policymaking and at times counteract domestic efforts to stabilize inflation. Moreover, depending on the driving force, the same change in financial market variables can have different implications for macroeconomic variables. Therefore, a comprehensive understanding of the underlying drivers of financial market dynamics is crucial.

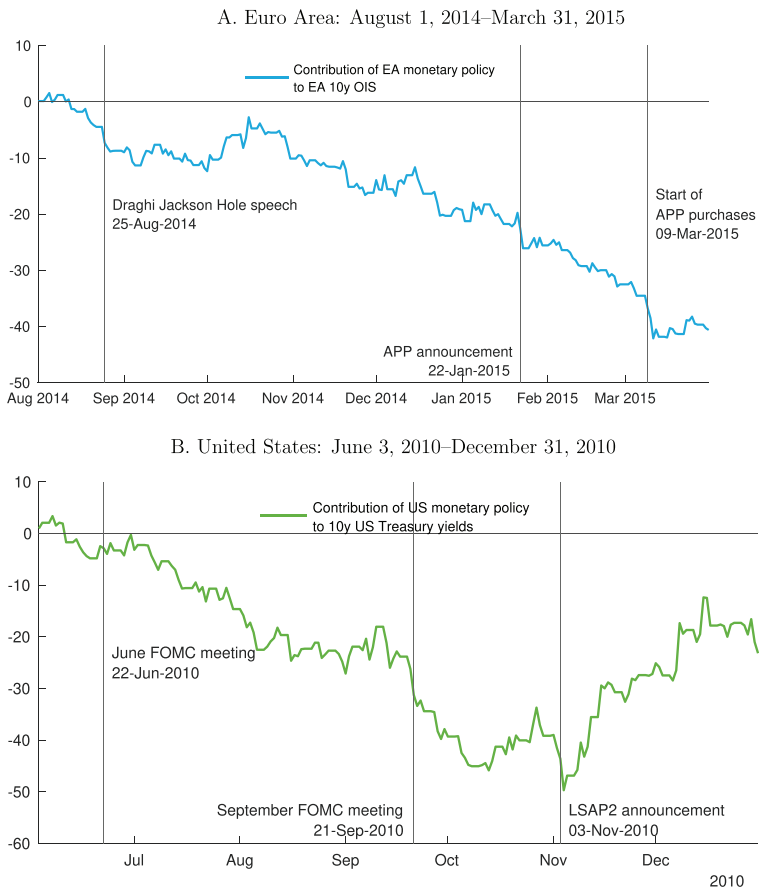
Appendix A. Additional Figures

Figure A.1. Posterior Distribution of Policy Shock Volatilities



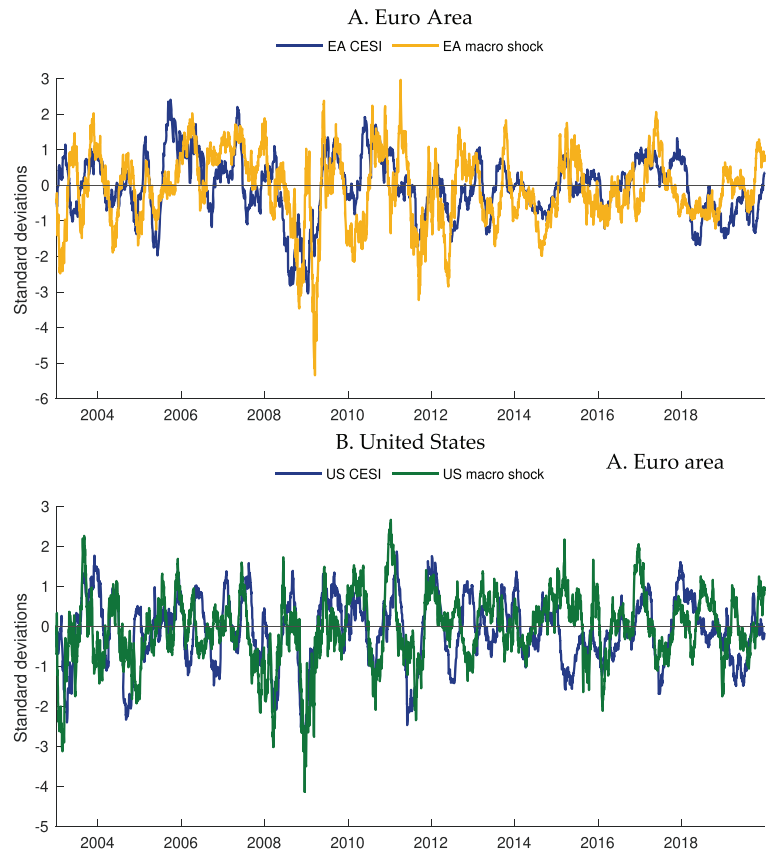
Note: The two panels show the posterior distribution of standard deviations of the two policy shocks summed over (i) all overlapping two-day windows, (ii) days of policy meetings and the day after, and (iii) those policy meetings at which rates were changed. The one-day standard deviation of the shocks in the model is standardized to unity. Therefore, the expected standard deviation of two-day sums is roughly $\sqrt{2} = 1.41$.

Figure A.2. Anticipation of ECB and Fed Asset Purchases



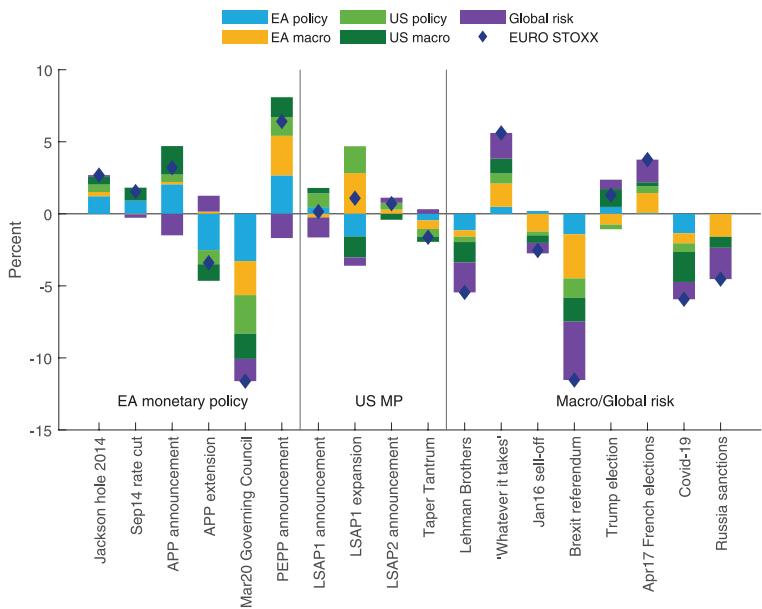
Note: Panel A shows the cumulative contribution of the euro-area monetary policy shock to changes in the euro-area 10-year OIS rate from August 1, 2014 to March 31, 2015. Panel B shows that of the U.S. monetary policy shock to the U.S. 10-year Treasury yield from June 3, 2010 to December 31, 2010.

Figure A.3. Comparison of Estimated Macro Shocks with the Citigroup Economic Surprise Index



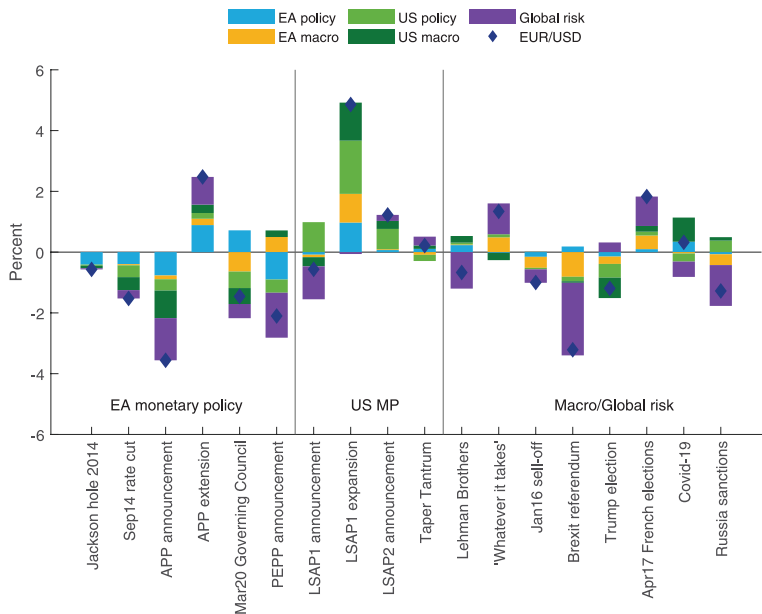
Note: The charts show the standardized rolling three-month sum of the respective posterior mean over all accepted draws from the daily BVAR.

Figure A.4. Drivers of the Euro-Area Equity Prices around Selected Events



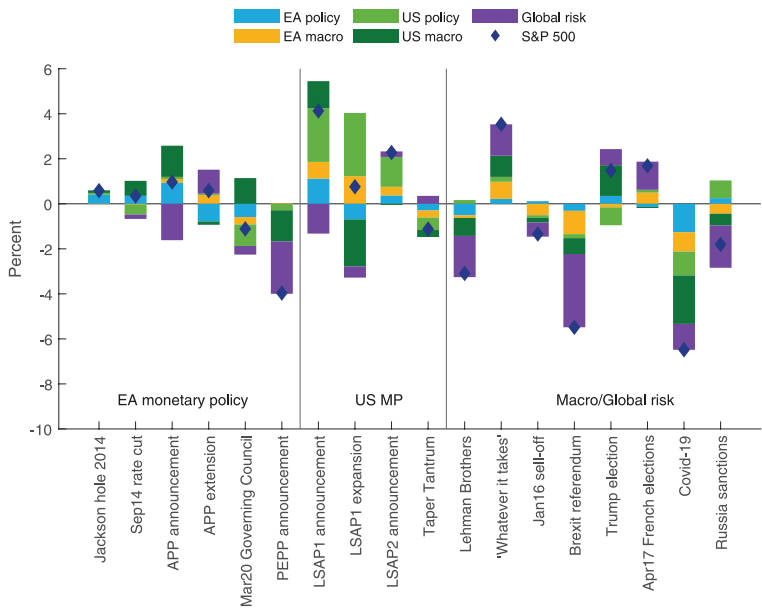
Note: The chart shows the decomposition of the change on the day of the event and the day after.

Figure A.5. Drivers of the Euro-Dollar Exchange Rate around Selected Events



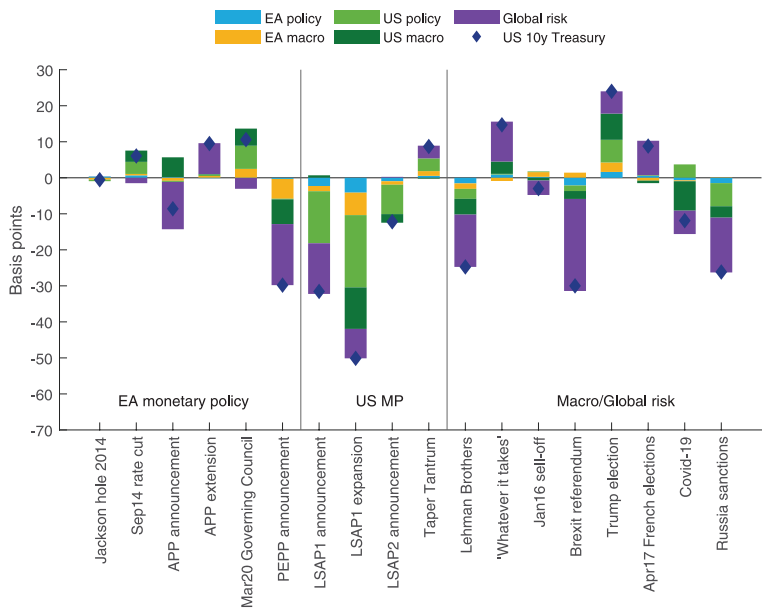
Note: The chart shows the decomposition of the change on the day of the event and the day after.

Figure A.6. Drivers of the U.S. Equity Prices around Selected Events



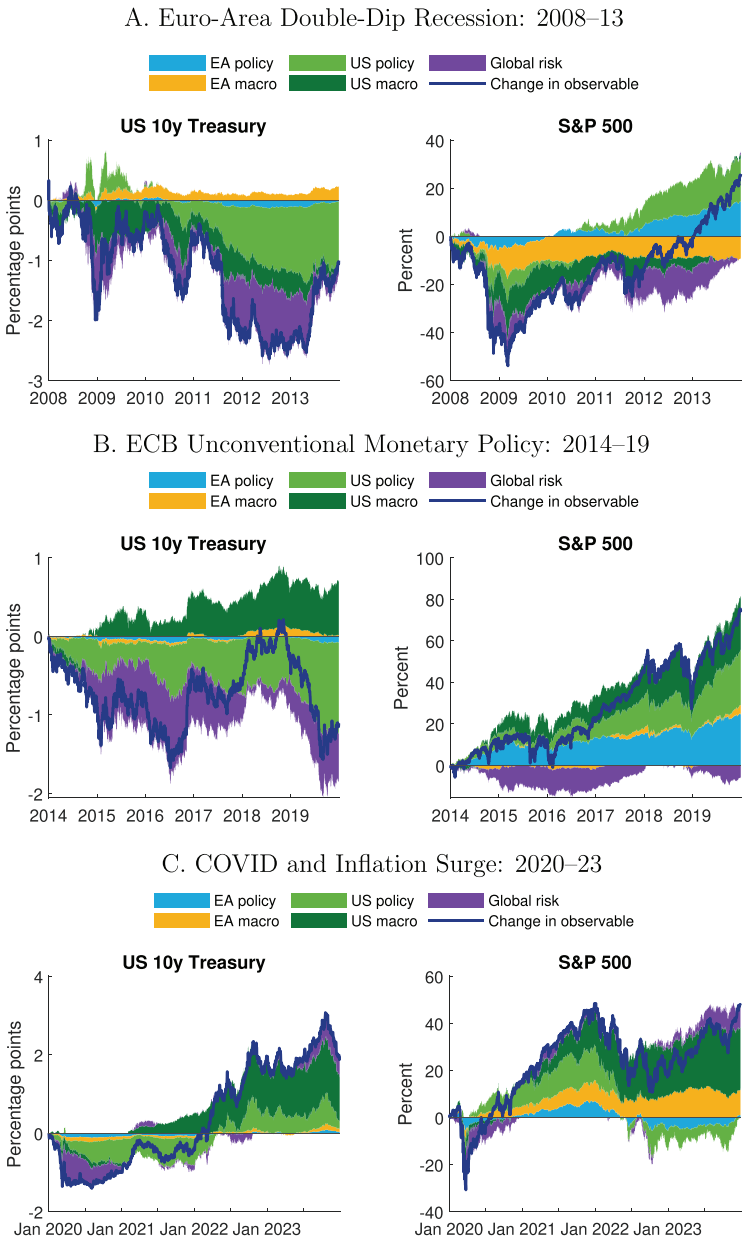
Note: The chart shows the decomposition of the change on the day of the event and the day after.

Figure A.7. Drivers of the U.S. Treasury Yields around Selected Events



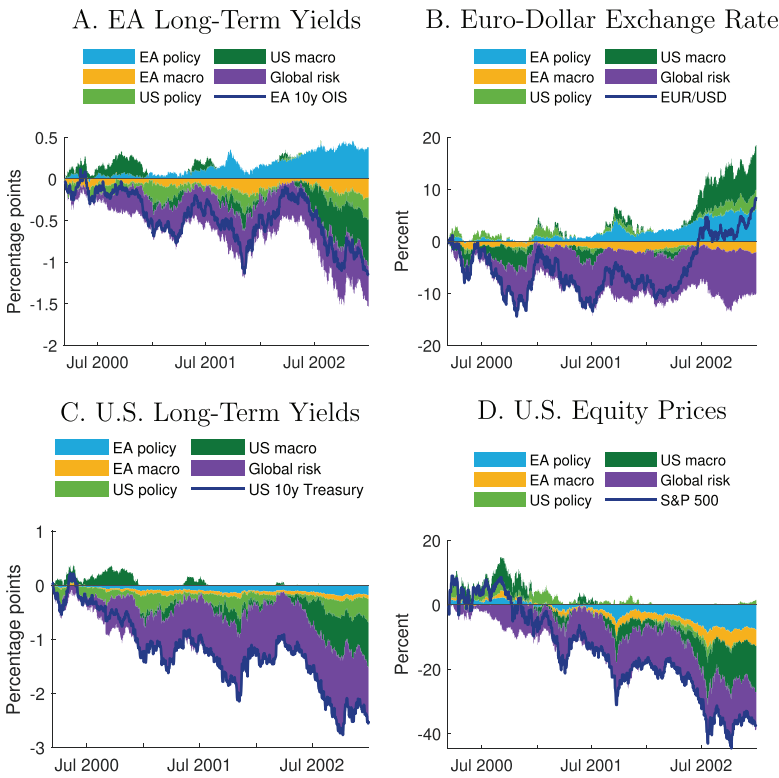
Note: The chart shows the decomposition of the change on the day of the event and the day after.

Figure A.8. Historical Decomposition of U.S. Asset Prices



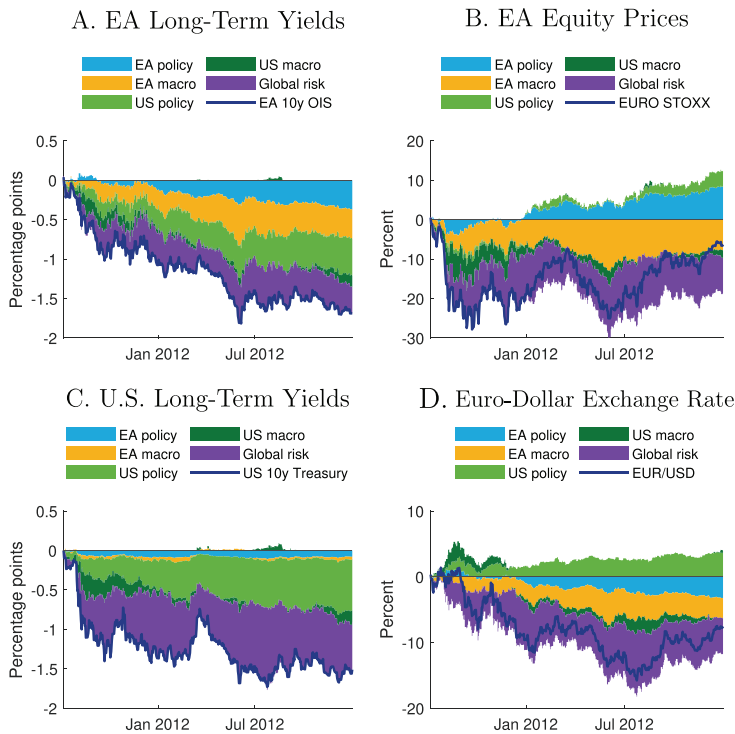
Note: Contributions are rebased to zero at the beginning of the review period. For equity prices and the exchange rate, they are rescaled to match cumulative growth in the observable variable in percent instead of log-differences.

Figure A.9. Cross-Atlantic Spillovers in Financial Markets: U.S. Dot-Com Crash 2000–02



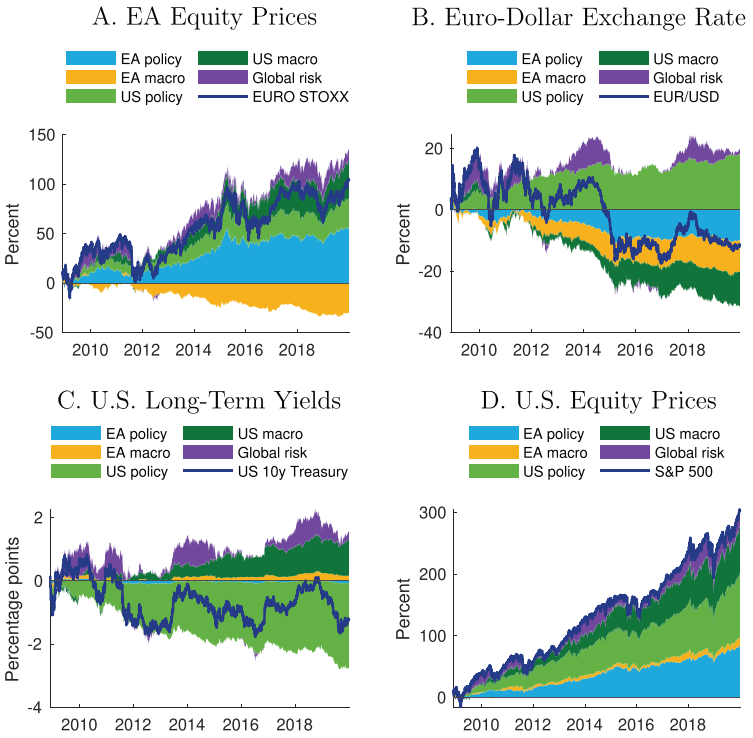
Note: The charts show the average historical decomposition of changes from March 10, 2000 to December 31, 2002 in asset prices not displayed in Figure 7. All shock contributions are normalized to zero at the beginning of the review period.

Figure A.10. Cross-Atlantic Spillovers in Financial Markets: EA Sovereign Debt Crisis 2011–12



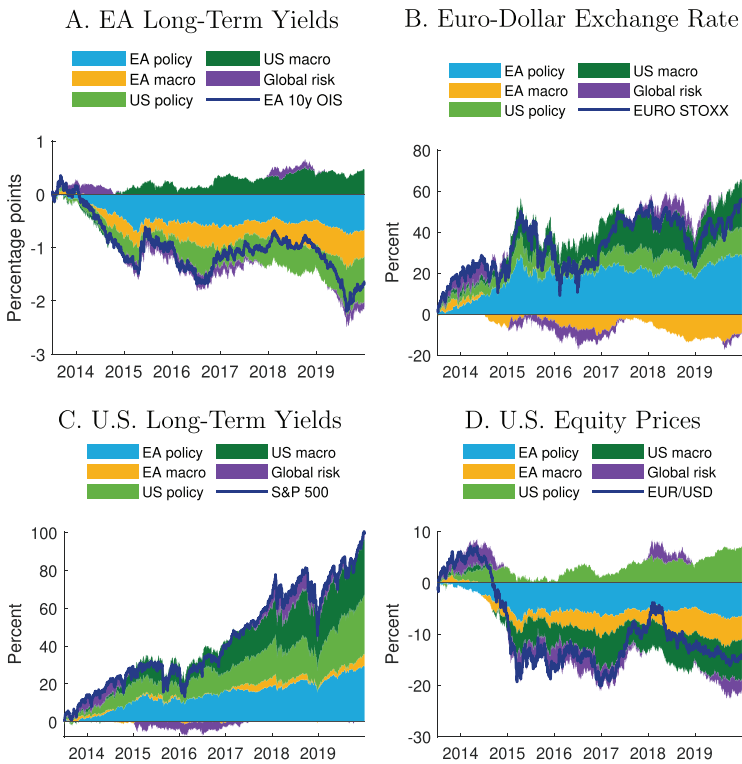
Note: The charts show the average historical decomposition of changes from July 7, 2011 to December 31, 2012 in asset prices not displayed in Figure 7. All shock contributions are normalized to zero at the beginning of the review period.

Figure A.11. Cross-Atlantic Spillovers in Financial Markets: Fed Unconventional Policy 2008–19



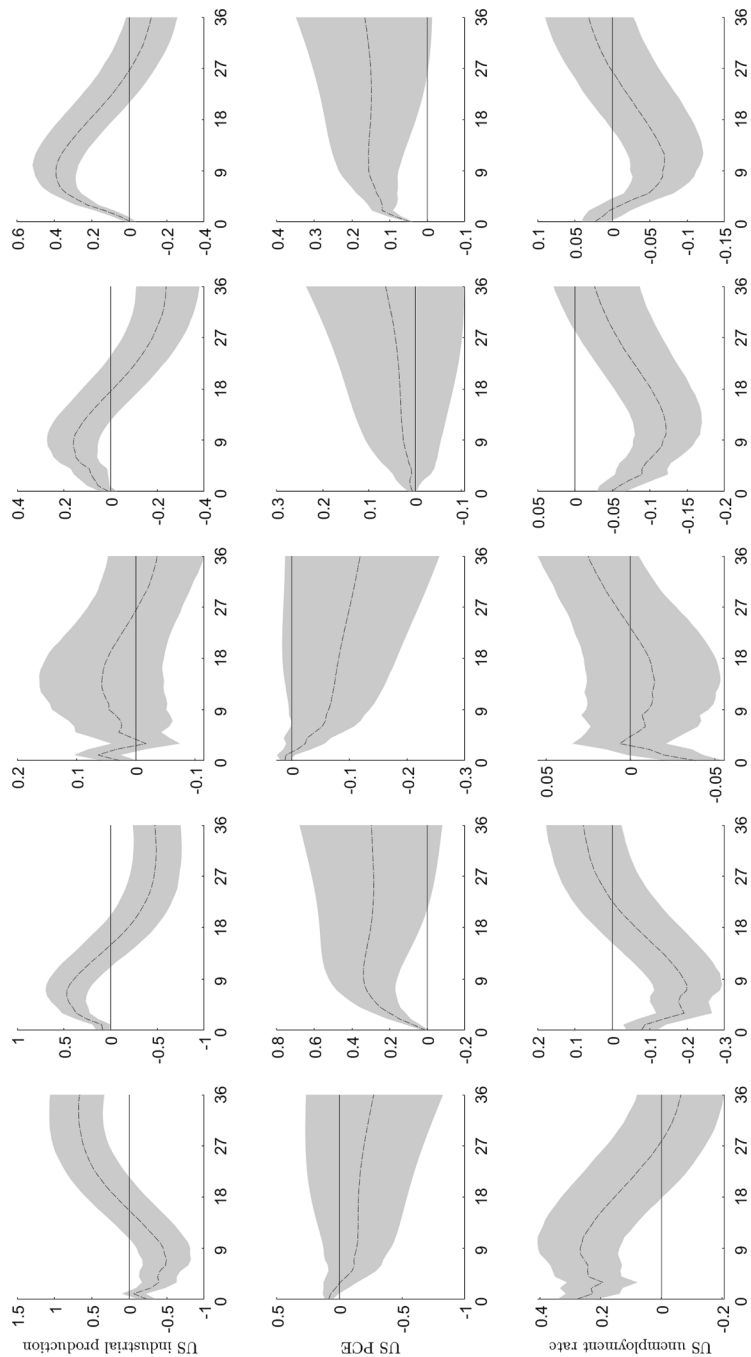
Note: The charts show the average historical decomposition of changes from November 24, 2008 to December 31, 2019 in asset prices not displayed in Figure 7. All shock contributions are normalized to zero at the beginning of the review period.

Figure A.12. Cross-Atlantic Spillovers in Financial Markets: ECB Unconventional Policy 2013–19



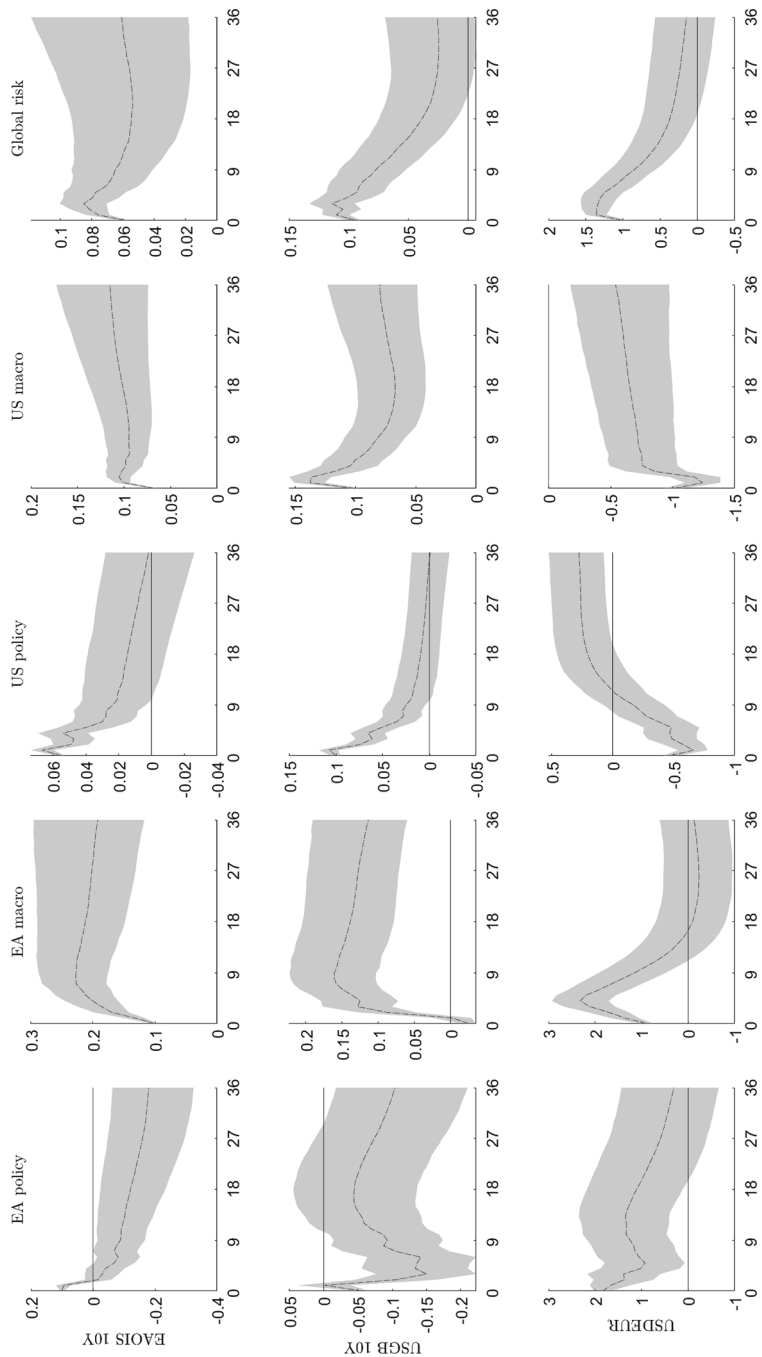
Note: The charts show the average historical decomposition of changes from July 4, 2013 to December 31, 2019 in asset prices not displayed in Figure 7. All shock contributions are normalized to zero at the beginning of the review period.

Figure A.13. PSVAR Impulse Response Functions for U.S. Macrovariables



Note: Responses to the policy and macro shocks are normalized to a shock which increases the respective long-term interest rate by 10 basis points on impact. Responses to the global risk shock are normalized to a shock which causes an appreciation of the bilateral euro-dollar exchange rate by 1 percent on impact.

Figure A.14. PSVAR Impulse Response Functions for Financial Variables



Note: Responses to the policy and macro shocks are normalized to a shock which increases the respective long-term interest rate by 10 basis points on impact. Responses to the global risk shock are normalized to a shock which causes an appreciation of the bilateral euro-dollar exchange rate by 1 percent on impact.

Appendix B. Additional Robustness Exercises

B.1 Choice of Maturity

Table B.1 presents the results of an alternative estimation of the model using the 2-year rate instead of the 10-year rate. The maturity affects the identification of the various shocks, but overall the results remain close with a highly positive correlation across the shocks from the two specifications.

Table B1. Correlation of Shocks
Relative to Benchmark Specification

	EA Policy	EA Macro	U.S. Policy	U.S. Macro	Global Risk
Two-Year	0.79	0.74	0.85	0.95	0.86

B.2 Alternative Risk Indicators

In Table B.2, we test the robustness of the model by (i) replacing the bilateral euro-U.S. dollar exchange rate with the broad U.S. dollar exchange rate and (ii) replacing the euro-area 10-year OIS rate with the euro-area GDP-weighted sovereign yield (also in the interest rate spread). It appears that the estimated global risk shock in both cases is highly correlated with the global risk shock of our benchmark model when making these changes (correlation of 0.7 and 0.99, respectively), which indicates that the results are robust to these alternative risk indicators.

Table B2. Correlation of Shocks
Relative to Benchmark Specification

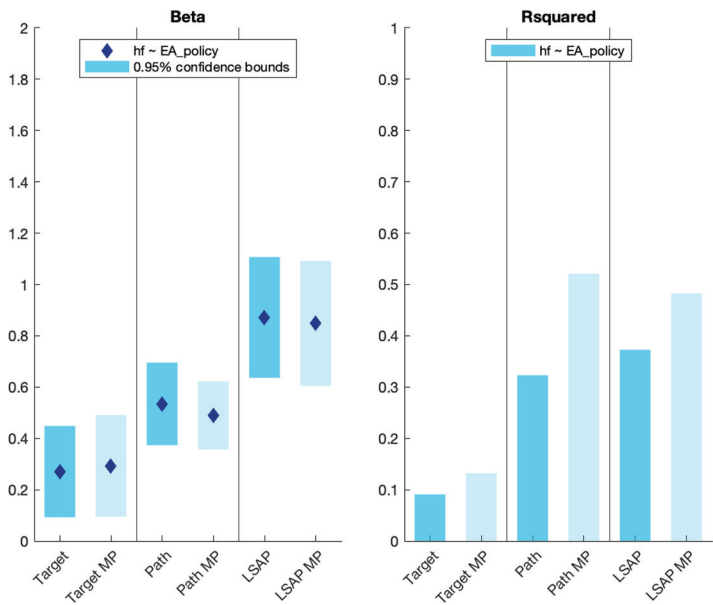
	EA Policy	EA Macro	U.S. Policy	U.S. Macro	Global Risk
EA Sov.	0.75	0.74	0.98	0.96	0.99
U.S. NEER	0.92	0.99	0.91	0.74	0.70

However, it is important to note that using euro-area sovereign yields to identify shocks might inadvertently incorporate euro-area-specific risk factors into broader shock definitions, such as the global risk shock and the euro-area monetary policy shock. The correlation of shocks shown in Table B.2 above suggests, for example, that the identified euro-area monetary policy shocks differ when using sovereign yields. This discrepancy may arise because sovereign yields could misinterpret shifts in euro-area sovereign spreads—such as those observed during the euro-area sovereign debt crisis—as monetary policy shocks, which might be problematic.

B.3 Composition of the Monetary Policy Shocks

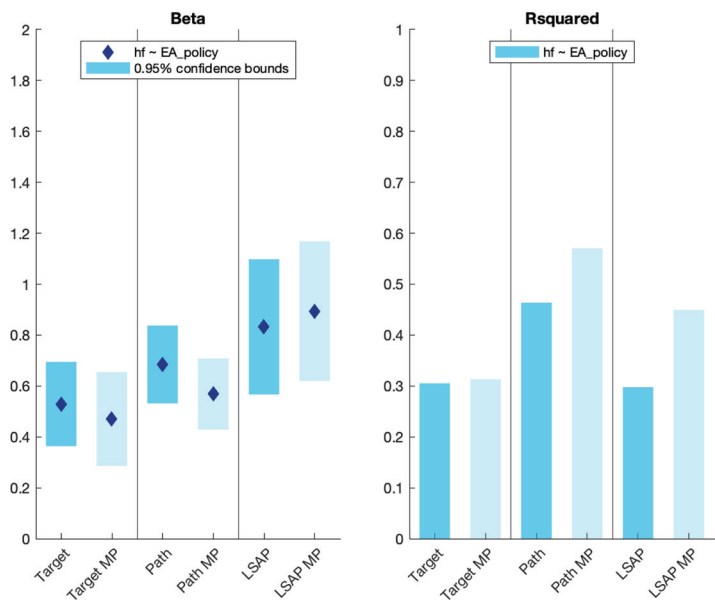
In this section, we present a robustness exercise where we regress the three monetary policy factors from Miranda-Agrippino and Nenova (2022) (target, path, QE) onto our own monetary policy factor. Several results are worth highlighting. First, all three monetary policy factors load positively on our monetary policy factor with a reasonable fit (see Figure B.1). Second, as expected, our monetary policy shock loads more positively on the path and QE dimensions than on the target dimension. And when using the two-year rate instead, the loading on the target factor increases significantly (Figure B.2). Last, using the target, path, and QE shocks purged from the information effects, as has become usual practice in the literature, tends to improve the fit of the regression (see light blue bars compared to dark blue bars). This is reassuring because our identification scheme to separate monetary policy and macro shocks based on the comovement of yields and stock prices bears similarity with the “poor man’s restriction” of Jarociński and Karadi (2020), which is precisely intended to extract monetary policy shocks distinct from information effects.

Figure B.1. Euro Area: Benchmark Specification



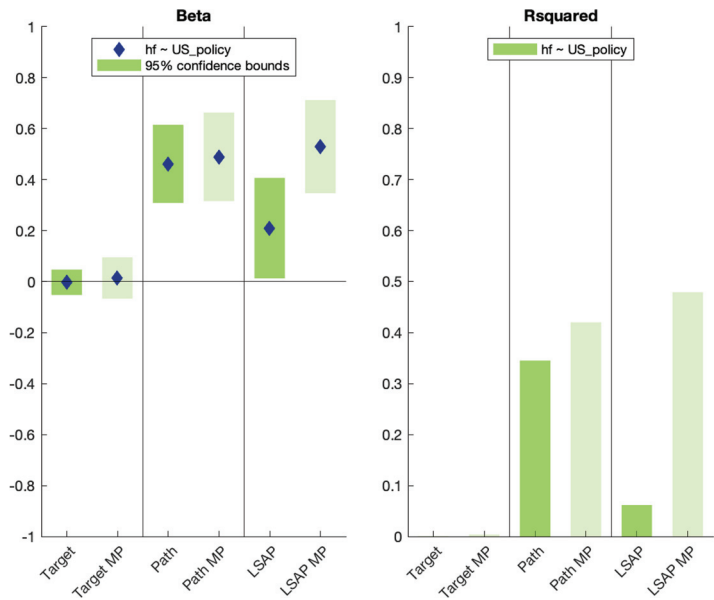
Note: This figure shows coefficients and goodness-of-fit statistics from a regression of the EA monetary policy factors of Miranda-Agrippino and Nenova (2022) onto the mean EA policy shock from the benchmark specification of the daily VAR.

Figure B.2. Euro Area: Alternative Specification



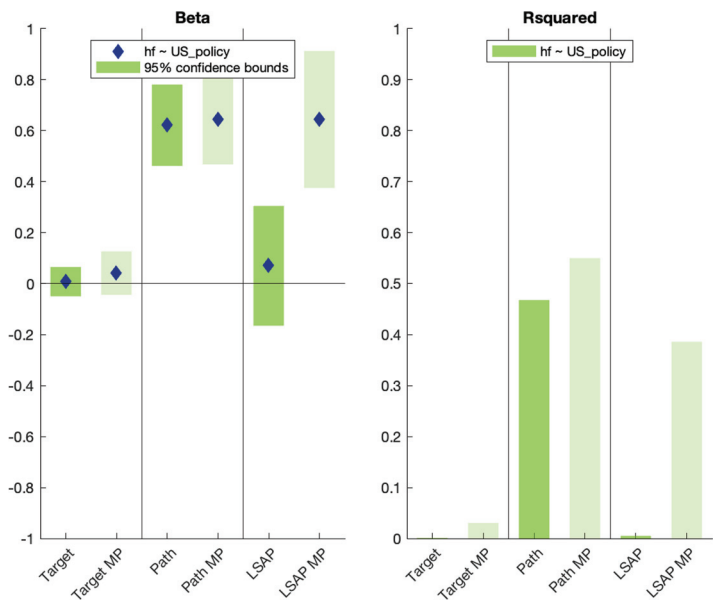
Note: This figure shows coefficients and goodness-of-fit statistics from a regression of the EA monetary policy factors of Miranda-Agrippino and Nenova (2022) onto the mean EA policy shock from an alternative specification using two-year yields in the daily VAR.

Figure B.3. U.S.: Benchmark Specification



Note: This figure shows coefficients and goodness-of-fit statistics from a regression of the U.S. monetary policy factors of Miranda-Agrippino and Nenova (2022) onto the mean U.S. policy shock from the benchmark specification of the daily VAR.

Figure B.4. U.S. Alternative Specification



Note: This figure shows coefficients and goodness-of-fit statistics from a regression of the U.S. monetary policy factors of Miranda-Agrippino and Nenova (2022) onto the mean U.S. policy shock from an alternative specification using two-year yields in the daily VAR.

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