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Working Paper

News shocks spillovers: How the euro area responds to expected Fed policy

MAGKS Joint Discussion Paper Series in Economics, No. 32-2018

Provided in Cooperation with:

Faculty of Business Administration and Economics, University of Marburg

Suggested Citation: Rudel, Paul; Tillmann, Peter (2018) : News shocks spillovers: How the euro area responds to expected Fed policy, MAGKS Joint Discussion Paper Series in Economics, No. 32-2018, Philipps-University Marburg, School of Business and Economics, Marburg

This Version is available at:

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MAGKS



**Joint Discussion Paper
Series in Economics**

by the Universities of
**Aachen · Gießen · Göttingen
Kassel · Marburg · Siegen**

ISSN 1867-3678

No. 32-2018

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This paper can be downloaded from
<http://www.uni-marburg.de/fb02/makro/forschung/magkspapers>

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News Shock Spillovers: How the Euro Area Responds to Expected Fed Policy*

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October 31, 2018

Abstract

Monetary policy increasingly relies on steering market expectations about future policy. This paper identifies a monetary policy news shock based on a VAR model. A monetary news shock is equivalent to new information about the Fed's *future* monetary policy becoming available today. One example of a monetary news shock is a Forward Guidance announcement, where the Fed unveils its prospectively (binding) monetary policy, today. In this paper, we study the spillover effects of news shocks. We estimate the response of the euro area to an expected future policy tightening of the Fed. The U.S. news shock improves sentiment and business cycle expectations in the euro area, which is consistent with the notion of the Fed revealing favorable news by a tightening announcement. We also distinguish the news shock from a conventional U.S. policy surprise and find that they lead to diverging responses in the euro area.

Keywords: News shock, spillovers, forward guidance, monetary policy, interest rates, expectations

JEL classification: E43, E58, F42

*We thank seminar participants at the CEF conference (Milan, 2018), the Western Economic Association International (Vancouver, 2018), and the University of Giessen for helpful comments on an earlier draft.

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1 Introduction

Central banks increasingly aim at steering financial market expectations. Releasing information about the monetary policy stance prevailing in the future, the argument goes, allows market participants to anticipate interest rate changes and thus stabilizes markets. The case for steering market expectations became even stronger when several advanced economies hit the zero lower bound on nominal interest rates. When changes to the short-term interest rate were no longer feasible, central banks engaged in Forward Guidance, that is providing guidance on future monetary conditions.

A surprise change to Forward Guidance, e.g. surprisingly lower interest rates in the future are communicated after a meeting of the Federal Open Market Committee (FOMC), is one example of a monetary news shock. In this case, a news shock reflects information becoming available today about a *future* policy step. In the case of effective Forward Guidance, the Fed maintains a low level of the federal funds rate in the future even though the economy improves. Hence, the Forward Guidance announcement issued today pertains to policy actions in the future. While a surprise change to Forward Guidance is one obvious example of a news shock, there are others. Think of a central bank announcing a path for future asset purchases. The monetary policy action, i.e. the actual purchases, often happens in the future. Yet, the news themselves enter the market today. Importantly, a news shock needs to be distinguished from a standard monetary policy surprise, which pertains to an unexpected change in the contemporary monetary conditions.

A large body of literature documents that standard policy surprises have cross-border effects. A contemporaneous policy tightening of the Fed spills over to advanced as well as emerging market economies, leading to a depreciation of domestic currencies and a tightening of local real and monetary conditions, as reported in i.a. Georgiadis (2016) and Dedola et al. (2017). The contribution of this paper is to study the nature and the magnitude of monetary news shock spillovers.

We focus on news shocks originating from the U.S. and their effects on the euro area. The identification of the U.S. news shock follows Ben Zeev et al. (2017). In particular, we estimate a standard Taylor rule for the Fed, whose residuals reflect unexpected changes in the (shadow) federal funds rate. These residuals are included in a vector autoregression along with other endogenous variables such as interest rates, forecasts, bonds, or other assets. We identify a news shock as the shock which is orthogonal to a contemporaneous, exogenous change in the Taylor rule residual, which at the same is explaining the largest share of (shadow) federal funds rate changes. This identification follows the work of Barsky and Sims (2011) and

Kurmann and Otrok (2013).

In the second step, we extend the analysis and augment the VAR with euro area variables such as asset prices, uncertainty indicators and expectations. Importantly, the additional variables do not interfere with the identification of the news shock. The resulting impulse response functions show the adjustment of euro area variables to an U.S. monetary news shock.

The results suggest that a positive monetary news shock, i.e. an announced about a future increase in interest rates, raises long-term interest rates in the U.S. contemporaneously. This is consistent with the expectations hypothesis whereupon long rates incorporate information about the expected future short-rate interest path. At the same time, the shock boosts U.S. equity prices and leads to a decrease in uncertainty. In the euro area, sentiment indicators improve after the shock while uncertainty about the future falls. At first sight, these results appear to contradict the expected effects of an U.S. tightening. However, we rationalize the findings based on the notion that by announcing a future policy tightening, the Fed reveals private information about its assessment of the current state of the economy. In this regard, Cieslak and Schrimpf (2018) report that market participants predominantly react to news concerning economic growth during central bank press conferences and other communication events. If markets are uncertain about the true state of the cycle, such a policy move should be expansionary today, which is in line with what we find. We use the response of stock prices to separate the negative effect of the expected tightening from the positive effect of revealing new information. If the latter dominates, we should observe an increase in stock prices. This argument is similar to the recent work of Jarocinski and Karadi (2018) and Lakdawala and Schaffer (2018), who study the role of information shocks originating on FOMC meeting days.

The euro area responds consistently: new information about the Fed's assessment of the cyclical position of the U.S. economy is good news for markets and the private sector in the euro area. While the literature on policy spillovers typically focuses on spillovers from a contemporaneous tightening, the shift to news shock spillovers suggest that the Fed's revelation of information is also beneficial for the euro area. Our contribution adds to two strands of the literature. The first is the literature on anticipated monetary policy shocks and their identification. D'Amico and King (2015) use a combination of sign and zero restrictions in a VAR model, an approach different from Barsky and Sims (2011), to identify an anticipated monetary policy shock. The authors refer to the shock as a "shock to expectations", which has even stronger effects on inflation and real economic activity than a conventionally

identified monetary policy surprise. The paper closest to this one is Ben Zeev et al. (2017). We follow their identification of U.S. monetary news shocks. While Ben Zeev et al. (2017) study the domestic (real) effects of news shocks only, this paper extends the analysis and quantifies international news shock spillovers.¹

The second line of research relevant for this paper addresses the Fed's possible information advantage reflected in monetary policy decisions. Nakamura and Steinsson (2018) employ a high-frequency identification of monetary policy shocks based on intra-day meeting data to separate the policy surprise from the revelation of new information. They find upward revisions in growth expectations following a policy tightening, which is consistent with superior information available to the Fed about the current state of the economy, e.g. as famously reported in Romer and Romer (2000). Miranda-Agrippino and Ricco (2017) and Jarocinski and Karadi (2018) use structural VAR models to separate the information inherent in policy decisions. As mentioned before, the latter paper uses the response of stock prices to differentiate between a detrimental surprise tightening and a revelation of favorable information. The remainder of this paper is organized as follows. Section two introduces the empirical model and outlines the identification of U.S. monetary news shocks. Section three extends the analysis to spillover effects on the euro area. Section four provides evidence for the favorable nature of news emerging from an anticipated Fed tightening. Section five presents results from alternative model specifications before section six concludes.

2 Identifying U.S. News Shocks

In this chapter we present the scheme to identify U.S. monetary news shocks. To verify the consequent shocks, we analyze the impulse responses of a group of financial variables that proxy expectations about future Fed policy.

¹De Leo and Cormun (2017) also look at news shock spillovers. However, they only look at effects of U.S. policy on bilateral nominal exchange rates against a broad set of countries. A change in the exchange rate, however, does not need to be the result of a spillover effect. Rather, the bilateral exchange rate moves even in the absence of spillovers. In addition, they use a trivariate VAR model including the federal funds rate, the foreign short-term interest rate and the exchange rate. The VAR does not include information to which the Fed should respond, which raises doubts about the identification.

2.1 Fed Policy: Expectations, Surprises, and News

Assume the Fed's policy rule can be described as

$$i_t = E_{t-1}\{i_t\} + \epsilon_t. \quad (1)$$

That is, the nominal interest rate i_t is a combination of the expected interest rate $E_{t-1}\{i_t\}$ and an unanticipated shock ϵ_t . The aforementioned are formed from a set of available information at time $t - 1$. Shocks comprise both, surprises and news shocks. Formally,

$$\epsilon_t = v_t + \nu_{t-j}, \quad (2)$$

where v_t denotes the monetary policy surprise at time t and ν_{t-j} the news shock received j periods before. Given her mandate and interest rate smoothing behavior, expectations about future monetary policy of the U.S. Federal Reserve are formed via a Taylor rule that contains past realizations of the interest rate, inflation, and the unemployment rate. Thus, we estimate the expected interest rate in the form of

$$E_{t-1}\{i_t\} = \mu + \rho i_{t-1} + \phi_\pi(\pi_{t-1} - 2) + \phi_y(u_{t-1}^{NAIRU} - u_{t-1}), \quad (3)$$

where we take into account an inflation gap ($\pi_{t-1} - 2$) - we allege a two percent inflation target by the Fed - and the deviation of the unemployment rate from the NAIRU ($u_{t-1}^{NAIRU} - u_{t-1}$).² The constant μ captures the real interest rate and inflation.

Unexpected movements in the Fed's policy rate, the monetary policy residual, are then computed as

$$MPR_t = i_t - E_{t-1}\{i_t\}, \quad (4)$$

which in turn can be partitioned into

$$MPR_t = v_t + \nu_{t-j}. \quad (5)$$

Figure 1 plots the short-term (shadow) interest rate³ SIR , its expected value $E(SIR)$, as estimated in equation (3), and the monetary policy residual MPR . One can see

²The Non-Accelerating Inflation Rate of Unemployment is a long-term estimation drawn from the Federal Reserve Bank of St. Louis database. Likewise, this is our source for inflation and unemployment data.

³The short-term interest rate is a composition of the Federal Funds Rate and the Wu and Xia shadow rate.

that the jutting phases are the Dot-Com bubble burst in the early 2000', the "too-low for too-long" phase between 2004 and 2006, as well as the outburst of the financial crisis and the associated beginning of the Great Recession around 2008.

The exogenous movements of the monetary policy residual build the foundation for the upcoming identification of news shocks. As described by equation (5), we assume that these fluctuations are determined by both, contemporaneous surprises as well as news shocks.

2.2 The VAR Model

We build on the the total factor productivity (TFP) news shock identification procedure by Barsky and Sims (2011) who combine a VAR model with a set of restrictions in order to identify the TFP news shock. The basic idea is to extract the single shock that explains most of the forecast error variance (FEV) in TFP, yet has no contemporaneous effect on that variable. Since we are interested in monetary policy news shocks, we seek to identify the shock that explains most of the movements of the monetary policy residual introduced in the previous section, while leaving the monetary policy residual unaffected on impact. Such a constraint would be consistent with an unexpected Forward Guidance announcement: the Fed's future policy steps will drive the monetary policy residual in the future, but not at the time of the announcement. In what follows, we lay the foundation for the subsequent identification of our news shock.

The starting point is an unrestricted VAR model that can be written as

$$\mathbf{y}_t = \mathbf{A}_0 + \mathbf{A}_1\mathbf{y}_{t-1} + \mathbf{A}_2\mathbf{y}_{t-2} + \cdots + \mathbf{A}_p\mathbf{y}_{t-p} + \mathbf{u}_t. \quad (6)$$

Let \mathbf{y}_t be a $m \times 1$ vector of observables of length T . The succeeding analysis of the responses of the U.S. financial market to our identified news shock relies on a variety of data series with focus on indicators of market expectations covering a sample period from January 1999 to November 2015.

The short-term interest rate (SR_t), our primary indicator of monetary policy, is a composition of the effective Federal funds rate and the shadow rate provided by Wu and Xia (2016). We use the shadow rate in order to incorporate the Fed's unconventional policy measures, such as Forward Guidance and asset purchases, implemented after 2008. While we interpret the short-rate as the lower-end of the yield curve, we incorporate the two-year (R_t^{2y}), five-year (R_t^{5y}), and ten-year (R_t^{10y}) bond yields taken from Adrian et al. (2013) to depict the yield curve.

Furthermore, to encompass changes in expectations about the future interest rate

path we withdraw the outlook for the t-bill four quarters ahead from the survey of professional forecasters (SPF_t^{Tbill}). Ordering the monetary policy residual first, the vector of endogenous variables, \mathbf{y}_t is therefore

$$\mathbf{y}'_t = [MPR_t \quad SR_t \quad SPF_t^{Tbill} \quad R_t^{2y} \quad R_t^{5y} \quad R_t^{10y}] .$$

The remainder is standard in the VAR literature. \mathbf{A}_i for $i > 0$ are $m \times m$ matrices of coefficients, \mathbf{A}_0 is the $m \times 1$ vector of constants, and \mathbf{u}_t is the $m \times 1$ vector of reduced-form innovations with variance-covariance matrix Σ . The lag order is denoted by p and set to six following the Schwarz information criterion. The reduced-form moving average representation of this specification can be rewritten as

$$\mathbf{y}_t = \mathbf{B}(\mathbf{L})\mathbf{u}_t , \quad (7)$$

with $\mathbf{B}(\mathbf{L}) = \sum_{i=0}^p \mathbf{B}_i \mathbf{L}^i$ as an $m \times m$ matrix polynomial in the lag operator, L , of moving average coefficients. Assume the existence of a linear mapping between the prediction errors \mathbf{u}_t and the mutually orthogonal shocks $\boldsymbol{\epsilon}_t$, i.e.

$$\mathbf{u}_t = \mathbf{P}\boldsymbol{\epsilon}_t , \quad (8)$$

with variance-covariance matrix $\Sigma = E[\mathbf{u}_t \mathbf{u}'_t]$. From equation (8) we see that the key restriction on the impact matrix \mathbf{P} is that it must satisfy $\mathbf{P}\mathbf{P}' = E[\mathbf{P}\boldsymbol{\epsilon}_t \boldsymbol{\epsilon}'_t \mathbf{P}'] = \Sigma$. However, \mathbf{P} is not unique. Let $\tilde{\mathbf{P}}$ be a valid alternative orthogonalization (e.g. a Cholesky decomposition). Hence, we can write the space of permissible impact matrices as

$$\tilde{\mathbf{P}}\mathbf{Q} = \mathbf{P} \quad (9)$$

where \mathbf{Q} is an orthonormal matrix ($\mathbf{Q}' = \mathbf{Q}^{-1}$ and $\mathbf{Q}\mathbf{Q}' = \mathbf{I}_m$) and therefore $\tilde{\mathbf{P}}\tilde{\mathbf{P}}' = \Sigma$.

2.3 Identification of News Shocks

From equations (7) - (9), we can deduce the h-step ahead forecast error as

$$\mathbf{y}_{t+h} - \hat{\mathbf{y}}_{t+h} = \sum_{\tau=0}^h \mathbf{B}_\tau \tilde{\mathbf{P}}\mathbf{Q}\boldsymbol{\epsilon}_{t+h-\tau} , \quad (10)$$

where \mathbf{B}_τ denotes the matrix of moving average coefficients at horizon τ . The share of the forecast error variance of variable i attributable to a structural shock j at

horizon h is then

$$\Omega_{ij}(h) = \frac{\sum_{\tau=0}^h \mathbf{B}_{i,\tau} \tilde{\mathbf{P}} \boldsymbol{\gamma} \boldsymbol{\gamma}' \tilde{\mathbf{P}}' \mathbf{B}'_{i,\tau}}{\sum_{\tau=0}^h \mathbf{B}_{i,\tau} \boldsymbol{\Sigma} \mathbf{B}'_{i,\tau}}. \quad (11)$$

$\tilde{\mathbf{P}} \boldsymbol{\gamma}$ is the $m \times 1$ impulse vector corresponding to the j th column of a possible orthogonalization while $\mathbf{B}_{i,\tau}$ denotes the i th row of the moving average coefficients matrix at horizon τ .

Owing to the fact that the identification of news shocks requires the identification of a shock orthogonal to innovations in the monetary residual, the optimization problem can be expressed as

$$\boldsymbol{\gamma}^* = \underset{\boldsymbol{\gamma}}{\operatorname{argmax}} \sum_{h=0}^H \Omega_{1,2}(h) = \frac{\sum_{\tau=0}^h \mathbf{B}_{1,\tau} \tilde{\mathbf{P}} \boldsymbol{\gamma} \boldsymbol{\gamma}' \tilde{\mathbf{P}}' \mathbf{B}'_{1,\tau}}{\sum_{\tau=0}^h \mathbf{B}_{1,\tau} \boldsymbol{\Sigma} \mathbf{B}'_{1,\tau}} \quad (12)$$

s.t.

$$\tilde{\mathbf{P}}(1, j) = 0 \quad \forall j > 1 \quad (13)$$

$$\boldsymbol{\gamma}(1, 1) = 0 \quad (14)$$

$$\boldsymbol{\gamma}' \boldsymbol{\gamma} = 1. \quad (15)$$

The first two restrictions ensure that news shocks have no contemporaneous effect on the policy residual, while the third restriction imposes that $\boldsymbol{\gamma}$ is a column vector belonging to an orthonormal matrix. Regarding Uhlig (2004), this approach identifies the news shock as the first principal component of the monetary policy residual orthogonalized vis-à-vis its own innovation.

Since we use monthly data, we set the truncation horizon to $H = 24$ months. Swanson and Williams (2014) and Hanson and Stein (2015), among others, argue that Forward Guidance operates within this window.⁴

The restrictions we impose in order to identify a monetary news shock, zero contemporaneous impact on the short rate but maximum explanatory power in the future, allows us to capture all policies which are announced in period t but become effective later. Forward Guidance is one candidate for a policy captured by this identification. Under Forward Guidance, the Fed announces today to maintain a lower level of the policy rate in the future than it would otherwise do. Hence, to the extent this announcement comes as a surprise, it should leave the contemporaneous short-rate unaffected but drive future policy rates. Nonetheless, Forward Guidance

⁴However, robustness checks show that our results do not hinge on this specification. The results can be obtained upon request.

shocks are not the only candidates that fit to this identification scheme. A Fed announcement of asset purchases commencing in the future should not only leave today's short rate unchanged, but at the same time, drive the future short rate and other forward-looking variables.

Likewise, news shocks are also possible in periods in which monetary policy is not constrained by the effective lower bound on nominal interest rates. Take for example the Fed chair giving a speech hinting at future policy. To the extent this has not been anticipated, the news should drive forward-looking variables instantaneously, yet leave the short-rate unchanged.

In what follows, we use the terms "news shock" and "Forward Guidance" interchangeably. However, we should keep in mind that the nature of the policy captured by these shocks goes above and beyond Forward Guidance in that sense.

2.4 Domestic Effects of U.S. News Shocks

In this section we discuss the results of our estimates for the US economy. Figure (2) shows the median impulse responses to the identified monetary policy news shock along with 68% posterior probability bands. On impact, the news shock does not move the MPR. This reflects the constraint imposed on the VAR system. Beyond period t , however, we find that the Fed tightens monetary policy with the MPR response peaking four months after the shock. Hence, the identified shock corresponds to a policy tightening announced in t becoming effective a few months later.

We find that news about the forthcoming monetary policy tightening affect the entire term structure of interest rates. At the short end, the shadow interest rate increases within a two-year window by up to 37 basis points. That is, the contractionary monetary policy materializes in increasing interest rates. That is to say - the Fed keeps her word. Market participants expect a notable increase in the T-bill rate four quarters in the future. The peak median response, 30 basis points, is only slightly smaller than the corresponding response of the short-term interest rate. Moreover, yields on two-, five-, and ten-year bonds increase by 25, 20 and 13 basis points, respectively. The effect becomes smaller for longer maturities, which is consistent with the findings of Gürkaynak et al. (2005) and Gertler and Karadi (2015). This is consistent with the expected future policy tightening. News shocks do not only predict short term interest rate movements but also successfully flatten the yield curve.

To get further insights into the relevance of our identified news shocks, we depict the share of the forecast error variance explained by news shocks, see figure (3). Over a

24 months horizon, news shocks explain up to 50% of the variance of the monetary residual. In other words, a notable fraction of the movements in the (unanticipated) interest rate path can be explained by news shocks - that is, anticipated Fed policy. News shocks explain up to 80% of the movement of interest rates at the short end of the yield curve. Furthermore, almost the entire variance of T-bill expectations is explained by news shocks. The explanatory power decreases with longer maturities of the underlying securities. Roughly 75% of the variance of two-year bond yields is explained by news shocks within a two-year horizon. Moreover, news shocks explain 50% and 40% of the forecast error variance of five- and ten-year bond yields, respectively. Overall, our results suggest that Forward Guidance is successfully forming expectations concerning future interest rate policy.

Finally, to emphasize the role of Forward Guidance, we compare the influence of both, the monetary news shock identified before and a conventional monetary shock, i.e. a surprise policy tightening effective at time t .⁵ In this context, Gürkaynak et al. (2005) provide a much-noticed work of the distinct impact of current shocks and news shocks.⁶ For the sake of comparability with Gürkaynak et al. (2005), we adjust our analysis twofold: Firstly, in our baseline model we substitute the T-bill outlook with the three-month Eurodollar future to analyze the impact of news shocks on a comparable set of variables.⁷ Unlike Gürkaynak et al. (2005), we include the three-month Eurodollar future instead of the one-year Eurodollar future due to data availability. Secondly, as Gürkaynak et al. (2005), we constrain the current shock to lead to the same peak median impulse response of the three-month Eurodollar future, as prompted by the news shock. To be more precise, we adjust the current shock to match the peak median response of the Eurodollar future to a news shock which we in turn cannot manipulate because the impulse vector is the result of an optimization procedure and restricted to have a length of one in order to belong to an orthonormal matrix. Thus, manipulating the news shock vector would violate the imposed restrictions.

Before we turn to the analysis of the impulse responses to both shocks and juxtapose our findings with Gürkaynak et al. (2005), it is worth noting that the size of our shock compared to Gürkaynak et al. (2005) differs. Thus, a quantitative comparison with the point estimates from Gürkaynak et al. (2005) would be misleading. However,

⁵The conventional monetary shock is identified based on a recursive Cholesky ordering of the variables. According to this ordering, the monetary policy shock is allowed to have a contemporaneous impact on all other variables, while monetary policy responds with at least a lag of one months to innovations in the other variables.

⁶The authors refer to the current shock as *target factor* and the news shock as *path factor*.

⁷Gürkaynak et al. (2005) identify their *path factor* through (unrestricted) principal components analysis given a set of high-frequency data. See also Nakamura and Steinsson (2018).

we can evaluate our findings qualitatively.

Figure (4) reveals the impulse responses to a current monetary policy shock (blue) and a monetary policy news shock (orange). Firstly, by construction, the maximum median responses of the three-month Eurodollar future are akin, though the timing of the maximum response differs across shocks. As the current shock becomes effective immediately, the maximum response of the three-month future is reached earlier. Not surprisingly, monetary surprises have an immediate 35bp impact on the interest rate, while the news shock, by definition, has no direct effect but materializes over time. However, the peak responses do not differ vastly: the short-rate increases by 50bp in response to a current shock and by 40bp to a news shock. Given the width of the probability bands, both responses are statistically indistinguishable.

The responses of the return on the two-year government bond are virtually indistinguishable with a response of 15-20bp on impact and peak responses of 25-30 bp. Gürkaynak et al. (2005) find qualitatively similar responses to the two types of shocks at the short end of the yield curve. They estimate highly significant marginal effects on two-year yields of 48 and 41bp for the *target factor* and the *path factor*, respectively.

Our impulse responses of the five-year bond yield also resemble the findings of Gürkaynak et al. (2005). News shocks have a somewhat greater effect on the five-year yield than monetary surprises. The response to a news shock is 20bp on impact, as opposed to a significantly lower 5bp response to a monetary surprise. Again, qualitatively our results do not differ much from the findings of Gürkaynak et al. (2005). Likewise, the response of the ten-year yield is comparable to the results in the literature.

To sum up, we are able to identify a news shock which leads to plausible responses of U.S. bond yields which are in line with the literature using alternative approaches to the identification of path-shocks. We also see that for longer maturities, the impact responses of the news and the conventional monetary policy shock differ. While the monetary policy shock drives yields on impact, the response to news shocks builds-up gradually. The longer the maturity of the security, the shorter is the amount of time needed for the news shock to materialize relative to the duration of the bond. Hence, the differential impact responses across both types of shocks vanishes for longer maturities.

3 How the Euro Area Responds to Expected Fed Policy

We now turn to the response of market participants in the euro area to an expected monetary tightening of the Federal Reserve. We estimate the spillover effects of news shocks within a VAR system similar to the one used in the previous section. The model includes both, U.S. and euro area variables.

The U.S. variables consist of the monetary policy residual, the (shadow) short-term interest rate, the expected three-month T-bill rate and the two-year yield. The rationale behind this is that Forward Guidance aims at forging the future interest rate path within a two year window as stated by Campbell et al. (2012) and Gertler and Karadi (2015), among others. These four core variables are included throughout the subsequent analyses, while we substitute the five- and ten-year yields with survey data on sentiment and expectations about the future economic stance of the euro area. Since the news shock is restricted to be orthogonal to current short-rate changes and to maximize the share of the forecast error variance of the U.S. monetary policy residual, the inclusion of additional euro area variables is innocuous. To obtain insights into the role of U.S. news shocks for sentiment and expectations in the euro area, we consider aggregate survey responses from both, firms and households. Data on consumer sentiment and the business climate are taken from business and consumer surveys provided by the European Commission. This is also the source of the responses to expectations about prices, unemployment, consumption, and production. The ifo outlook for the eurozone is provided by the CES ifo Group. Finally, the composite index for systemic stress (CISS) stems from the ECB's statistical data warehouse.

To make the responses of the various survey data to an U.S. news shock comparable, we transform them as follows: following the OECD CCI Harmonization Guidelines, we first normalize the data to have a mean of zero and a standard deviation of one. The data is then amplitude adjusted around 100. Finally, we take the natural log and multiply it by 100. As a result, we can interpret the impulse responses as percentage changes following a U.S. news shock.

Figure (5) depicts the impulse responses of the euro area variables to an U.S. monetary news shock. First, regarding the sentiment indicators, U.S. news shocks lead to an improvement in both indicators by a similar magnitude. Consumer sentiment as well as business climate increase by about 0.1 percent due to a news shock. Given a standard deviation of 9.7 (8.9) for the consumer sentiment (business climate) this is a small, yet notable and statistically significant spillover effect. Moreover, news

shocks contribute up to 30% (42%) to the forecast error variance of the indexes (not shown here). In other words, Forward Guidance by the Fed has a sizable effect on private-sector's sentiment in the euro area.

Not only sentiment increases, but also the economic outlook, as depicted by the ifo index which captures expectations about economic activity six months in the future. The ifo index jumps on impact by about 0.05 percent and reaches a maximum response of 0.15 percent after five months. The responses of the ifo index and private-sector sentiment shown before suggest that an expected Fed tightening has expansionary effects in the euro area. This is consistent with the notion that a news shock reveals new information about the current and future business cycle. In the case of a positive news shock, the Fed reveals information about its assessment of a continuing boom in the U.S. economy, which spills-over to the euro area. We will discuss the interpretation in detail below.

The positive tone is furthermore reflected in the response of the STOXX50, an index which comprises stocks of 50 blue-chips from the euro area. The STOXX50 increases by up to 2 percent in response to the news shock. This reaction is in line with the findings in Jarocinski and Karadi (2018).

The indicator for systemic stress in the euro area (CISS) decreases in a hump-shaped manner by up to 0.1 percent. This is consistent with the argument made before: the economic outlook for the euro area improves and, hence, financial stress in the subsequent months falls.⁸

A future Fed tightening, which we will argue below reveals information about a positive assessment of the current economic situation, should reduce economic uncertainty. Since the euro area business cycle expands upon the news originating from the Fed, we should also expect a reduction of macroeconomic uncertainty in the euro area. Indeed, uncertainty concerning inflation and unemployment in the euro area decreases as shown in figure (5).⁹ Uncertainty concerning future economic growth does not respond significantly.

Manufacturing firms in the euro area report increasing production expectations for the months ahead following the U.S. news shock. On the demand side, consumers report their intention to increase major purchases over the next 12 months by 0.1 percent. Additionally, firms report an increase in expected production by 0.1 percent. Both responses are statistically and economically significant.

⁸See Bachmann et al. (2013) for an analysis of the nexus between uncertainty and economic activity and Jarocinski and Karadi (2018) for the accommodative effects of information shocks on financial condition. Bernal et al. (2016) provide an examination of the impact of economic policy uncertainty on risk spillovers within the euro area.

⁹The estimation period is 1999m1 - 2015m6 due to data availability.

Furthermore, the optimistic tone is mirrored by a positive response concerning the labor market. Both, producers and consumers expect an increase in employment (decrease in unemployment) by 0.1 (0.15) percent.

Moreover, figure (5) reveals expected selling prices for the months ahead as stated by manufacturers and the expected price trends over the next 12 months as stated by households. Both groups expect decreasing prices in the first four (eight) months but overall increasing prices within a 24 month horizon. The peak median responses are akin around 0.1 percent. Again, this is consistent with the good news emanating from the U.S., which have a favorable effect on the euro area economy. The additional demand causes price expectations to increase. Jarocinski and Karadi (2018) show for the U.S. and the euro area that shocks that exhibit a concurrent co-movement of interest rates and stock markets lead to a notable increase in prices. Our results indicate that such shocks have considerable spillover effects.

Finally, we want to assess in how far the responses of expectations and sentiment to a news shock differ from their responses to a monetary surprise. Figure (6) plots findings discussed above (solid lines) and the responses to a U.S. monetary surprise (dashed line) along with their respective posterior 68% probability bands.¹⁰ In part, the responses differ remarkably.

We find that monetary surprises, that is, the contemporaneous implementation of a more restrictive monetary policy than expected, leads to a notable deterioration of consumer sentiment and business climate in the euro area. Both indicators decrease by up to 0.25 percent in response to a monetary policy tightening.

Likewise, returns of the STOXX50 decrease immediately by 3 percent. The reason is that (i) real interest rates and risk premia increase and (ii) expected payoffs decline with the deteriorating outlook. Systematic stress is barely affected.

While inflation and unemployment uncertainty decrease, growth uncertainty increases. One reason could be that as central banks call out their interest rate decisions, they enable market participants to adjust their assessment concerning the state of the business cycle. Such that this information decreases uncertainty. On the other hand, an interest hike higher than expected could outpace market participant's expectations concerning future business cycle movements.

The response of expected production within the next 12 months is puzzling. After a surprising increase, expected production eventually decreases, as higher interest rates slow down the economy, increase unemployment and thus decrease demand. As a consequence, firms respond with lower production. The decrease in demand becomes evident given the decrease in planned purchases by households. The de-

¹⁰The monetary surprise is the same as examined in figure (4).

crease in supply and demand, and hence economic slowdown, gets further evident given the responses concerning expected employment and unemployment: firms report that they are expecting to employ less, while households report to be more likely unemployed within the next 12 months.

The responses of expected prices complete the overall picture. While there is no notable change in the responses of expected selling prices, households expect a slowdown in the price trend.

It is worth noting that our findings concerning the role of news shocks and monetary surprises on (expectations about) inflation and economic activity are very similar to Jarocinski and Karadi (2018) threefold. Firstly, our current monetary shock and their monetary surprise lead to similar responses. Secondly, the effect of our news shock is comparable to their *information shock* and thus emphasizes the vital role of central bank communication furthermore. Finally, our results indicate an asymmetric response to monetary surprises and news shocks. We find that expectations tend to respond stronger to an actual monetary tightening than to the accommodating information of news as such.

However, our findings stand out as we find that U.S. monetary news play a remarkable role in the expectation formation in the euro area.

4 Black Clouds and Silver Linings

So far, our results suggest that a monetary news shock, which raises expected interest rates in the U.S., has expansionary effects in the euro area. A contemporaneous Fed tightening, in contrast, has contractionary effects on expectations in the euro area and leads to a fall in uncertainty. These opposing responses between an expected and current policy tightening are consistent with the notion that news shocks convey favorable information about the business cycle, which spill over to the euro area.

In this section, we provide evidence for this interpretation of our results. For that purpose, we jump back to the model for the U.S. economy and study the effect of the news shock on equity prices and volatility. A negative co-movement of anticipated interest rate hikes and stock returns would indicate that market participants expect the present value of future payoffs to decline because (i) real interest rates and risk premia increase and (ii) the expected payoffs decline with the deteriorating outlook caused by the indicated policy tightening. However, news concerning current and future monetary policy are to some extent based on information that are not open to the public. Thus, a concurrent co-movement between expected interest rate tightening and stock return reveals that market participants construe the announced

policy action as a measure to counteract the impact of current and future demand conditions on the economy.

Figure (7) shows that our identified news shock leads to an appreciation of equity prices as reflected by the S&P 500 index.¹¹ That is, expected future corporate earnings increase upon receiving the news about the intentions of the Fed. Hence, the news shock can also be seen as an information shock in the sense of Jarocinski and Karadi (2018) of a *Delphic shock* as in Lakdawala and Schaffer (2018).

Figure (7) further reveals that monetary news entering the market not only increase stock returns, but also decrease volatility. The VIX index of implied volatility falls significantly by about 4%. As new information concerning future monetary policy enters the market, whether through FOMC statements or speeches, uncertainty decreases notably. Since elevated levels of uncertainty are typically seen as depressing economic activity, see Bachmann et al. (2013), the fall in the VIX index is again consistent with the favorable information content of the news shock and the responses of sentiment and expectations in the euro area.

Another way to infer the information content of news shocks is to take a closer look at changes in forecasters expectations concerning future macroeconomic outcomes. If the inherent news carry a positive tone, forecasters should revise their outlook concerning i.a. expected prices and output upward. For this task, we compute the revision of CPI and real GDP (RDGP) expectations as the difference in the forecaster's assertion of the respective variables' value four quarters ahead and the respective statement in the previous forecast vintage.¹² Formally, we compute

$$rev_t = E_t x_{t+4} - E_{t-1} x_{t+4},$$

where x_{t+4} is either CPI or real GDP.

Figure (8) reveals that there is a movement in the same direction between interest rate expectations and projections of real GDP as well as prices in the presence of a news shock. In this sense, our results confirm the findings of Campbell et al. (2017b), whereupon Delphic Forward Guidance reveals information about macroeconomic fundamentals, and are similar to the effects that the *information shock* by Jarocinski and Karadi (2018) to real GDP and inflation generates.

Moreover, the positive change in expected real GDP is consistent with the upward revision of prices. Note that this does not imply that forecasters do not believe that

¹¹We take data of the monthly average of daily S&P500 returns from Yahoo Finance. VIX data stem from FRED St. Louis database.

¹²Data on CPI and real GDP expectations are taken from the survey of professional forecasters (SPF). Data is available only on a quarterly frequency. To get monthly data, we convert them using the technique of *quadratic-match average*.

a future interest rate hike is not effective in fighting inflation. Such revisions only state that forecasters initially underestimated the true state of the business cycle and believe that the Fed is capable to assess the state of the economy more correctly and thus adjust their expectations upward.

5 Robustness

Our analysis crucially depends on the monetary policy residual. We therefore estimate alternative residuals from diverging policy rules closely related to Coibion and Gorodnichenko (2012). Among their variations, the authors incorporate i.a. Greenbook forecasts and a higher lag order of the interest rate. Greenbook forecasts are made publicly available five years after the respective FOMC meeting. This shortens our estimation period notably by roughly two years (23 observations). As a first exercise, we therefore incorporate mean SPF forecasts as a proxy for the respective Greenbook forecast. The estimated policy rule is thus

$$i_t = \mu + \rho_1 i_{t-1} + \rho_2 i_{t-2} + \phi_\pi E_t \pi_{t+2,t+1}^{SPF} + \phi_{dy} E_t dy_t^{SPF} + \epsilon_t^{MPR_1}, \quad (16)$$

for the period 1999m01 to 2015m11. In this equation, μ is a constant, i_t is the shadow rate, and i_{t-1} and i_{t-2} its two lags. $E_t \pi_{t+2,t+1}^{SPF}$ is the average SPF forecast of CPI inflation over $t+1$ and $t+2$, and $E_t dy_t^{SPF}$ is the SPF now-cast for the contemporaneous growth rate of real output.¹³ Finally, $\epsilon_t^{MPR_1}$ is the resulting monetary policy residual.¹⁴

The responses of our baseline U.S. variables to the alternative MPR are depicted in figure (9). Dashed impulse responses refer to our baseline results from section (2.4) while the gray areas relate to the 68% probability masses of responses to the alternative MPR.

In general, the impulse responses are almost indistinguishable. The only notable difference is the response of the monetary policy residual itself. The forward-looking policy rule results in a lower maximum mean response of about 3 basis points. Furthermore, the response of the alternative MPR is less persistent which is likely due to the additional interest rate lag in the policy rule. Nonetheless, the mean responses of the interest rate as well as the forward-looking variables from the baseline model

¹³The now-cast for the contemporaneous growth rate refers to the current quarter of data collection. As before, we transform the data to a monthly frequency. In contrast to Coibion and Gorodnichenko (2012), we do not incorporate the now-cast of the contemporaneous output gap due to data availability.

¹⁴We also estimate a specification where we incorporate an inflation target of two percent in the forecast, i.e. $E_t \pi_{t+2,t+1}^{SPF} - 2$. Our results remain unchanged. Results are provided upon request.

lie within the 68% probability mass of the responses to the alternative MPR and are thus statistically indistinguishable.

One potential caveat of (16) could be the inferiority of SPF forecasts to Greenbook forecasts, as documented by i.a. Romer and Romer (2000). We therefore re-estimate equation (16) using the respective Greenbook forecasts. Thus, we estimate

$$i_t = \mu + \rho_1 i_{t-1} + \rho_2 i_{t-2} + \phi_\pi E_t \pi_{t+2,t+1}^{GB,CPI} + \phi_{dy} E_t dy_t^{GB} + \epsilon_t^{MPR_2}, \quad (17)$$

for the period 1999m01 to 2012m12. Again, i_t is the shadow rate with its lags i_{t-1} and i_{t-2} . $E_t \pi_{t+2,t+1}^{GB,CPI}$ is the average Greenbook forecast of CPI inflation over $t+1$ and $t+2$, and $E_t dy_t^{GB}$ is the Greenbook now-cast for the contemporaneous growth rate of real output. It is worth mentioning that we do not have to transform the data from a quarterly to monthly frequency because FOMC meetings usually take place eight times a year which provides us 8/12 observations a year on a monthly basis. We calculate the missing four observations as the average between the prior and subsequent forecast.¹⁵

Figure (10) reveals that our results are robust to this alternative specification. All impulse responses from the baseline model (dashed lines) except the MPR are located within the 68% probability mass (gray area). That is, they are statistically not distinguishable.

One could argue that core personal consumption expenditures (PCE) inflation is the more appropriate inflation indicator to describe policy decisions by the Fed.¹⁶ To evade potential misspecification, we therefore estimate (17) using average Greenbook forecast of core PCE inflation over $t+1$ and $t+2$ instead of CPI inflation. That is, we estimate

$$i_t = \mu + \rho_1 i_{t-1} + \rho_2 i_{t-2} + \phi_\pi E_t \pi_{t+2,t+1}^{GB,PCE} + \phi_{dy} E_t dy_t^{GB} + \epsilon_t^{MPR_3}, \quad (18)$$

where $E_t \pi_{t+2,t+1}^{GB,PCE}$ is the average Greenbook forecast of PCE core inflation over $t+1$ and $t+2$.

The results are shown in figure (11). Yet again, our baseline model is robust to this alternative as the median responses of our baseline model (dashed line) lie within the probability mass of the responses of the alternative specification.

Especially in the course of the 2007-08 financial crises and the subsequent recession

¹⁵For example, the January 1999 ($t = 99, 1$) now-cast for dy is $E_{99,1} dy_{99,1} = 2.7$. The respective now-cast for March 1999 ($t = 99, 3$) is $E_{99,3} dy_{99,3} = 3.4$. Thus, we calculate the missing now-cast for February 1999 ($t = 99, 2$) as $E_{99,2} dy_{99,2} = (E_{99,1} dy_{99,1} + E_{99,3} dy_{99,3})/2$. We do the same for CPI inflations forecasts and core PCE inflation forecasts.

¹⁶For example, during the FOMC meeting in December 1999, Chairman Greenspan provided a clear statement as to why to prefer the PCE price index to the CPI.

with interest rates at the zero lower bound, central bank communication and expectation formation became increasingly important. At the same time, the Fed faced a trade-off between flexibility in and commitment to its designated monetary policy. To avoid financial stress and uncertainty, the Fed might therefore take market expectations into account. To control for that possibility, we estimate

$$\begin{aligned} i_t = & \mu + \rho_1 i_{t-1} + \rho_2 i_{t-2} + \phi_\pi E_t \pi_{t+2,t+1}^{GB,CPI} + \phi_{dy} E_t dy_t^{GB} \\ & + \phi_\pi^d (E_t \pi_{t+2,t+1}^{GB,CPI} - E_t \pi_{t+2,t+1}^{SPF,CPI}) + \phi_{dy}^d (E_t dy_t^{GB} - E_t dy_t^{SPF}) + \epsilon_t^{MPR_4}. \end{aligned} \quad (19)$$

$E_t \pi_{t+2,t+1}^{GB,CPI} - E_t \pi_{t+2,t+1}^{SPF,CPI}$ captures discord in expectations concerning CPI inflation between the Fed and the market. $E_t dy_t^{GB} - E_t dy_t^{SPF}$ is the divergence in expectations concerning real output growth. The results are depicted in figure (12). Once more, our baseline results are robust to this alternative specification.

Lastly, we want to assure that the responses of the euro area are robust to alternative specifications. We therefore take the MPR as in equation (19) and look at the impulse responses of our euro area variables, which are depicted in figure (13). In principle, our results are qualitatively and quantitatively robust to this alternative specification. The only notable differences are in the initial responses of the consumer sentiment, business climate, ifo outlook, expected production, and expected employment. In all cases, the response to anticipated monetary tightening is "more pessimistic" in the sense that the perceived economic stance decreases. Consumer sentiment, business climate, expected production, and expected employment decrease initially statistically stronger than in the baseline model. This is evident because the respective grey areas lie beyond the dashed baseline impulse responses.

6 Conclusions

This paper quantifies spillovers of U.S. monetary news shocks to the euro area. News shocks originate from anticipated Fed policy actions such as credible Forward Guidance. We identified news shocks based on a VAR approach and estimate the responses of euro area variables to an anticipated Fed tightening.

Our main results are twofold. First, we find significant spillovers. Variables such as asset prices, expectations, and sentiment indicators in the euro area respond to an anticipated Fed policy. Hence, our analysis underlines the relevance of policy spillovers among advanced economies. Our second finding pertains to the sign of these spillover effects. An expected Fed tightening is shown to be expansionary for the euro area, rather than contractionary. Confidence indicators improve and

uncertainty falls after the anticipated tightening. Likewise, stock prices appreciate in the euro area.

This pattern is difficult to reconcile with economic intuition. However, these findings are in line with the notion that an announcement issued today about a future tightening reveals private information the Fed might have about the state of the U.S. economy. This favorable news triggers an upward revision of sentiment indicators in the euro area. We underline this interpretation by showing that the news shock, although raising expected future interest rates, also raises equity prices in the U.S. and lowers equity market volatility. Hence, it's the new information about a stronger than expected economic expansion that spills over to the euro area. This logic also implies that an anticipated policy *easing* in the U.S., such as the one implemented at the zero lower bound, had *contractionary* effects on the euro area as the policy step reveals worse than expected fundamentals.

Our results shed new light on the discussion of policy spillovers. Traditionally, the literature studies spillovers with an opposite sign: a policy tightening in the U.S. reduces euro area exports, which has contractionary effects on the economy. Tighter monetary conditions in the U.S., the argument goes, also raise global interest rates and lead to capital outflows back into the U.S. dollar, which is contractionary abroad. Most policy prescriptions to deal with this kind of spillover effects are based on this notion of policy spillovers. For example, small open economies often ease monetary conditions as a result of the Fed tightening in order to reduce the fallout from the contraction in the U.S. economy. Hence, spillovers in this sense lead to a divergence of policy stances between the U.S. and other economies.

The notion of spillovers highlighted in this paper, however, suggests that an anticipated U.S. tightening is expansionary abroad, such that the monetary policy response in the euro area is also a policy tightening. Thus, the spillovers shown here lead to a convergence of policy stances. This reduces the scope for international policy coordination.

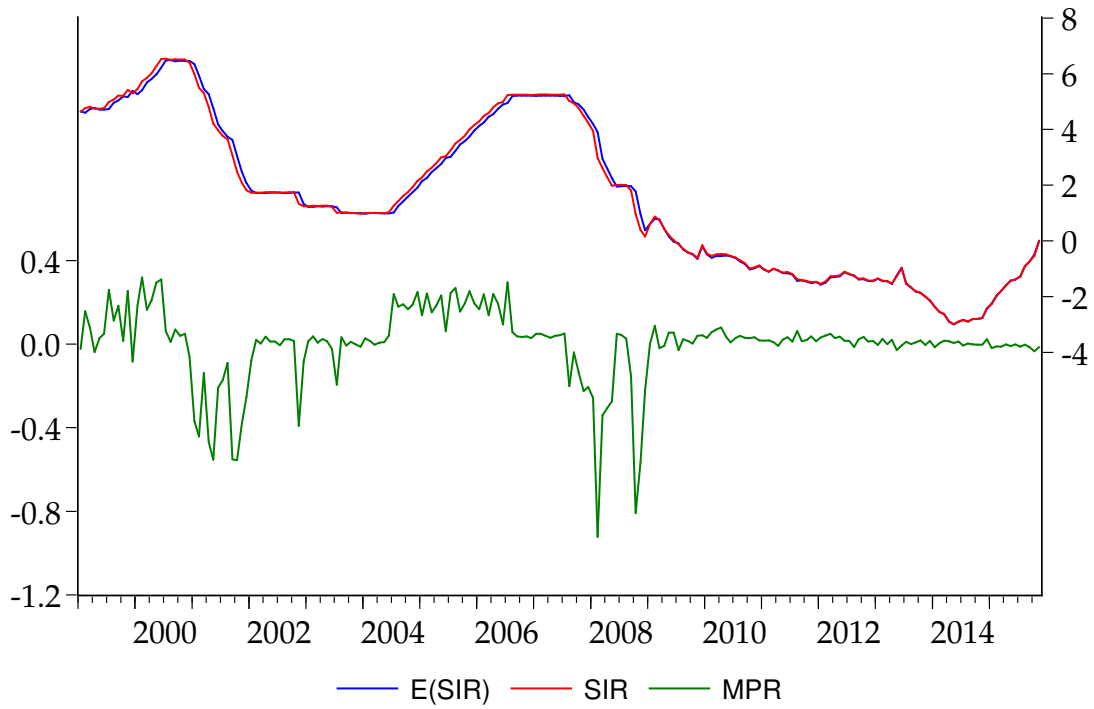
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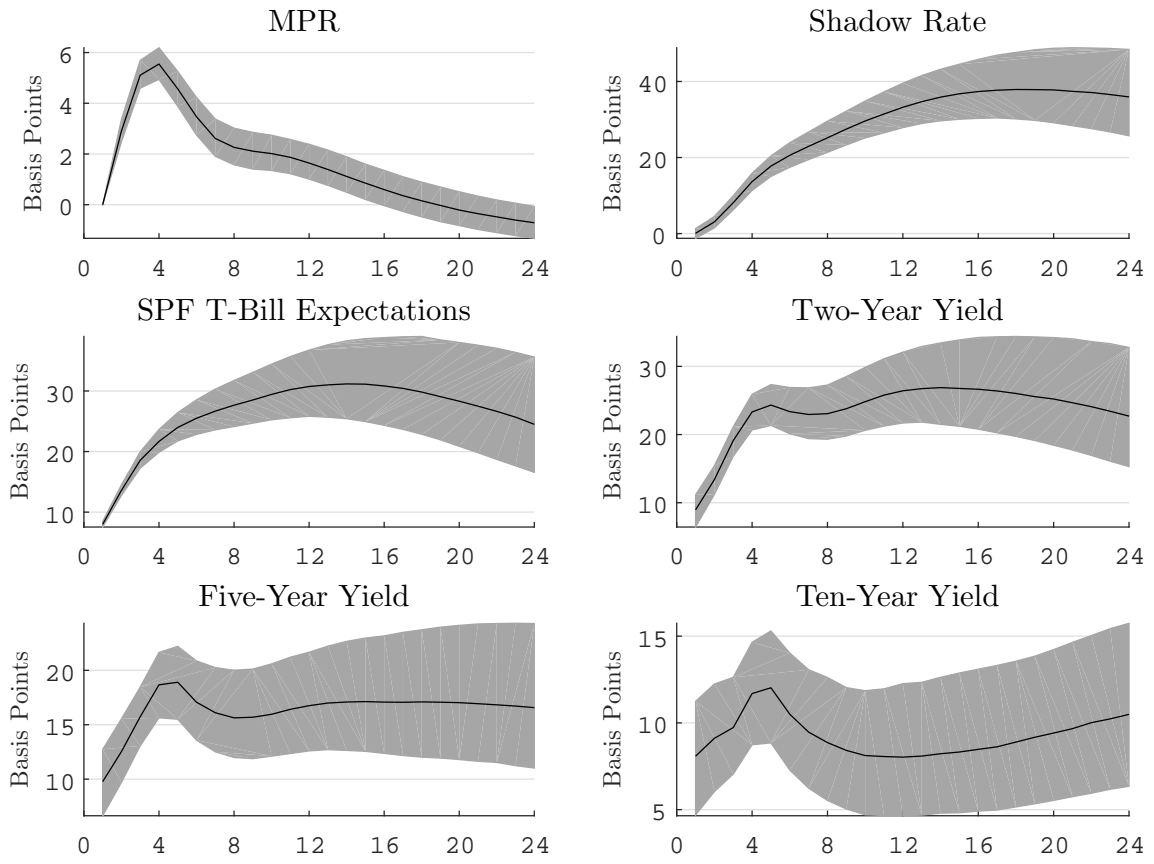
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Figure 1: Monetary Policy Residual



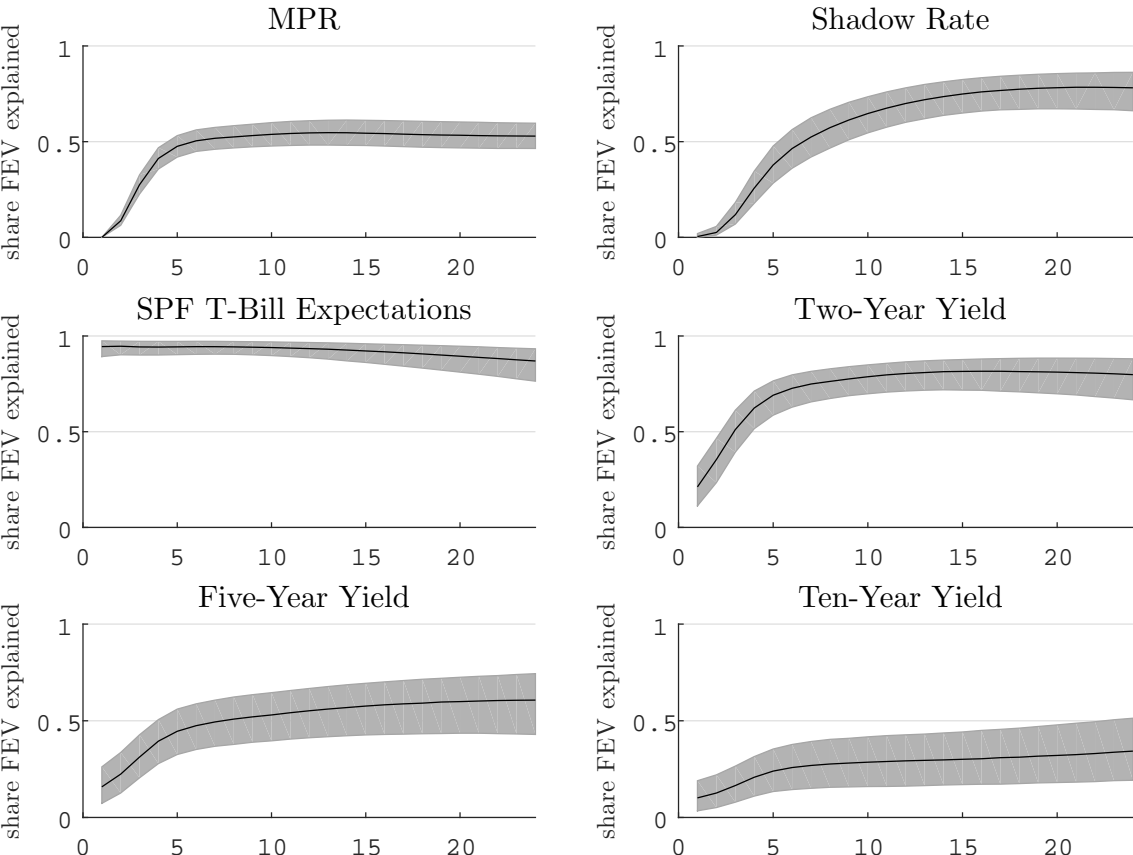
Note: Actual (red) and fitted (blue) shadow interest rate on right y-axis, their deviation, the monetary policy residual, on left y-axis.

Figure 2: Domestic Responses to U.S. Monetary Policy News Shock



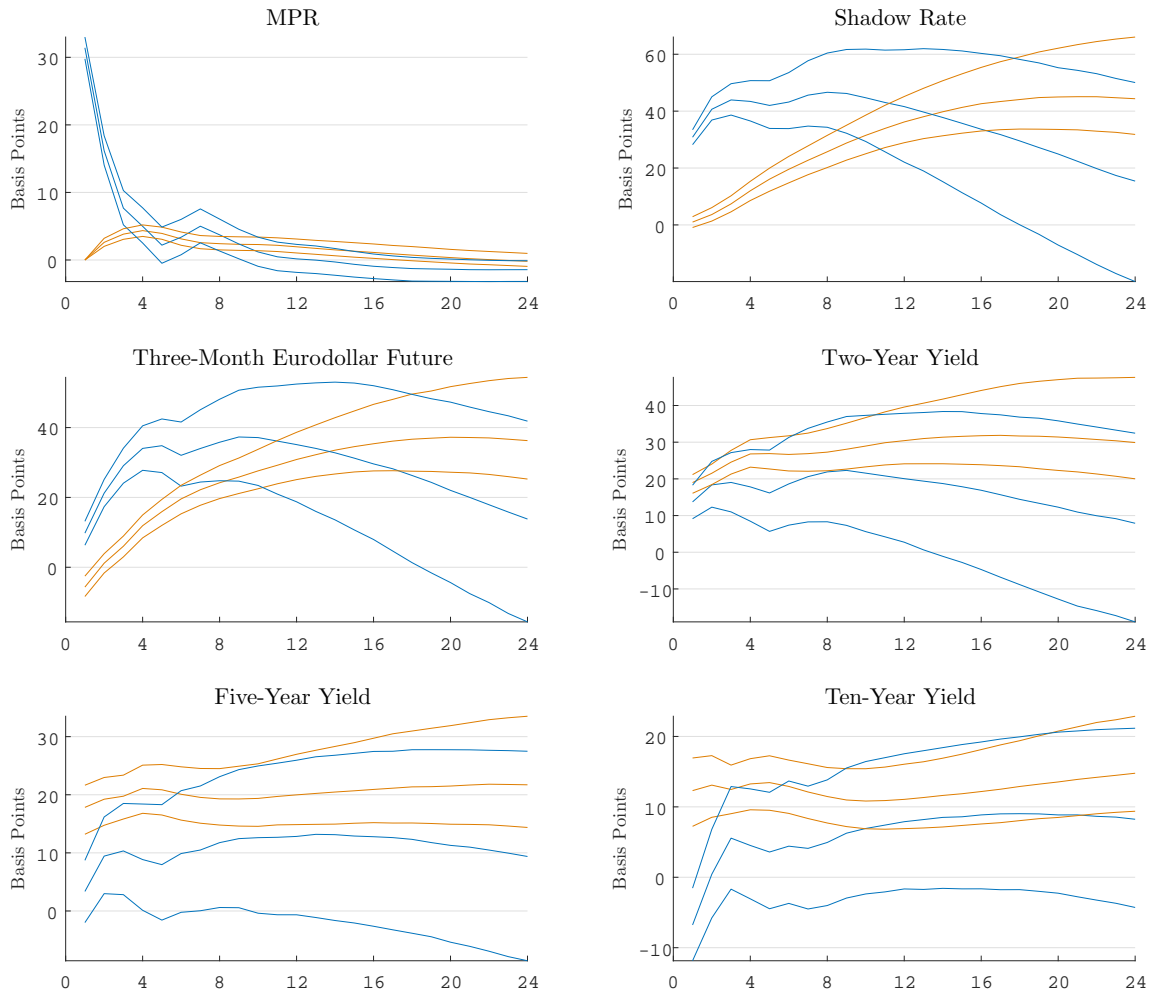
Note: Posterior median impulse responses to a monetary news shock with 68% probability mass.

Figure 3: Forecast Error Variance Explained by U.S. Monetary Policy News Shock



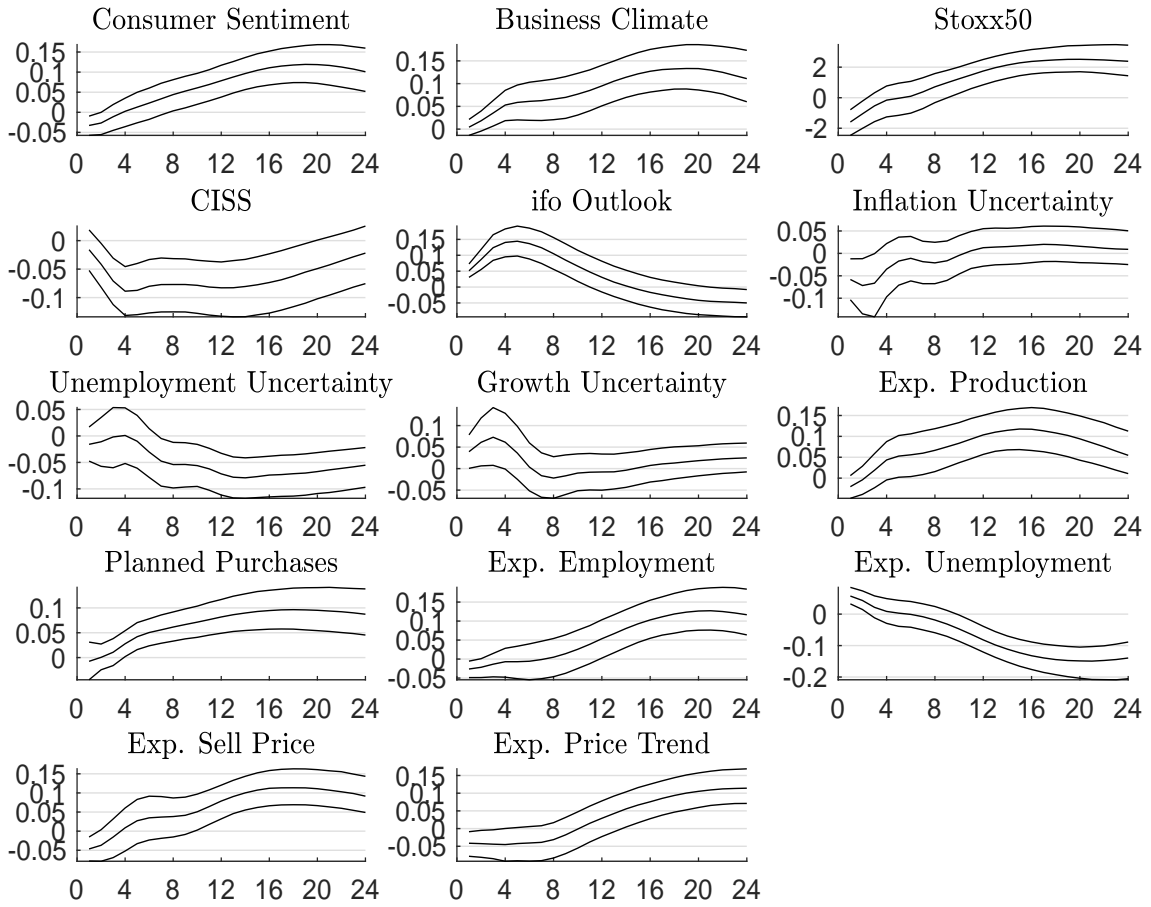
Note: The figure shows the fraction of the forecast error variance of each variable, in %, explained by the monetary policy news shock along with posterior 68% mass.

Figure 4: Monetary News Shock vs Conventional Monetary Policy Shock



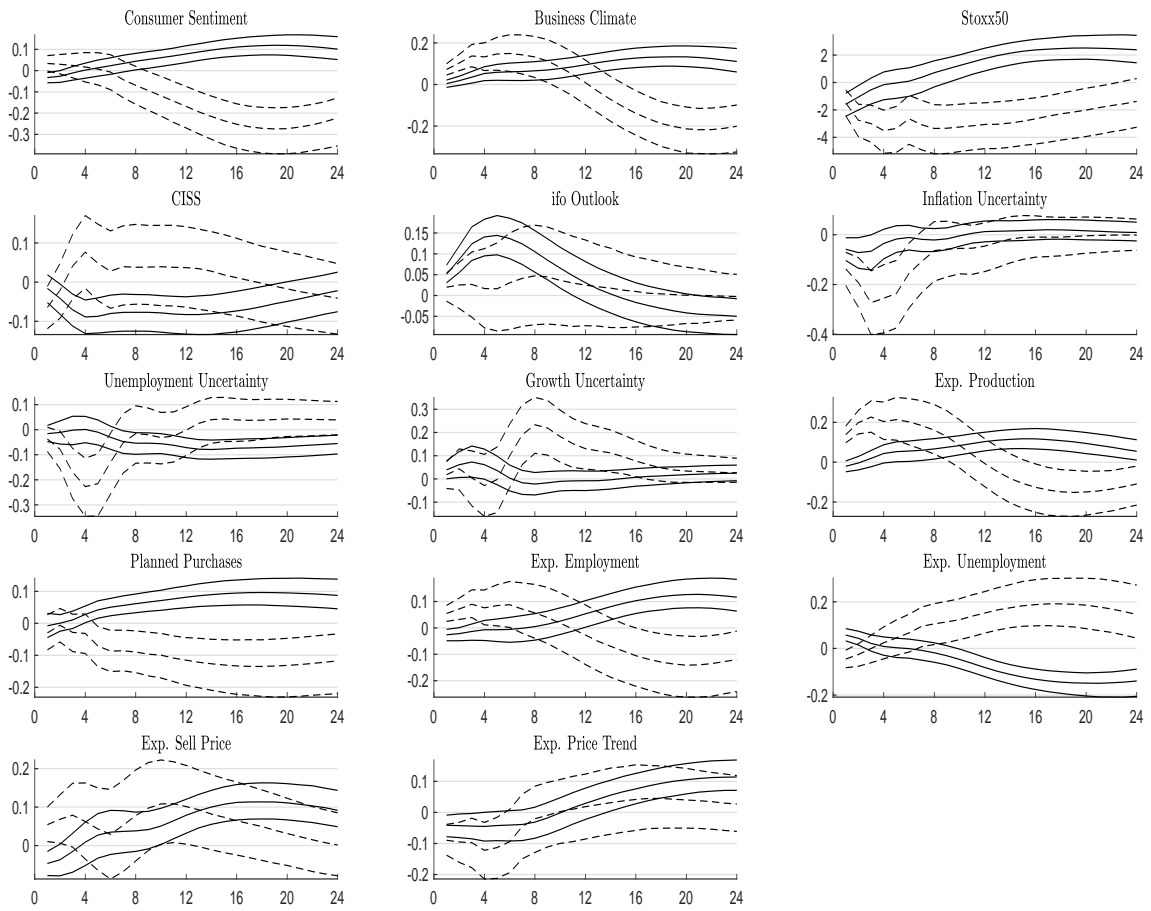
Notes: Median impulse responses to both, news shock (orange) and current monetary policy shock (blue) along with their respective 68% posterior probability bands. The magnitude of the current shock is adjusted to lead to similar responses of the Eurodollar future as implied by news shocks.

Figure 5: Euro Area Responses to U.S. Monetary Policy News Shock



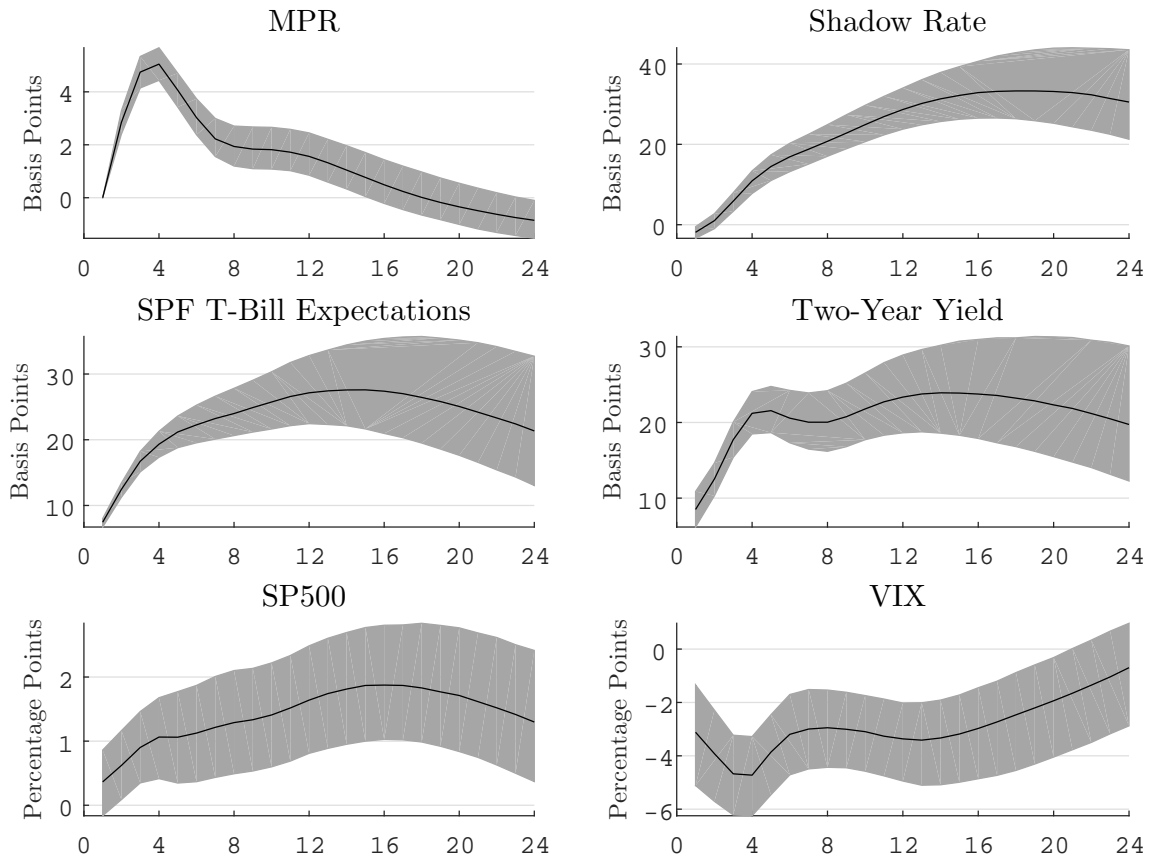
Note: Median impulse responses to anticipated U.S. monetary tightening along with posterior 68% mass. Percentage changes on y-axis.

Figure 6: Euro Area: News vs. Surprise



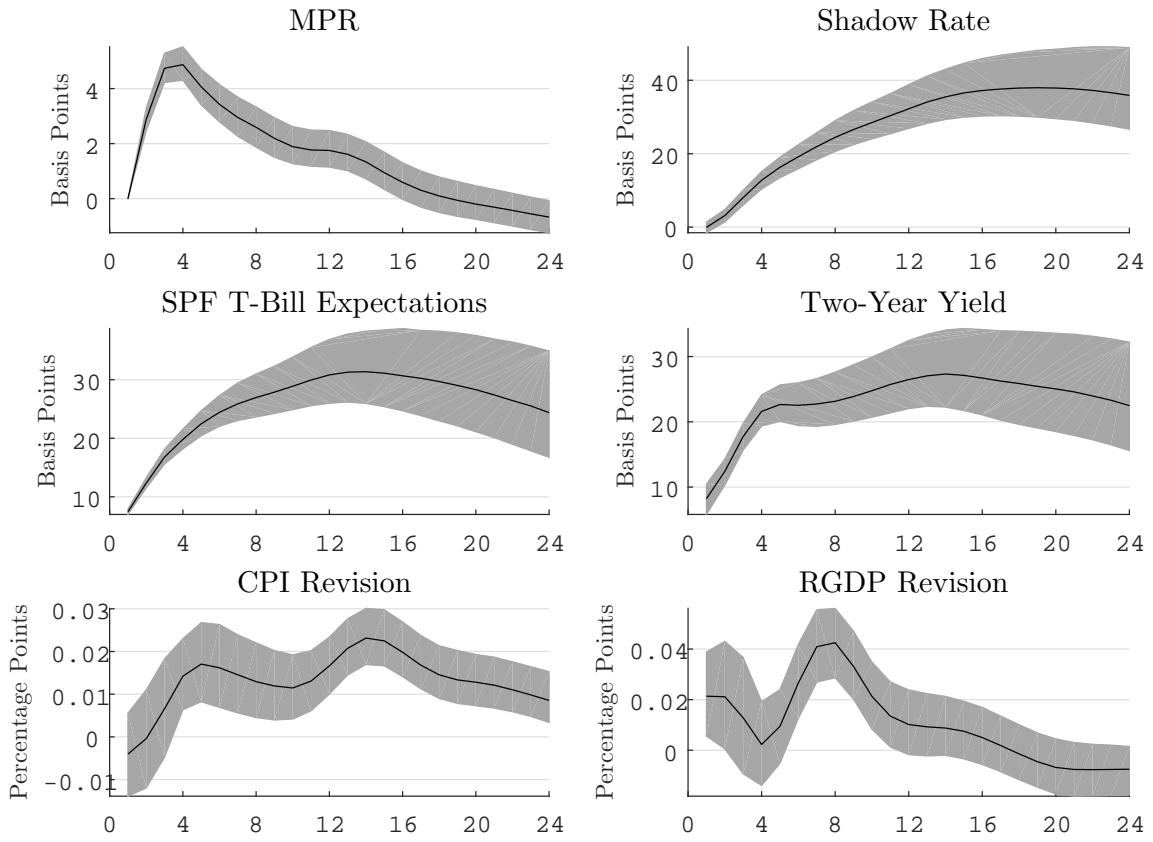
Note: Median impulse responses to anticipated U.S. monetary tightening (solid) and monetary surprise (dashed) along with posterior 68% masses. Percentage points on y-axis.

Figure 7: Monetary News Shock and the Stock Market



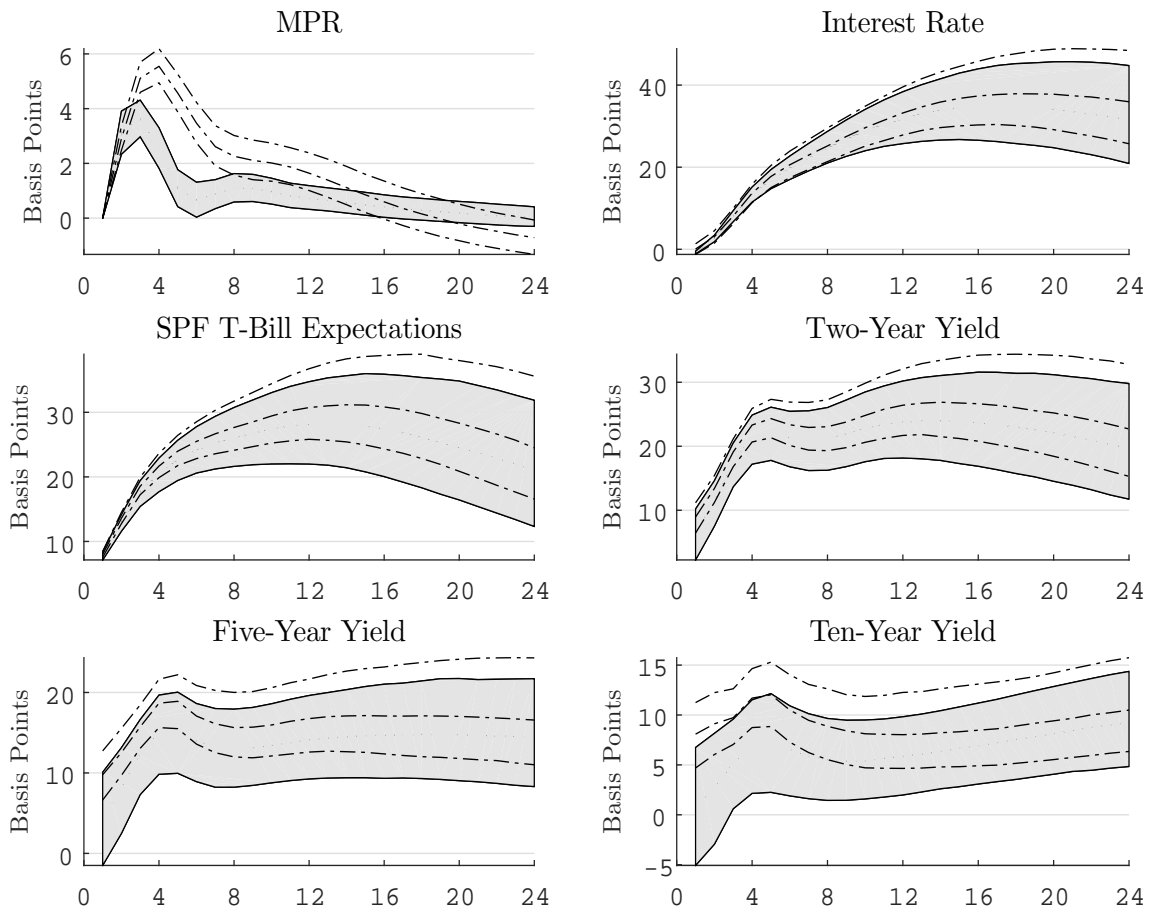
Notes: Posterior median impulse responses to a monetary news shock with 68% probability mass.

Figure 8: Monetary News Shock and SPF Expectations



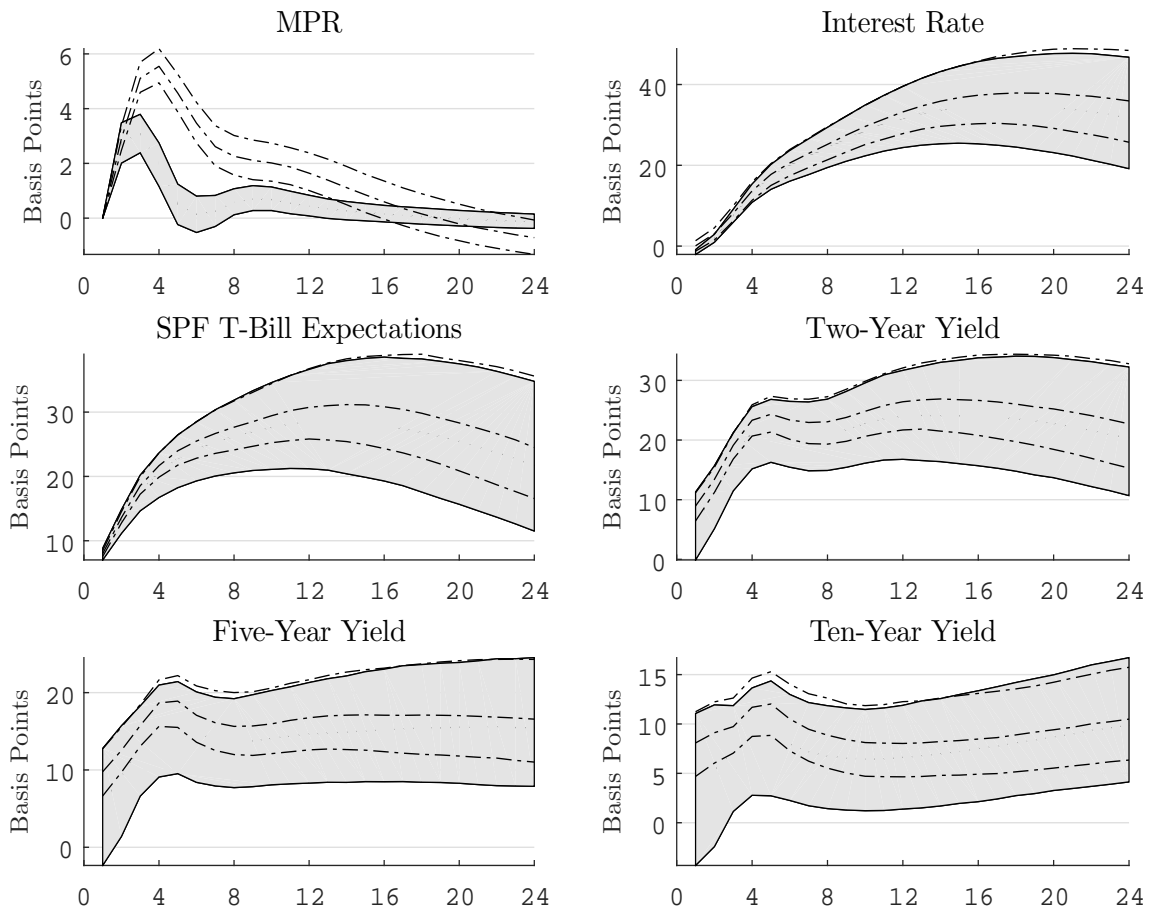
Notes: Posterior median impulse responses to a monetary news shock with 68% probability mass.

Figure 9: Alternative Interest Rate Rule w/ SPF expectations



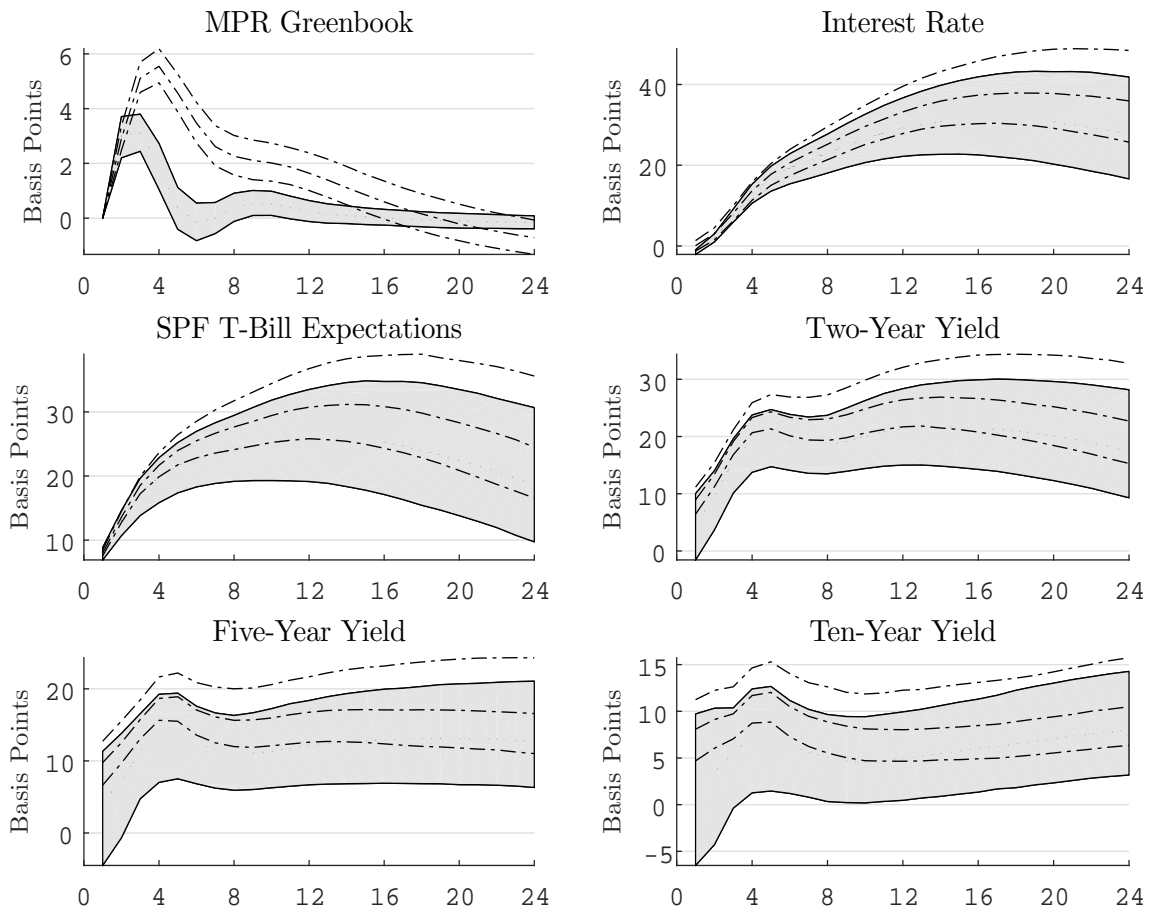
Note: Median impulse responses to anticipated U.S. monetary tightening. Grey areas refer to 68% probability mass of impulse response to alternative MPR (eq. 16) while dashed lines refer to median impulse response as in section 2 along with respective posterior 68% masses.

Figure 10: Alternative Interest Rate Rule w/ Greenbook CPI Forecast



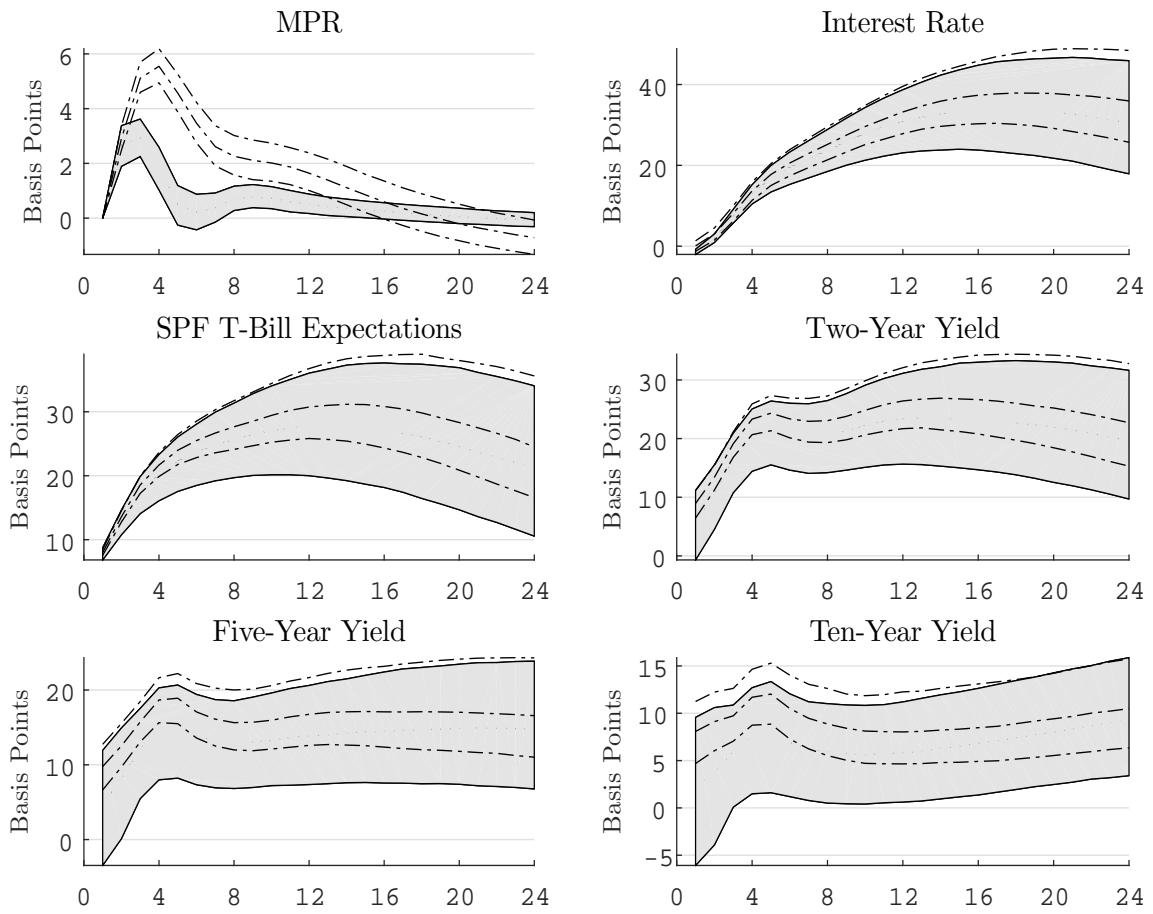
Note: Median impulse responses to anticipated U.S. monetary tightening. Grey areas refer to 68% probability mass of impulse response to alternative MPR (eq. 17) while dashed lines refer to median impulse response as in section 2 along with respective posterior 68% masses.

Figure 11: Alternative Interest Rate Rule w/ PCE Core Inflation



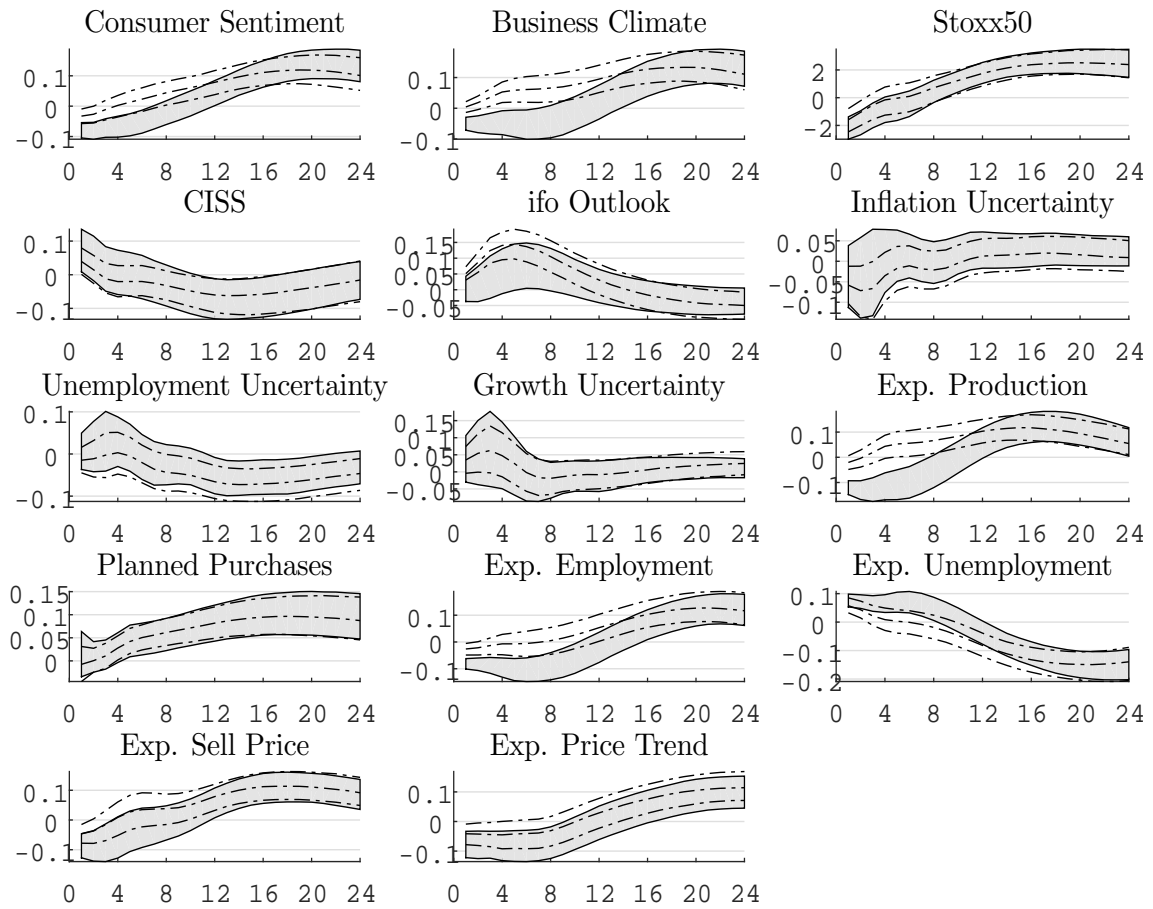
Note: Median impulse responses to anticipated U.S. monetary tightening. Grey areas refer to 68% probability mass of impulse response to alternative MPR (eq. 18) while dashed lines refer to median impulse response as in section 2 along with respective posterior 68% masses.

Figure 12: Alternative Interest Rate Rule w/ Expectation Discord



Note: Median impulse responses to anticipated U.S. monetary tightening. Grey areas refer to 68% probability mass of impulse response to alternative MPR (eq. 19) while dashed lines refer to median impulse response as in section 2 along with respective posterior 68% masses.

Figure 13: Alternative Interest Rate Rule and the EA



Note: Median impulse responses to anticipated U.S. monetary tightening. Grey areas refer to 68% probability mass of impulse response to alternative MPR (eq. 19) while dashed lines refer to median impulse response as in section 3 along with respective posterior 68% masses.