Are US Monetary Surprises Surprising? Evidence from Global Markets*

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Abstract

We show that FOMC announcement surprises are predicted by preceding ECB monetary policy announcement surprises. Specifically, a 1 p.p. ECB monetary policy surprise predicts a subsequent 0.19-0.31 p.p. FOMC surprise. Movements in asset prices around the ECB meeting also predict movements around subsequent FOMC meetings. We rationalize these empirical facts with a model in which the Fed responds to non-US economic conditions more strongly than investors expect and the ECB releases growth news at the time of its announcements. Our results suggest that the Fed's response to non-US news is an important facet of monetary policy transmission.

Keywords: Fed surprises, ECB surprises, monetary policy identification, international finance

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1 Introduction

A major empirical challenge to quantifying monetary policy transmission is the identification of monetary policy shocks. A common approach is to use movements in policy rate futures during a small window around central bank announcements to identify exogenous monetary surprises. A key assumption of this approach is that the change in the policy rate observed during this small window reflects only updates to beliefs about monetary policy provided by the central bank announcement. Indeed, if all ex-ante information and ex-ante expectations about monetary policy are already reflected in the price before the announcement, monetary surprises should not be predictable by information prior to the announcement.

We document a surprising fact about Federal Open Market Committee (FOMC) surprises: high frequency identified Fed Funds surprises from 2001 to 2022 are predicted by the monetary surprise of the most recent European Central Bank (ECB) monetary announcement. We do not, however, find evidence of the reverse: preceding US monetary shocks do not significantly predict ECB monetary shocks. Consistent with this policy rate predictability, we also find that movements in bond yields and stock indexes around the ECB meeting predict movements around subsequent FOMC meetings. We find that increases in both US and EU stock futures around ECB meetings predict drops in stock futures around FOMC meetings. In contrast, increases in bond futures around ECB meetings predict increases in bond futures around FOMC meetings.

Previous hypotheses on FOMC surprises' predictability do not explain this result. We first consider whether our results can be explained by investors underestimating the Fed response to US macroeconomic news, as in Bauer and Swanson (2022). They find that ex-ante US economic news predicts FOMC surprises, suggesting consistent misspecification of the Fed's response function. We find that ECB monetary surprises predict FOMC surprises even after controlling for ex-ante US macroeconomic news. Moreover, we do not find that ECB monetary surprises predict changes to US macroeconomic expectations. We also investigate whether the ECB's predictive ability is due to the Fed

updating its forecasts on US macroeconomic conditions, consistent with an information effect. ECB surprises predict neither investor revisions to US macro expectations nor revisions to the Fed's internal Tealbook macro expectations.

Instead, we propose a new channel to account for the predictability we observe in the data: the Federal Reserve responds to global output news more than investors expect. Both domestic and global variables impact the Fed's and the ECB's policy decisions. We argue that while investors pay attention to global markets and correctly anticipate the ECB's reaction to them, investors underestimate the degree to which the Fed reacts to global variables.

Next, we propose a simple model where investors use their expectations of the US and EU output gaps to predict each central bank's policy rate. Consistent with our model, if investors *underestimate* the extent to which the US policy rule responds to the EU output gap, investors will underestimate subsequent movements in the Fed Funds rate after the ECB releases news on the EU output gap, creating a positive surprise during the FOMC announcement.

Our results do not contradict the view that the Federal Reserve sets policy exogenous to other central banks (Brusa, Savor, and Wilson (2020)). In fact, belief in the widespread dominance of the Federal Reserve might lead investors to assume the Federal Reserve also does not react to non-US news. In contrast, investors accurately expect the ECB to react to US economic conditions. This combination of perceived Federal Reserve exogeneity and ECB endogeneity is consistent with ECB shocks predicting FOMC surprises but not the reverse.

Our model also accounts for the positive correlation between bond returns and the negative correlation between stock returns on central bank announcement days. As documented by Jarociński and Karadi (2020), a greater proportion of ECB meetings contain growth information rather than Fed meeting days. In other words, when the ECB increases the policy rate, investors often interpret this rate increase as positive growth news, so stocks and bonds co-move. In contrast, an unexpected increase in the

US policy rate is interpreted as primarily a shock to interest rates rather than information about future growth and hence leads instead to an increase in bond returns but a drop in stock returns. In our model, when the ECB increases its rate to signal future growth, investors' expectations about the EU output gap increase along with stocks and bond prices. Since investors underestimate the dependence of the FFR on the EU output gap, they are positively surprised by the increase in the FFR, which in turn leads to a drop in stocks and a rise in bonds, thus explaining our empirical findings.

To test our model, we split the ECB meeting days into days with growth news and days with monetary news following Jarociński and Karadi (2020) and Jarociński (2022). We find that the predictability of stock and bond returns around FOMC meetings by asset returns around ECB meetings is primarily explained by ECB meeting days with growth news. There is little to no predictability in the sample of ECB meeting days with monetary news.

We also conduct several additional robustness checks. First, we cluster standard error by dates to mitigate the impact of the serial correlation on our results. Second, we test if the surprises are more predictable when meeting dates are closer. ECB meetings are, on average, two weeks before the FOMC meetings, while FOMC meetings are four weeks before the ECB meetings. We find that the predictability is stronger when the dates are closer. Finally, we rule out concerns that our results may be driven by influential observations.

High-frequency monetary shocks play a large role in quantifying monetary policy transmission. Hence, we consider the role of ECB predictability in two seminal papers on monetary policy transmission. We re-evaluate each paper's results using the component of Fed surprises predicted by the preceding ECB announcement. First, we find that a small portion of the monetary transmission to equity returns found by Bernanke and Kuttner (2005) can be driven by the part of Fed Funds surprises explained by ECB surprises. We also revisit Gertler and Karadi (2015)'s results. ECB-predicted Fed monetary policy shocks impact the one-year rate and do not affect CPI. However,

these shocks have significant effects on industrial production and excess bond premium. Specifically, monetary transmission could have been stronger if investors accounted for ECB surprises.

We contribute to several strands of the literature. First, we contribute to to the literature on the predictability and methodology of construction of monetary policy shocks. Economists have proposed numerous variations of monetary shocks to identify the impact of monetary policy on the economy (Bernanke and Mihov (1998); Kuttner (2001); Romer and Romer (2004); Bernanke and Kuttner (2005); Nakamura and Steinsson (2018b)). Many papers use high-frequency changes to Fed Fund futures around FOMC meetings as a measure of monetary surprise (Bernanke and Kuttner (2005); Gorodnichenko and Weber (2016); Paul (2020); Indarte (2023)): because the announcement window is extremely short, this reduces concerns that other news may be reflected in the measured surprise (Stock and Watson (2018)). However, several papers find that monetary surprises are predictable by stock returns or macroeconomic announcements (Ramey (2016); Cieslak (2018); Miranda-Agrippino and Ricco (2021); Bauer and Swanson (2022, 2023); Karnaukh and Vokata (2022)). We add to this literature with evidence that monetary surprises are also predicted by ECB surprises.

We also contribute to the literature on central bank information and investor reaction. Several papers study how central banks cooperate and pass information to investors (Savor (2012); Savor and Wilson (2014); Hanson and Stein (2015); Campbell, Fisher, Justiniano, and Melosi (2017); Miranda-Agrippino (2017); Nakamura and Steinsson (2018b); Cieslak and Schrimpf (2019). Other papers look into the interaction of stock returns and monetary policy shocks to understand how information is passed through stocks (Rigobon (2003); Rigobon and Sack (2004); Cieslak, Morse, and Vissing-Jorgensen (2019)).

Finally, we add the literature on monetary policy transmission. Monetary policy shocks have been used in many papers to show that monetary policy has an impact on the real economy (Kuttner (2001); Gurkaynak, Sack, and Swanson

(2005); Gertler and Karadi (2015); Gorodnichenko and Weber (2016); Drechsler, Savov, and Schnabl (2017); Nakamura and Steinsson (2018b); Indarte (2023); Pflueger and Rinaldi (2022)). Moreover, these shocks have been used to identify the impact of monetary policy on global and foreign markets (Cetorelli and Goldberg (2012); Schnabl (2012); Brusa, Savor, and Wilson (2020); Hale, Kapan, and Minoiu (2020); Sarkisyan and Viratyosin (2022)). We show that the component of FOMC surprises predicted by ECB shocks drives key results in several of these papers. This indicates that the Fed's response to non-US news released by the ECB is a key driver of the effects of US monetary policy.

The rest of the paper is organized as follows. Section 2 describes our data sources. Section 3 proposes an empirical strategy and presents evidence that ECB announcements predict subsequent FOMC announcements. Section 4 proposes a theoretical framework to explain the main empirical results and suggest a channel. Section 5 discusses traditional explanations of the predictability of monetary shocks and provides evidence that these explanations do not encompass our findings on FOMC surprise predictability. Section 6 contains robustness tests. Section 7 replicates seminal papers that use monetary surprises to identify the causal impact of monetary policy on the real economy, stocks, and bonds. Section 8 concludes.

2 Data and identification

2.1 High frequency data

Studies on how monetary policy impacts the economy have a significant identification challenge – monetary policy is endogenous to economic variables. Indeed, central bank policy decisions are often in response to macroeconomic conditions, including anticipated inflation. To address this concern, the literature has focused on unexpected components of monetary policy rate changes – so-called monetary surprises.

We identify FOMC surprises from 1994 to 2022 using intraday trading data on 1-

month Federal Funds futures from Thompson Reuters. Following Paul (2020), we measure short-term Federal Funds Rate Surprises as fluctuations of 1-month Fed Fund futures in a 1-hour window around FOMC meetings. We follow Nakamura and Steinsson (2018a) and construct a proxy for forward guidance surprises using FFR surprises. This proxy is the first principle component of movements in the current month and next month's Fed Funds Futures rates, as well as changes in Eurodollar futures that expire two, three, and four quarters in the future.

We measure ECB surprises starting in 1999 with the formation of the ECB. We follow Altavilla, Brugnolini, Gurkaynak, Motto, and Ragusa (2019) and utilize movements in Euro Area Overnight Index Swap rates (collected from Thompson Reuters) around ECB announcements. ECB announcements begin with a press release containing direct, to-the-point information on interest rates and asset purchases. Shortly after the press release, the president of the ECB explains the ECB's policies and economic forecasts in a press conference. Altavilla, Brugnolini, Gurkaynak, Motto, and Ragusa (2019) record the time of the press release and press conference separately and the corresponding movements in OIS rates, allowing us to identify the surprise of each announcement.

Similar to Altavilla, Brugnolini, Gurkaynak, Motto, and Ragusa (2019) we split the ECB surprises into the surprises coming from the release and the part coming from the press conference. This enables us to better understand if our results are driven by the unexpected change in policy rates or the accompanying ECB comments.

We supplement data on policy rates with high-frequency futures on equity and bond index prices from TickData. We retrieve high-frequency movements in U.S. and German bond future prices, as well as S&P E-Mini futures and DAX futures. We also collect high-frequency exchange rates and industry production futures from Thompson Reuters.

2.2 Macroeconomic data

One of the goals of this paper is to show that our results are not driven by any of the existing explanations of the predictability of the FOMC surprises. Two popu-

lar explanations are the predictability coming from the macroeconomic announcements (Bauer and Swanson (2022)) and the Fed information effect (Nakamura and Steinsson (2018a)). We collect macroeconomic data to reconcile our results with the previous explanations.

We use macroeconomic announcement data from Bloomberg's Economic Calendar. The Economic Calendar records the announcement and consensus pre-announcement expectation of official US releases of key macroeconomic variables. The variables we study in this paper include non-farm payrolls, GDP growth, core CPI growth, and unemployment. We augment these announcements with historical data on S&P returns, commodity prices, and treasury yields provided by Bauer and Swanson (2022). Finally, we retrieve the daily VIX from the Federal Reserve Economic Database maintained by the Federal Reserve Bank of St. Louis.

We retrieve the Federal Reserve's internal Tealbook forecasts from the Federal Reserve Bank of Philadelphia. Tealbooks contain the Fed's internal forecasts of macroeconomic variables updated before FOMC meeting. These forecasts are released with a lag of five years, giving us Fed forecasts from the beginning of our sample to 2016.

3 Results

3.1 Policy rates

We first test if ECB monetary surprises predict subsequent FOMC monetary surprises. In our baseline regression, we regress Fed surprises on the previous ECB surprise:

$$\Delta Fed_t = \beta_0 + \beta_1 \Delta ECB_{ME,t-\delta} + \epsilon_t \tag{1}$$

where ΔFed_t is the surprise around the FOMC announcement on date t and $\Delta ECB_{ME,t-\delta}$ is the surprise around the previous ECB announcement. We remove cases where there was no ECB announcement between FOMC meetings so that ΔFed_{t-1} al-

Table 1: Policy and Asset Price Movement around FOMC Announcement
Predicted by Preceding Policy and Asset Price Movement around ECB Announcement

$$\Delta y_t = \beta_0 + \beta_1 \Delta y_{ME,t-\delta} + \epsilon_t$$

	Dependent variable:						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Policy Rate	5-Year DE	10-Year DE	DAX	5-Year US	10-Year US	S&P
	0.19*	0.12**	0.14***	-0.16**	0.22*	0.15	-0.36***
	(0.10)	(0.04)	(0.04)	(0.07)	(0.11)	(0.17)	(0.12)
N	184	123	123	128	166	141	141
R^2	0.03	0.10	0.09	0.10	0.12	0.00	0.01

Note: Column (1) of this table provides the results of estimation for equation (1). Columns (3)-(7) provide the analogous estimations for EU 5 and 10-year government bonds, DAX index, US 5 and 10-year treasuries, and S&P 500 index, respectively. For example, Column (2) shows the results of regressing the high-frequency yield change in the EU 5-year bond around the FOMC announcement on the high-frequency yield change of the EU 5-year bond during the preceding ECB announcement. Column (4) shows the results of regressing the high-frequency return of the DAX around the FOMC announcement on the high-frequency return of the DAX during the ECB announcement. Standard errors are clustered by year and displayed in parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

ways occurs before $\Delta ECB_{ME,t-\delta}$, which occurs before ΔFed_t. We define ΔFed_t as the movement in the Federal Funds Rate future around an announcement. We use movements in the 1-month Overnight Index Swap rate from Altavilla et al. (2019) as our measure of ECB surprises, $\Delta ECB_{ME,t-1}$.

Table 1 presents the results. We find that ECB monetary surprises predict subsequent FOMC monetary surprises. Specifically, a hundred basis point unexpected increase in the ECB rate predicts a 19 basis point increase in the Fed Funds rate. The results are robust to the types of standard errors and controlling for the time distance between the meetings, macro announcements, removal of influential observations, and the Fed information effect. We also do not find any significance if we run the reverse regression – FOMC surprises do not significantly predict the ECB surprises.

Moreover, we observe similar predictability in other assets: movements in futures of stock indexes and German bond prices around the ECB announcements predict movements around the subsequent FOMC announcement. Specifically, increases in bond future prices around ECB meetings predict increases in bond future prices around FOMC

meetings. On the contrary, increases in stock futures around ECB meetings predict decreases in stock prices around FOMC meetings.

In addition to measuring the surprise released over the entire ECB announcement, we utilize the ECB's separate press releases and press conferences to distinguish between the ECB's release of information on short-term monetary policy vs. forward guidance and its macroeconomic outlook. As discussed in Altavilla et al. (2019), the initial press release contains a short statement outlining the ECB's new policy rate. After 2014, any changes to monthly asset purchases by the ECB were also included in the press release. During the subsequent press conference, the president of the ECB discusses the basis for the previously announced policy decision, including the ECB's economic outlook, and then answers questions from reporters. Investors use the press conference to infer the ECB's forward guidance.

In our second set of regressions, we disentangle the predictive power of press release surprises and press conference surprises. We estimate Fed surprises on ECB surprises identified around press releases $\Delta ECB_{PR,t-\delta}$ and press conferences $\Delta ECB_{PC,t-\delta}$ separately:

$$\Delta Fed_t = \beta_0 + \beta_1 \Delta ECB_{PR,t-\delta} + \beta_2 \Delta ECB_{PC,t-\delta} + \epsilon_t \tag{2}$$

We run regressions 1 and 2 on our 2001-2022 sample. The results are shown in Table 2. The first column of each table shows the results of Regression 1. The second column shows the regression where ECB press releases and press conferences predict FOMC surprises separately, as in Regression 2. The final two columns in each table repeat these regressions and add lagged ECB surprises.

We further test if this predictive power is asymmetric between positive (contractionary) and negative (expansionary) ECB shocks. We divide our sample into periods where the ECB monetary event surprises were positive and negative in Table 3. The first two columns of each table show the baseline regressions predicting FOMC surprises with ECB surprises. The third and fourth columns restrict the sample to positive ECB

surprises. The last two columns restrict the sample to negative ECB surprises.

ECB press conferences continue to predict Fed surprises within each subsample. In particular, the coefficient on the press conference surprise, where details underlying the rate change decision are released, is both economically meaningful and statistically significant in nearly all specifications. These subsample-based results indicate that ECB press conferences reveal information pertinent to the Fed across our entire sample.

Our results indicate that information released during the ECB's announcements informs the Fed's monetary policy decisions but is not accurately priced by investors before the subsequent FOMC announcements. In Section 6, we find little evidence that the ECB's predictive power can be accounted for by previous explanations of monetary surprise predictability, such as differences between the Fed's information set and that of investors or incorrect predictions on the Fed's reaction to macroeconomic variables by investors. In Section 4, we suggest that ECB surprises predict FOMC surprises because investors underestimate how much the Fed reacts to the global variables.

3.2 Stocks and bonds

In addition to the policy rate predictability we document above, we find that movements in stock markets and European bonds around ECB announcements predict asset price movements around Fed announcements. We run the following regression for each asset:

$$\Delta P_t = \beta_0 + \beta_1 \Delta P_{t-\delta} + \epsilon_t \tag{3}$$

ΔP_t denotes an asset's price movement around an FOMC announcement and $\Delta P_{t-\delta}$ around the preceding ECB announcement. We show the results for our entire sample in the first panel of Table 4.

Movements in German 5- and 10-year bonds and European and US stock markets around ECB announcements predict subsequent movements around FOMC meetings. Specifically, increases in stock futures (both European and US) around ECB meetings predict decreases around FOMC meetings. In contrast, increases in European bonds

around ECB meetings predict increases around FOMC meetings. However, there is little initial evidence that movements in US bonds around ECB announcements predict subsequent movements around FOMC announcements.

In the following section, we propose an explanation for the observed predictability of policy rate surprises and asset price movements. The key ingredients of the model are that the ECB releases private information on the EU economy in its policy rate announcements and that investors systematically underestimate the Fed's reaction to EU economic news. Hence, when the ECB releases positive growth information, the Fed will systematically surprise investors in its next meeting with higher-than-expected interest rates.

4 Theoretical framework

4.1 Model Setup

We introduce a model that rationalizes the predictability of policy rate surprises, bond yield movements, and stock returns. In this model, the Fed and the ECB set policy rates in response to output gaps in the US and the EU. Investors do not observe output gaps directly but instead attempt to infer them based on central bank announcements. However, investors routinely under-predict the degree to which the Fed reacts to the EU output gap.

We argue that these ingredients allow us to jointly explain the positive correlation between ECB date and FOMC date policy rate surprises and bond yields and the negative correlation for stock returns. Intuitively, an increase in the ECB policy rate which primarily confers growth news will raise bond yields and stock returns as investors update their beliefs on the EU output gap. However, investors underestimate the extent to which the Fed responds to the EU output gap. Hence, in subsequent FOMC meetings, the Fed will, on average, raise its policy rate more than investors expect. If investors interpret the Fed's surprise tightening as a monetary policy surprise, bond yields will

increase, and stock valuations will fall. Therefore, a rise (fall) in bond yields during ECB announcements will predict a rise (fall) in bond yields and a fall (rise) in stock returns around the subsequent Fed announcement. In contrast, if the monetary surprise by the ECB does not confer information on the EU output gap, such surprises will not correlate with subsequent Fed surprises.

Formally, the Fed chooses its policy rate i_t in response to the US output gap x_t and the EU output gap x_t^*:

$$i_t = ax_t + a'x_t^* + \epsilon_t$$

where $\epsilon_t \sim N(0, \sigma_\epsilon^2)$. a and a' reflect the Fed's responsiveness to the US and EU output gaps, x_t and x_t^*. Similarly, the ECB has the reaction function

$$i_{t-\delta}^* = a^* x_t + a^{*'} x_t^* + \epsilon_{t-\delta}^*$$

where $\epsilon_{t-\delta}^* \sim N(0, \sigma_{\epsilon^*}^2)$

For simplicity, we assume the ECB's meeting precedes the Fed's,[1] and that both output gaps are unchanged after the ECB meeting and before the Fed meeting.[2] Furthermore, The US output gap is known to investors, as are the Fed and ECB's reaction functions to the US output gap.[3]

Consider if investors believe the Fed reacts less strongly to the EU output gap than it does in reality: $\widehat{a'} < a'$. We denote the variance of the expectation at time t by $\sigma^2_{\widehat{a'_t}}$. Investors do not observe x_t^* directly but have belief $\mathbf{E}x_t^*|\mathcal{H}_{t-\delta-}]$ before the ECB announcement, where $\mathcal{H}_{t-\delta-}$ denotes the information set available to investors before the ECB announcement at $t-\delta$. If the ECB announcement contains growth news, this

[1]This assumption is validated in the data – on average, Fed meetings are two weeks after the ECB meeting, while ECB meetings are four weeks after the FOMC meetings.

[2]One can think about this statement as assuming that x_t and x_t^* are first cleaned of all observable and unobservable events between the meeting and hence, only depend on the policy decisions.

[3]The first part of the assumption is in line with Jarociński and Karadi (2020) and Jarociński (2022), who find that a greater proportion of ECB meeting days have growth news than Fed meeting days. We relax this assumption and also the second part of the assumption about investors knowing a below.

belief is updated to $\mathbf{E}[x_t^*|\mathcal{H}_{t-}]$.

4.2 Announcement surprise predictability

The policy rate surprise for the Fed's announcement is:

$$mps_t = i_t - E[i_t|\mathcal{H}_{t-}] = a'x_t^* + \epsilon_t - \widehat{a'}\mathbf{E}[x_t^*|\mathcal{H}_{t-}] \tag{4}$$

and for the ECB:

$$\begin{aligned} mps_{t-\delta}^* &= i_t^* - E[i_{t-\delta}^*|\mathcal{H}_{t-\delta-}] = a^{*'}x_t^* + \epsilon_t^* - (a^{*'}\mathbf{E}[x_t^*|\mathcal{H}_{t-\delta-}]) \\ &= a^{*'}(x_t^* - \mathbf{E}[x_t^*|\mathcal{H}_{t-\delta-}]) + \epsilon_t^* \end{aligned} \tag{5}$$

The ECB surprise consists of both an information release $a^{*'}(x_t^* - \mathbf{E}[x_t^*|\mathcal{H}_{t-\delta-}])$ and a pure monetary surprise ϵ_t^*. We can write the Fed's surprise in terms of the ECB's surprise to show that only the component of the ECB's surprise uncorrelated with the monetary surprise (in this formulation, the information release) predicts the Fed's surprise at the subsequent FOMC meeting. Note that consistent with Brusa, Savor, and Wilson (2020), the Fed only responds to information on the EU output gap and not the pure monetary surprise.

$$mps_t = \frac{a'}{a^{*'}}(mps_{t-\delta}^* - \epsilon_t^*) + a'\mathbf{E}[x_t^*|\mathcal{H}_{t-\delta-}] - \widehat{a'}\mathbf{E}[x_t^*|\mathcal{H}_{t-}] + \epsilon_t \tag{6}$$

This gives us our first lemma:

Proposition 1. *Suppose investors underestimate the Fed's reaction to international economic conditions:* $\widehat{a'} < a'$. *Suppose also that investors do not underestimate the degree to which the ECB reacts to the international output gap:* $\widehat{a^{*'}} \geq a^{*'}$. *Then,* $mps_{t-\delta}^*$ *positively predicts* mps_t.

Proof.

$$\frac{\partial mps_t}{\partial mps_{t-\delta}^*} = \frac{a'}{a^{*'}} - \widehat{a'}\frac{\partial \mathbf{E}[x_t^*|\mathcal{H}_{t-}]}{\partial mps_{t-\delta}^*}$$

Note that if investors fully attribute the ECB's surprise to an information effect, $\frac{\partial \mathbf{E}[x_t^*|\mathcal{H}_{t-}]}{\partial mps^*_{t-\delta}} = \frac{1}{\widehat{a^{*\prime}}}$. If $\widehat{a^{*\prime}} = a^{*\prime}$, then

$$\widehat{a'}\frac{\partial \mathbf{E}[x_t^*|\mathcal{H}_{t-}]}{\partial mps^*_{t-\delta}} = \frac{\widehat{a'}}{\widehat{a^{*\prime}}} = \frac{\widehat{a'}}{a^{*\prime}}$$

If investors underestimate the Fed's reaction to the international output gap,

$$\frac{a'}{a^{*\prime}} > \frac{\widehat{a'}}{a^{*\prime}} \implies \frac{\partial mps_t}{\partial mps^*_{t-\delta}} > 0$$

□

When investors observe the FOMC surprise, they update their belief about how strongly the Fed reacts to the ECB output gap. Specifically, their expectation of a' evolves according to Bayesian updating:

$$\mathbb{E}[a'|\mathcal{H}_t] = \widehat{a'}_t + \omega_t \frac{1}{x_t} mps_t$$

where $\omega_t \equiv \frac{(x_t^*)^2 \sigma^2_{\widehat{a'}_t}}{(x_t^*)^2 \sigma^2_{\widehat{a'}_t} + \sigma^2_\epsilon}$. At the subsequent FOMC meeting at time $t+1$, the derivative of the FOMC surprise with respect to the most recent ECB surprise becomes

$$\frac{\partial mps_{t+1}}{\partial mps^*_{t+1-\delta}} = \frac{a'}{a^{*\prime}} - \frac{\widehat{a'}}{a^{*\prime}}\left(1 + \omega_t \frac{1}{x_t^*} mps_t\right) \tag{7}$$

The expected increase in the FOMC surprise, given the same ECB surprise, becomes smaller over time. This is because investors have updated their belief in the Fed's reaction to the EU output gap, a'. As the number of periods goes to infinity,

$$\frac{\partial mps_{t+s}}{\partial mps^*_{t+s-\delta}} = \frac{a'}{a^{*\prime}} - \frac{\widehat{a'}}{a^{*\prime}}\left(1 + \sum_{s=1}^{\infty} \omega_{t+s} \frac{1}{x^*_{t+s}} mps_{t+s}\right)$$

Since $\widehat{a'} \sum_{s=1}^{\infty} \omega_{t+s} \frac{1}{x^*_{t+s}} mps_{t+s} \to a'$, $\frac{\partial mps_{t+s}}{\partial mps^*_{t+s-\delta}} \to 0$, the ECB fails to predict the Fed in the limit.

4.3 Stock and bond returns

A potentially puzzling result we find is that bond yield movements around ECB announcements positively predict movements of the same bond yields around subsequent FOMC announcements, but stock returns around the ECB announcement negatively predict stock returns around the next Fed announcement. Our model can reconcile these opposite patterns. Intuitively, only the ECB surprise due to the release of information about the international output gap x_t^* predicts the subsequent Fed surprise, not pure monetary policy news. This implies that news from the ECB that moves yields and stock returns in the same direction (either both up in the case of positive growth news or down in the case of bad economic news) will predict the subsequent Fed surprise.

Investors will treat the subsequent Fed surprise as a pure monetary policy shock since they do not believe the Fed's policy rate releases additional information on the international output gap. Consequently, Fed monetary policy surprises will tend to move yields and stock in opposite directions.

To make this concrete, suppose the ECB releases positive growth news. Yields and stocks will rise around the ECB announcement. The positive surprise in the ECB's policy rate predicts a positive surprise in the subsequent Fed announcement. The markets interpret this positive Fed surprise as pure monetary news, which pushes yields up further, but lowers stock returns.

To see this, we examine two extreme cases: days where the ECB releases only a pure monetary policy surprise, $mps_{t-\delta}^* = \epsilon_t^*$, and days where the ECB's surprise is entirely due to the information effect, $mps_{t-\delta}^* = a^{*'}(x_t^* - \mathbf{E}[x_t^*|\mathcal{H}_{t-\delta-}]$. In the former case,

$$mps_t = \frac{a'}{a^{*'}}(\epsilon_t^* + a^{*'}\mathbf{E}[x_t^*|\mathcal{H}_{t-\delta-}] - \epsilon_t^*) - \widehat{a'}\mathbf{E}[x_t^*|\mathcal{H}_{t-\delta-}] + \epsilon_t$$

$$\implies mps_t = (a' - \widehat{a'})\mathbf{E}[x_t^*|\mathcal{H}_{t-\delta-}] + \epsilon_t$$

The ECB surprise does not predict the Fed surprise. In the latter case, where the ECB releases information on the international output gap,

$$mps_t = \frac{a'}{a^{*'}}(a^{*'}(x_t^* - \mathbf{E}[x_t^*|\mathcal{H}_{t-\delta-}]) + a'\mathbf{E}[x_t^*|\mathcal{H}_{t-\delta-}] - \widehat{a'}\mathbf{E}[x_t^*|\mathcal{H}_{t-}] + \epsilon_t$$

$$\implies mps_t = a'x_t^* - \widehat{a'}\mathbf{E}[x_t^*|\mathcal{H}_{t-}] + \epsilon_t$$

$$\implies mps_t = \frac{a'}{a^{*'}}mps_{t-\delta}^* - \widehat{a'}\mathbf{E}[x_t^*|\mathcal{H}_{t-}] + \epsilon_t$$

If the conditions in Proposition 1 hold, a positive growth surprise from the ECB predicts a positive pure monetary policy surprise from the Fed.

4.4 Empirical evidence

A prediction of the model is that asset price movements around an ECB announcement should predict subsequent FOMC announcement asset price movements only when information on the economy is released by the ECB. To test this hypothesis, we use split ECB announcements by whether they caused a positive or negative co-movement in bonds and stocks. We follow Jarociński (2022), who classifies days where the 1-year German government bond yield moved in the same direction as the Euro STOXX50E Index as released of news on the economy by the ECB. We run the predictability regressions separately on days where this co-movement was positive and negative. As shown in Table 4, the predictability of every asset (with the exception of DAX futures) is present in the sample with positive bond-stock co-movement and absent in the sample with negative co-movement.

4.5 Relaxing reaction function assumption

In the model derivations, we assumed that investors know how ECB and the Fed react to the US output gap. In other words, we assumed that $\widehat{a} = a$ and $\widehat{a^*} = a^*$. If we relax the assumption, monetary policy surprises become

$$mps_t = i_t - E[i_t|\mathcal{H}_{t-}] = (a - \widehat{a})x_t + a'x_t^* + \epsilon_t - \widehat{a'}\mathbf{E}[x_t^*|\mathcal{H}_{t-}] \tag{8}$$

and for the ECB:

$$\begin{aligned} mps^*_{t-\delta} &= i^*_t - E[i^*_{t-\delta}|\mathcal{H}_{t-\delta-}] = (a^* - \widehat{a^*})x_t + a^{*'}x^*_t + \epsilon^*_t - (a^{*'}\mathbf{E}[x^*_t|\mathcal{H}_{t-\delta-}]) \\ &= (a^* - \widehat{a^*})x_t + a^{*'}(x^*_t - \mathbf{E}[x^*_t|\mathcal{H}_{t-\delta-}]) + \epsilon^*_t \end{aligned} \tag{9}$$

Then, the predictive equation becomes

$$mps_t = \frac{a'}{a^{*'}}(mps^*_{t-\delta} - \epsilon^*_t) + a'\mathbf{E}[x^*_t|\mathcal{H}_{t-\delta-}] - \widehat{a'}\mathbf{E}[x^*_t|\mathcal{H}_{t-}] + \epsilon_t + \left((a - \widehat{a}) - \frac{a'}{a^{*'}}(a^* - \widehat{a^*})\right)x_t \tag{10}$$

Note that since investors know x_t, Proposition 1 still holds. If investors did not know x_t, then $\frac{\partial \mathbf{E}[x_t|\mathcal{H}_{t-}]}{\partial mps^*_{t-\delta}} = \frac{1}{\widehat{a^*}}$. Then

$$\frac{\partial mps_t}{\partial mps^*_{t-\delta}} = \frac{a'}{a^{*'}} - \frac{\widehat{a'}}{\widehat{a^{*'}}} + \frac{a - \widehat{a}}{a^*}$$

The derivative is positive under assumptions in Proposition 1 as long as $\widehat{a} < a$. In fact, the predictability is even stronger since now it also comes from the fact that the US investors are also surprised by the changes in their own output gap. The other propositions also follow.

5 Traditional explanations for FOMC surprise predictability

We are not the first to show predictability in high frequency identified monetary surprises. Previous research has shown that surprises around FOMC announcements are predictable by economic forecasts and news. Indeed, a large body of literature has studied the implications of the Federal Reserve releasing private information on the economy during FOMC announcements, where movements in futures around these announcements reflect both economic news and pure monetary policy surprises. More recently, Bauer and Swanson (2022) point out that public economic news surprises predict both

changes in forecasts and FOMC surprises, suggesting instead of the Fed releasing information on the economy, the predictability is instead explained by a systematic underestimation by investors of the Fed's response to economic news.

In this section, we examine whether these previous explanations for monetary policy predictability account for our results on ECB announcements predicting FOMC announcements. Our testable hypotheses about each channel follow:

1. Fed Response to Economic News: Investors accurately predict how ECB surprises predict US economic conditions, but underestimate how strongly the Fed will react to those conditions. This is consistent with the ECB *not* predicting US economic surprises (because investors update their economic forecasts based on the ECB announcements). Furthermore, when we regress FOMC surprises on both ECB surprises and US economic news surprises, the latter should drive out the predictive power of the former if the ECB predicts the Fed only insofar as it moves investors' expectations about the US economy.

2. Information Effect: During ECB announcements, information pertinent to the US economy is revealed. Suppose this information is reflected in updates to the Fed's internal forecasts but not incorporated into investors' expectations of US equity and stock prices. Under this channel, ECB announcement surprises should predict revisions to the Fed's forecasts between meetings and, if investors fail to incorporate this information in their economic forecasts, also predict subsequent US economic news announcements.

In this section, we show that the ECB's predictive power on FOMC surprises does not work through either of these channels. Our analysis indicates that a new channel, which we designate as the global monetary shock channel, drives the ECB's predictability of the Fed.

5.1 Fed Response to Economic News

Bauer and Swanson (2022) argue that professional forecasters and the Fed respond to the same set of economic news, but that investors systematically under-predict the Fed's response. To support their hypothesis, they regress Blue Chip forecast revisions on economic news surprises in addition to FOMC surprises, repeating the information effect regression with economic surprises as control variables. They find that the sign of the FOMC surprises flips: controlling for economic news, Fed tightening makes Blue Chip forecasts more contractionary, consistent with standard economic theory. To explain why economic news predicts FOMC announcements, Bauer and Swanson (2022) propose investor misspecification of the Fed's reaction function to the economy. They argue that the Fed consistently reacts more strongly to economic fundamentals than investors predict, leading to the ability of economic news to predict FOMC surprises.

To test if the ECB's predictive ability over FOMC surprises is subsumed by this channel, we rerun the regression in Equation (1) controlling for the economic news variables in Bauer and Swanson (2022). These variables include the previous surprises on unemployment news, non-farm payrolls news, GDP, and core inflation, as well as the change in core CPI over the previous 6 months, the change in core CPI expectations over the previous 6 months. They also include the change in the log S&P 500 index, the change in the yield curve slope, and the change in the Bloomberg commodity price index over the previous 3 months. The regression takes the form

$$\Delta Fed_t = \beta_0 + \beta_1 \Delta ECB_{ME,t-\delta} + \Gamma X_t \epsilon_t \tag{11}$$

$\Delta ECB_{t-\delta}$ are movements in OIS futures around ECB announcements in the ECB meeting before an FOMC meeting. X_t are the Bauer and Swanson (2022) variables. Surprises are defined as the difference between the value of a macroeconomic variable publicly revealed at announcement time t before the FOMC meeting and the expectation of that release as suggested by the survey.

The results from these regressions are shown in Table 5. The first three columns

predict FFR surprises, while the last three predict NS surprises. The first column within each group of three runs the baseline regression from Table 3 in Bauer and Swanson (2022).

ECB press conference surprises continue to predict FOMC surprises controlling for the Bauer and Swanson (2022) variables. In fact, the point estimates for the press conference surprises in these regressions are higher than the point estimates in the baseline regressions shown in Tables 2, indicating that the ECB reveals information relevant to FOMC surprises that is orthogonal to US economic news announcements. These regressions show that the Fed's response to the news channel does not explain why FOMC surprises are predicted by the ECB.

5.2 Information Effect

We now examine whether the information effect is a plausible channel to explain our results. If the ECB reveals information that the Fed uses to update its economic forecast, but investors ignore, ECB surprises can be considered a source of private information for the Fed.

We first test whether ECB surprises predict US economic news surprises. If they do, this would indicate that investors systematically ignore information released by the ECB that is relevant for the US economy. If the ECB surprises do not predict economic news surprises, then either investors incorporate this information in their forecasts, or the ECB does not reveal relevant information.

We regress macroeconomic surprises on ECB surprises:

$$Surprise_{t,v} = \beta_0 + \beta_1 ECB_{ME,t-\delta} + \epsilon_t \tag{12}$$

$Surprise_{t,v}$ is the surprise to a macroeconomic variable v revealed at announcement time t, where surprises are defined in the previous section.

As shown in Tables 6 and 7, ECB surprises have do not have significant predictive power over subsequent US economic news surprises. Based on these results, either in-

vestors accurately incorporate revelations from the ECB into their forecasts, or the ECB does not reveal private information relevant to the US economy.

We also consider whether the Fed uses ECB releases to update its private view of the economy. If this is the case, then ECB surprises are effectively revealing private information the Fed uses to update its view of the economy. We directly test whether the Fed updates its forecasts using ECB surprises by regressing Greenbook Forecast changes on ECB surprises that occurred before each meeting and after the previous meeting, as well as economic news releases. The regressions take the form:

$$\Delta GB_{v,t} = \beta_0 + \beta_1 ECB_{t-\delta} + \Gamma X_t + \epsilon_{v,t} \tag{13}$$

where $\Delta GB_{v,t}$ is the update at time t to the Fed's forecast of variable v and X_t are the Bauer and Swanson economic news variables. We run this regression for unemployment, GDP, and CPI forecasts. The results are shown in Tables 8, 9, and 10. We predict the nowcast, 1 quarter ahead forecast, and 2 quarter ahead forecast revisions for each variable. The first three columns of each table predict these revisions using OIS movements around the entire ECB monetary announcement, and the last three columns predict them using separate press releases and press conference movements.

With the exception of one quarter ahead of CPI revisions, ECB surprises have little predictive power over Greenbook forecast revisions of US economic conditions, including measures of unemployment and real GDP growth. Given these results, it is unlikely that the Fed uses ECB announcements to update its private forecasts for the US economy.

Lastly, we test whether the predictive power of the ECB surprises on subsequent FOMC surprises may be confounded with the Fed's forecasting updates. Following Miranda-Agrippino (2017), we regress FOMC surprises on changes in the Fed's forecasts for real GDP growth, inflation, and unemployment for the current quarter, subsequent quarter, and 2 quarters in the future. We also include the previous four FOMC surprises. The results in Table 11 indicate that the predictive power of ECB press conference surprises is not accounted for by updates to Greenbook forecasts. This result is inconsistent

with the Fed using ECB surprises to update its view of the US economy.

6 Robustness tests

6.1 Clustered standard errors

In periods of financial crises or economic booms, central banks can surprise markets for several consecutive meetings, which may result in monetary surprises being serially correlated. We address this concern by clustering standard errors at the day level in tables 12 and 13. While clustered standard errors are slightly larger, our main conclusions are robust – ECB surprises strongly predict subsequent FOMC surprises and the predictability is mostly driven by press conferences.

6.2 Date differences

FOMC meetings occur on average two weeks after the ECB meetings, while ECB meetings occur on average four weeks after the FOMC meetings. To mitigate the concern that our results may be driven by the pure date difference, we estimate our baseline regressions, adding interactions with weeks between the meetings.

Table 14 shows that although the predictability is stronger when meeting dates are closer, our main results still hold. Table 15 shows that even accounting for the date differences, FOMC shocks do not predict ECB shocks.

6.3 Influential Observations

Given the sample size of 137 FOMC meetings, individual observations can have a large effect on our estimate of how ECB surprises predict Fed surprises. To address this concern, we rerun our baseline regressions in Equations 1 and 2 while iteratively removing the most influential observation.

Our process for Regression 1 is as follows (the process for Regression 2 is identical). After running the baseline regression using our entire dataset, we calculate the initial

regression coefficient $\beta_{ME,0}$ and Cook's Distance of each point, $CD_{i,0}$.[4] We then remove the observation with the greatest $CD_{i,0}$ and rerun the regression on the dataset excluding that observation. We record the new coefficient $\beta_{ME,1}$ and the new Cook's Distance for each point, $CD_{i,1}$. We then remove the most influential observation from that regression, and repeat the process until we have removed 40 observations.

The coefficients $\beta_{ME,k}$ after removing k points from our dataset with the above procedure are shown in the first panel of Figure 1. While $\beta_{ME,k}$ becomes insignificant after removing the first four observations, it regains significance after removing the subsequent 3 most significant observations. Similarly, the coefficient falls as further observations are removed but rises again after the first 22 iterations. This pattern indicates that the predictive power of the ECB's monetary event surprise over the FOMC surprises is not driven by a handful of influential observations.

We repeat with Regression 2, predicting FOMC surprises using press releases and press conference surprises separately. $\beta_{PR,k}$ at each iteration is shown in the second panel, and $\beta_{PC,k}$ is shown in the third panel. The predictive ability of the press conference surprise is significant until 10% of the sample is removed, again indicating that this predictability does not depend on a small number of points. Interestingly, removing the most influential observations increases $\beta_{PR,k}$, suggesting that the predictive ability of press release surprises is disguised by the most influential observations in our sample.

7 Re-evaluation of monetary policy results

As discussed above, monetary policy shocks have been widely used to identify the impact of monetary policy on real variables. For example, seminal papers Gertler and Karadi (2015) and Bernanke and Kuttner (2005) use high-frequency identified monetary shocks to evaluate the impact of monetary policy on bond returns and stock returns, respectively.

[4]The Cook's Distance of observation i is given by $CD_i = \frac{\sum_{j=1}^{n}(\hat{y}_j - \hat{y}_{j\setminus i})}{ks^2}$, where $\hat{y}_j$ is the predicted value of observation j in the current regression, and $\hat{y}_{j\setminus i}$ is the predicted value of j when running the regression excluding observation i. k is the number of regressors and s^2 is the mean squared error of the regression.

In this section, we quantify the importance of the component of FOMC shocks predicted by ECB shocks on the results of each of these papers.

We start by replicating Bernanke and Kuttner (2005). We identify the effect of monetary policy on equity returns in the 2000-2020 period using the CRSP value-weighted equity index. We run the following regression:

$$Ind_t = \alpha + \beta MS_t + u_{it} \tag{14}$$

where ΔInd_t is the change in the value-weighted equity index around the FOMC announcement on date t and MS_t is the high-frequency monetary shock around that announcement. Table 16 shows the results. First, we replicate Bernanke and Kuttner (2005): a contractionary monetary shock, identified by movements in Fed Funds Rate futures around FOMC announcements, leads to lower equity returns. In column 2, we predict movements in the equity index using the ECB-predicted FOMC surprises. The coefficient in this regression (0.60) is almost identical to the coefficient on overall FOMC surprises (0.63), suggesting that the component of the Fed's policy surprises predicted by the ECB has a significant impact on equities in the US.

Next, we replicate Gertler and Karadi (2015), who provide evidence that monetary policy impacts the one-year rate, CPI, industrial production, and excess bond premium (see Figure 1 in Gertler and Karadi (2015)). We rerun their VAR using both instrumental variables and a Cholesky decomposition for identification. We replace one of the benchmark instruments – FF surprises – with our measure of shocks.[5]

Figure 2 shows the results. The left panel shows impulse responses (IRFs) from running benchmark VAR with external instruments, and the right panel shows VAR results with the Cholesky decomposition. Consistent with Gertler and Karadi (2015), ECB-predicted surprises impact the one-year rate. However, the magnitudes and significance levels are lower in our case. ECB-predicted surprises do not impact CPI. In contrast,

[5]We use the codes kindly provided by the authors and add our variables to their dataset.

ECB-predicted surprises have a strong impact on industrial production, indicating that the component of US monetary policy predicted by the ECB has significant effects on real US variables. Finally, the impact on the excess bond premium is stronger with our measure of shocks. In other words, if investors realized that ECB surprises impacted FOMC surprises, monetary transmission through credit costs would have been stronger.

We also replicate credit cost results of Gertler and Karadi (2015). Figure 3 shows the results. All spreads react stronger to monetary policy identified using our measure of shocks than the standard measure. In other words, monetary policy pass-through to the real economy might have been weaker due to the predictability of the surprises.

These exercises suggest that the Fed's response to news released by the ECB is a major driver of macroeconomic variables in the United States. ECB-predicted monetary surprises have significant effects on short-term bond yields and industrial production, indicating the importance of this international channel for US monetary policy.

8 Conclusion

In this paper, we take a critical look at the widely-used high-frequency identification of monetary policy surprises. We show that despite the assumed full-information rational expectations, high-frequency identified US monetary shocks are predictable by preceding ECB monetary shocks. Our findings are robust to considering the Fed response under-reaction explanation proposed by Bauer and Swanson (2022). Moreover, we show that ECB monetary surprises neither correspond to changes to US public expectations of US macroeconomic variables nor do they predict changes to the Federal Reserve's Tealbook internal macroeconomic projections. Furthermore, we find the explanatory power of ECB monetary shocks drives a large portion of the monetary transmission findings to stock returns, bond yields, and real variables. This suggests that, despite the outsized role of the Federal Reserve in international monetary policy transmission, the unanticipated response of the Federal Reserve to foreign monetary policy—particularly the news on foreign growth embedded within foreign monetary policy news—may be an important

driver of US monetary policy shocks.

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Table 2: Predicting FOMC Surprises with ECB Surprises
$\Delta Fed_t = \beta_0 + \beta_1 \Delta ECB_{ME,t-\delta} + \epsilon_t$
$\Delta Fed_t = \beta_0 + \beta_1 \Delta ECB_{PR,t-\delta} + \beta_2 \Delta ECB_{PC,t-\delta} + \epsilon_t$

	Dependent variable:			
	FF surprise			
	(1)	(2)	(3)	(4)
ECB Surprise	0.189**		0.187**	
	(0.0844)		(0.0844)	
ECB PR Surprise		0.174*		-0.123
		(0.101)		(0.113)
ECB PC Surprise		0.593**		0.490**
		(0.248)		(0.228)
ECB Surprise Lag			-0.0726	
			(0.0757)	
ECB PR Surprise Lag				-0.160
				(0.112)
ECB PC Surprise Lag				-0.180
				(0.228)
Observations	184	163	184	152
R^2	0.0270	0.0505	0.0319	0.0536

Note: This table provides results of estimation of equations (1) and (2). The first column shows benchmark result. The second column shows results of regression (2) where the ECB shock is computed separately for the press release and press conference. Columns 3 and 4 include lags. Standard errors are displayed in the parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

Table 3: Predicting FOMC Surprises with ECB Surprises: Expansionary vs Contractionary Surprises

$$\Delta Fed_t = \beta_0 + \beta_1 \Delta ECB_{ME,t-\delta} + \epsilon_t$$
$$\Delta Fed_t = \beta_0 + \beta_1 \Delta ECB_{PR,t-\delta} + \beta_2 \Delta ECB_{PC,t-\delta} + \epsilon_t$$

	Dependent variable:					
	FF surprise					
	(1)	(2)	(3)	(4)	(5)	(6)
ECB Surprise	0.189**		0.114		0.306***	
	(0.0844)		(0.151)		(0.0983)	
ECB PR Surprise		0.174*		0.125		0.291**
		(0.101)		(0.155)		(0.131)
ECB PC Surprise		0.593**		0.738*		0.674**
		(0.248)		(0.393)		(0.292)
Sample	Full	Full	Contr	Contr	Exp	Exp
Observations	184	163	114	101	104	90
R^2	0.0270	0.0505	0.00505	0.0410	0.0866	0.0877

Note: This table provides results of estimation of equations (1) and (2) separately for contractionary and expansionary shocks. The first two columns show results for the full sample. Columns 3 and 4 present results only for contractionary shocks. Columns 5 and 6 show results only for expansionary shocks. Standard errors are displayed in the parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

Table 4: Asset Price Movements Around FOMC Predicted by Preceding ECB Announcement

Full Sample							
	Policy Rate	5-Year DE	10-Year DE	DAX	S&P	5-Year US	10-Year US
Lag	0.19*	0.12**	0.14***	−0.16**	−0.36***	0.15	0.22*
	(0.10)	(0.04)	(0.04)	(0.07)	(0.11)	(0.17)	(0.12)
N	184	123	123	128	166	141	141
R^2	0.03	0.10	0.09	0.10	0.12	0.00	0.01
Positive Yield-Stock Return Comovement							
	Policy Rate	5-Year DE	10-Year DE	DAX	S&P	5-Year US	10-Year US
Lag	0.24**	0.19***	0.26***	−0.21**	−0.41***	0.46*	0.48*
	(0.11)	(0.04)	(0.06)	(0.08)	(0.11)	(0.24)	(0.24)
N	91.00	45.00	45.00	48.00	77.00	54.00	54.00
R^2	0.04	0.29	0.30	0.12	0.18	0.03	0.05
Negative Yield-Stock Return Comovement							
	Policy Rate	5-Year DE	10-Year DE	DAX	S&P	5-Year US	10-Year US
Lag	−0.04	0.04	0.05	−0.10***	−0.01	−0.14	−0.00
	(0.19)	(0.05)	(0.07)	(0.02)	(0.16)	(0.32)	(0.21)
N	93.00	78.00	78.00	80.00	89.00	87.00	87.00
R^2	0.00	0.01	0.01	0.09	0.00	0.01	0.00

Note: This table provides the results of predictive regressions of asset price movements around FOMC announcements using ECB announcements: $\Delta P_t = \beta_0 + \beta_1 \Delta P_{t-\delta} + \epsilon_t$. Only the coefficient β_1 of each regression is shown for brevity. The first column predicts movements in the 5-year German government bond yield around FOMC announcements using the movements around the preceding ECB announcement. The second column shows this coefficient for 10-year German government. The next columns do the same for the DAX European stock index, S&P E-mini futures, 5-year US government bonds, and 10-year US government bonds. The top panel shows the results for our entire sample. The middle panel uses observations where the 1-year German bond yield moved in the same direction as the Euro STOXX50E index. The bottom panel shows movements where this comovement was negative or zero. Standard errors are clustered by year. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

Table 5: Predicting FOMC Surprises with ECB Surprises and Economic News

	FF surprise			NS surprise		
	(1)	(2)	(3)	(4)	(5)	(6)
Unemployment Surprise	−419.4**	−412.0**	−321.2*	−357.1*	−351.9*	−295.9
	(191.9)	(189.0)	(193.2)	(194.8)	(192.6)	(200.1)
GDP Surprise	−68.41	−52.11	1.727	−59.17	−47.78	−101.1
	(81.40)	(80.11)	(84.66)	(72.72)	(71.80)	(71.77)
BBK Index	0.678	0.959	1.254	1.395	1.591*	1.498
	(1.264)	(1.234)	(1.272)	(0.886)	(0.885)	(0.937)
Core CPI Inflation Surprise	57.19	196.2	210.2	212.9	309.9	-3.186
	(541.5)	(524.7)	(541.0)	(453.4)	(446.3)	(437.6)
ECB Announcement Surprise		0.243*			0.170	
		(0.135)			(0.112)	
Press Release Surprise			0.179			0.0890
			(0.153)			(0.133)
Press Conference Surprise			0.910**			0.855***
			(0.370)			(0.264)
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	150	150	136	150	150	136
R^2	0.0520	0.0843	0.127	0.135	0.154	0.158

Note: This table provides results of estimation of equation (11). The first three columns predict FFR surprises, while the last three predict Nakamura and Steinsson (2018b) surprises. The first column within each group of three runs the baseline regression from Table 3 in Bauer and Swanson (2022). Standard errors are clustered at the time level and displayed in the parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

Table 6: Predicting US Economic Surprises with ECB Surprises
$Surprise_{t,v} = \beta_0 + \beta_1 ECB_{ME,t-\delta} + \epsilon_t$

	Dependent variable:			
	Unemployment	Nonfarm payroll	GDP	Core CPI
	(1)	(2)	(3)	(4)
ECB surprise	0.000	-0.040	-0.000	-0.000
	(0.000)	(2.764)	(0.000)	(0.000)
Observations	257	257	258	257
R^2	0.001	0.000	0.000	0.004

Note: This table provides results of estimation of equation (12). The first column shows results for unemployment surprise. The second column shows the results for nonfarm payroll surprise. The third column presents results for GDP surprise. Column 4 presents results for core CPI surprise. Standard errors are clustered at the time level and displayed in the parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

Table 7: Predicting US Economic Surprises with Disaggregated ECB Surprises
$Surprise_{t,v} = \beta_0 + \beta_1 \Delta ECB_{PR,t-\delta} + \beta_2 \Delta ECB_{PC,t-\delta} + \epsilon_t$

	Dependent variable:			
	Unemployment	Nonfarm payroll	GDP	Core CPI
	(1)	(2)	(3)	(4)
ECB PR surprise	0.000	-6.753	-0.000	-0.000*
	(0.000)	(6.553)	(0.000)	(0.000)
ECB PC surprise	-0.000	-0.639	-0.000	-0.000
	(0.000)	(9.337)	(0.000)	(0.000)
Observations	235	228	221	235
R^2	0.002	0.001	0.004	0.010

Note: This table provides results of estimation of equation (12) separately for press release and press conference surprises. The first column shows results for unemployment surprise. The second column shows the results for nonfarm payroll surprise. The third column presents results for GDP surprise. Column 4 presents results for core CPI surprise. Standard errors are clustered at the time level and displayed in the parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

Table 8: Predicting Greenbook Unemployment Revisions with ECB Surprises

	Current	1 qtr ahead	2 qtr ahead	Current	1 qtr ahead	2 qtr ahead
	(1)	(2)	(3)	(4)	(5)	(6)
Unemployment surprise	30.99***	21.93***	13.80	30.64***	21.12***	12.02
	(6.761)	(7.212)	(9.564)	(7.577)	(7.987)	(9.586)
Nonfarm payroll suprise	−0.0000	−0.000	−0.0003**	0.0001	−0.0000	−0.0002
	(0.0002)	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0001)
GDP surprise	−2.133	−2.012	−5.135*	−3.930	−3.066	−6.396**
	(2.468)	(2.451)	(2.753)	(2.591)	(2.551)	(2.848)
CPI surprise	−13.48	−10.03	−23.32*	−12.53	−5.053	−21.57
	(14.74)	(14.37)	(13.99)	(15.96)	(14.59)	(14.13)
ECB surprise	−0.007*	−0.003	−0.001			
	(0.004)	(0.004)	(0.004)			
ECB PR surprise				−0.007	−0.001	0.002
				(0.005)	(0.004)	(0.004)
ECB PC surprise				−0.001	−0.008	−0.002
				(0.011)	(0.012)	(0.012)
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes
Observation	147	147	147	134	134	134
R^2	0.232	0.276	0.288	0.254	0.282	0.301

Note: This table provides results of estimation of equation (13) for unemployment current and 1 and 2 quarter ahead forecast. The first three columns predict include ECB shocks. The last three columns include press release and press conference shocks separately. Standard errors are clustered at the time level and displayed in the parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

Table 9: Predicting Greenbook RGDP Revisions with ECB Surprises

	Current	1 qtr ahead	2 qtr ahead	Current	1 qtr ahead	2 qtr ahead
	(1)	(2)	(3)	(4)	(5)	(6)
Unemployment surprise	4.860	23.60	5.624	27.21	28.31	18.87
	(68.06)	(33.32)	(30.28)	(73.12)	(31.04)	(20.90)
Nonfarm payroll surprise	0.0014*	0.0001	−0.0001	0.0009	0.0002	0.0003
	(0.0008)	(0.0004)	(0.0004)	(0.0008)	(0.0004)	(0.0004)
GDP surprise	−4.253	16.25**	7.661	−5.274	13.12	2.180
	(14.64)	(8.212)	(8.346)	(17.49)	(10.05)	(7.550)
CPI surprise	82.29	60.12	49.60	72.50	48.28	31.04
	(74.06)	(54.92)	(38.83)	(76.88)	(60.13)	(42.00)
ECB surprise	−0.0051	−0.0032	−0.0027			
	(0.0167)	(0.0117)	(0.0139)			
ECB PR surprise				0.0124	0.0004	−0.0113
				(0.0150)	(0.0138)	(0.0123)
ECB PC surprise				−0.0398	−0.0056	0.0067
				(0.0524)	(0.0229)	(0.0184)
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes
Observation	147	147	147	134	134	134
R^2	0.0813	0.313	0.133	0.0715	0.243	0.166

Note: This table provides results of estimation of equation (13) for real GDP current and 1 and 2 quarter ahead forecast. The first three columns predict include ECB shocks. The last three columns include press release and press conference shocks separately. Standard errors are clustered at the time level and displayed in the parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

Table 10: Predicting Greenbook CPI Revisions with ECB Surprises

	Current	1 qtr ahead	2 qtr ahead	Current	1 qtr ahead	2 qtr ahead
	(1)	(2)	(3)	(4)	(5)	(6)
Unemployment surprise	7.644	30.26	-4.584	5.931	25.62	9.607
	(49.69)	(59.56)	(26.42)	(55.40)	(63.45)	(27.50)
Nonfarm payroll surprise	−0.0004	−0.0011	0.0008**	−0.0006	−0.0004	0.0007*
	(0.0009)	(0.0007)	(0.0004)	(0.0010)	(0.0008)	(0.0004)
GDP surprise	−24.32	7.560	−6.360	−21.62	−0.851	−11.01*
	(19.92)	(12.32)	(6.275)	(22.77)	(15.61)	(6.359)
CPI surprise	62.23	20.36	−32.94	79.87	6.209	−51.27
	(125.4)	(87.71)	(40.87)	(132.0)	(93.75)	(40.18)
ECB surprise	−0.0383	0.0321**	0.0057			
	(0.0281)	(0.0138)	(0.0085)			
ECB PR surprise				−0.0322	0.0279	−0.0015
				(0.0321)	(0.0177)	(0.0108)
ECB PC surprise				−0.0326	0.0435	0.0265
				(0.0470)	(0.0466)	(0.0225)
Macro controls	Yes	Yes	Yes	Yes	Yes	Yes
Observation	147	147	147	134	134	134
R^2	0.227	0.229	0.0692	0.226	0.228	0.0607

Note: This table provides results of estimation of equation (13) for CPI current and 1 and 2 quarter ahead forecast. The first three columns predict include ECB shocks. The last three columns include press release and press conference shocks separately. Standard errors are clustered at the time level and displayed in the parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

Table 11: Predicting FOMC Surprises with ECB Surprises and Greenbook Forecasts

	FF surprise			NS surprise		
	(1)	(2)	(3)	(4)	(5)	(6)
GDP forecast	-0.0349	0.0619	-0.374	-0.174	-0.0983	-0.150
	(0.556)	(0.536)	(0.484)	(0.555)	(0.558)	(0.550)
Unemployment forecast	0.523	1.709	-2.696	1.434	2.416	-0.765
	(6.094)	(5.858)	(5.702)	(4.784)	(4.763)	(4.968)
CPI forecast	0.0231	0.145	-0.123	0.747*	0.839**	0.675*
	(0.449)	(0.461)	(0.418)	(0.412)	(0.417)	(0.405)
ECB surprise		0.236			0.205*	
		(0.153)			(0.123)	
ECB PR surprise			0.197			0.224
			(0.162)			(0.164)
ECB PC surprise			0.662*			0.472**
			(0.368)			(0.199)
Future forecasts	Yes	Yes	Yes	Yes	Yes	Yes
Observations	147	147	136	147	147	136
R^2	0.0917	0.121	0.178	0.143	0.168	0.149

Note: This table provides results of estimation of equation (1) including greenbook forecasts and one and two quarters ahead forecasts. The first three columns predict FFR surprises, while the last three predict Nakamura and Steinsson (2018a) surprises. Standard errors are clustered at the time level and displayed in the parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

Table 12: Predicting FOMC Surprises with ECB Surprises: Clustered Standard Errors
$\Delta Fed_t = \beta_0 + \beta_1 \Delta ECB_{ME,t-\delta} + \epsilon_t$
$\Delta Fed_t = \beta_0 + \beta_1 \Delta ECB_{PR,t-\delta} + \beta_2 \Delta ECB_{PC,t-\delta} + \epsilon_t$

	Dependent variable:			
	FF surprise			
	(1)	(2)	(3)	(4)
ECB surprise	0.189*		0.187*	
	(0.109)		(0.108)	
ECB PR surprise		0.174		-0.123
		(0.149)		(0.128)
ECB PC surprise		0.593*		0.490*
		(0.308)		(0.272)
ECB surprise lag			-0.072	
			(0.137)	
ECB PR surprise lag				-0.162
				(0.243)
ECB PC surprise lag				-0.180
				(0.237)
Observations	184	184	152	128
R^2	0.0270	0.0505	0.0319	0.0536

Note: This table provides results of estimation of equations (1) and (2) with clustered standard errors. The first column shows benchmark result. The second column shows results of regression (2) where the ECB shock is computed separately for the press release and press conference. Columns 3 and 4 include lags. Standard errors are clustered at the time level and displayed in the parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

Table 13: Predicting FOMC Surprises with ECB Surprises: Expansionary vs Contractionary Surprises: Clustered Standard Errors

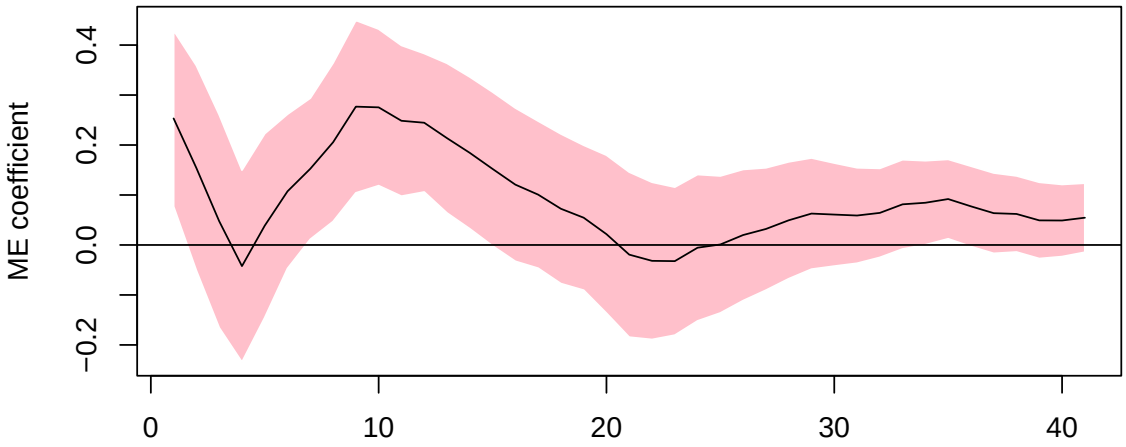
$$\Delta Fed_t = \beta_0 + \beta_1 \Delta ECB_{ME,t-\delta} + \epsilon_t$$
$$\Delta Fed_t = \beta_0 + \beta_1 \Delta ECB_{PR,t-\delta} + \beta_2 \Delta ECB_{PC,t-\delta} + \epsilon_t$$

	Dependent variable:					
	FF surprise					
	(1)	(2)	(3)	(4)	(5)	(6)
ECB Surprise	0.189*		0.114		0.306**	
	(0.109)		(0.193)		(0.118)	
ECB PR Surprise		0.174		0.125		0.291
		(0.149)		(0.194)		(0.193)
ECB PC Surprise		0.593*		0.738*		0.674
		(0.308)		(0.434)		(0.429)
Sample	Full	Full	Contr	Contr	Exp	Exp
Observations	184	163	114	101	104	90
R^2	0.0270	0.0505	0.00505	0.0410	0.0866	0.0877

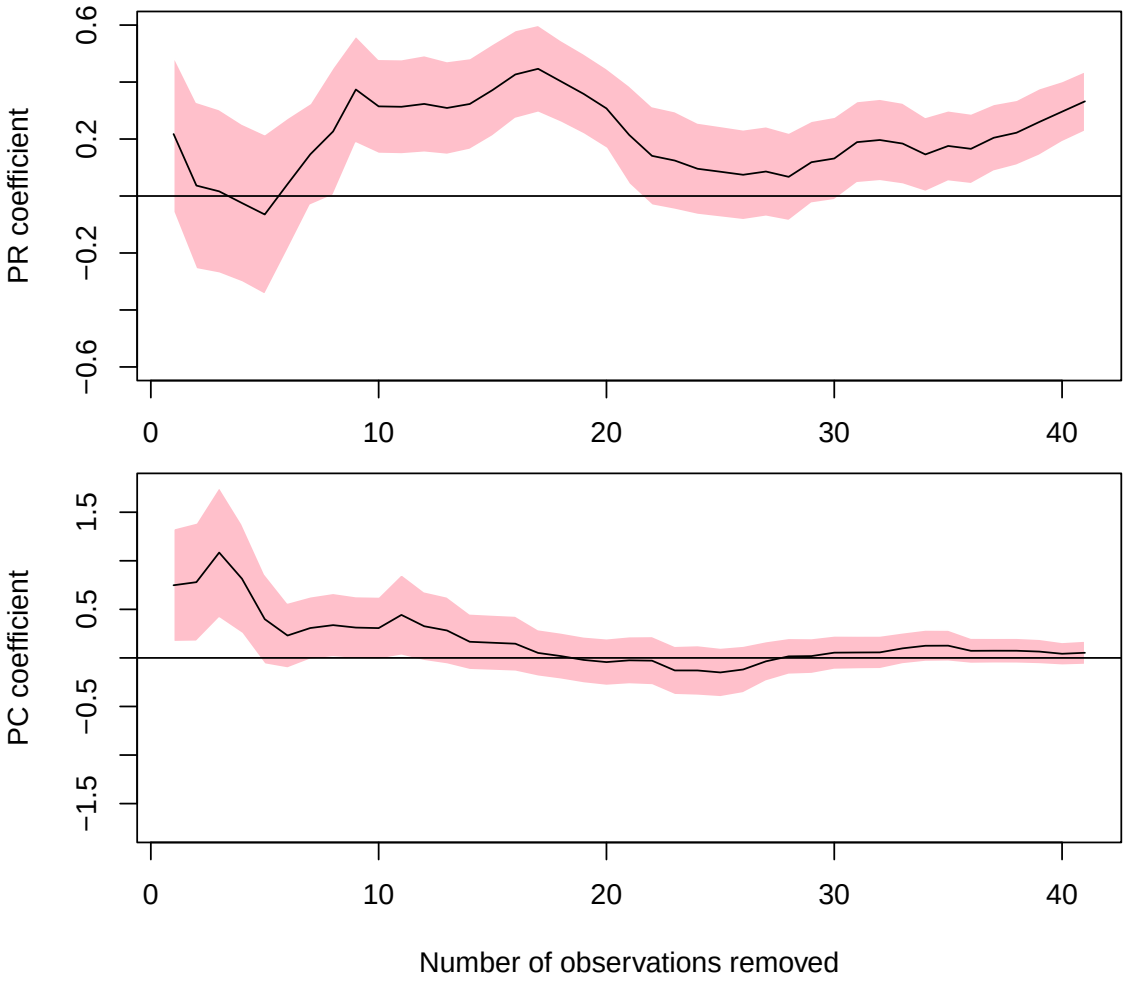
Note: This table provides results of estimation of equations (1) and (2) separately for contractionary and expansionary shocks with clustered standard errors. The first two columns show results for the full sample. Columns 3 and 4 present results only for contractionary shocks. Columns 5 and 6 show results only for expansionary shocks. Standard errors are clustered at the time level and displayed in the parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

Figure 1: Regression Coefficients After Iteratively Removing Most Influential Observations

$$\Delta Fed_t = \beta_0 + \beta_1 \Delta ECB_{ME,t-\delta} + \epsilon_t$$



$$\Delta Fed_t = \beta_0 + \beta_1 \Delta ECB_{PR,t-\delta} + \beta_2 \Delta ECB_{PC,t-\delta} + \epsilon_t$$



Coefficients on ECB surprises from Regressions 1 and 2, iteratively removing the most influential observation. 90% confidence bands with robust standard errors are shown.

Table 14: Effect of ECB Surprises on Subsequent FOMC Surprises, Controlling for Time between Surprises

	Dependent variable: FF surprise			
	(1)	(2)	(3)	(4)
ECB ME surprise	0.258*	0.679***		
	(0.144)	(0.151)		
Weeks		-0.211		-0.260
		(0.203)		(0.191)
ECB ME surprise X Weeks		-0.220***		
		(0.0667)		
ECB PR surprise			0.224	0.730***
			(0.156)	(0.105)
ECB PC surprise			0.685**	0.431
			(0.339)	(0.419)
ECB PR surprise X Weeks				-0.257***
				(0.0785)
ECB PC surprise X Weeks				0.197
				(0.341)
Observations	150	150	137	137
R^2	0.0439	0.100	0.0990	0.179

Note: Column (1) repeats the original regression result, regressing FF surprises on previous ECB monetary event surprises, controlling for lagged FF surprises and using robust standard errors. Column (2) adds as regressors the number of weeks between ECB announcement date and FOMC announcement date, and the interaction between the surprise and the announcement date. Column (3) separates the ECB monetary surprise. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

Table 15: Effect of FF Surprises on Subsequent ECB Surprises, Controlling for Time between Surprises

	Dependent variable:					
	ECB		ECB PR		ECB PC	
	(1)	(2)	(3)	(4)		
FF surprise	0.0344	0.489	0.0585	0.480	-0.0536	0.143
	(0.0855)	(0.440)	(0.0827)	(0.453)	(0.0476)	(0.141)
Weeks		-0.287		-0.244		-0.111
		(0.300)		(0.304)		(0.0816)
FF surprise X Weeks		-0.108		-0.100		-0.0517
		(0.114)		(0.117)		(0.0462)
Observations	146	146	146	146	124	124
R^2	0.00280	0.0444	0.00667	0.0462	0.0242	0.0637

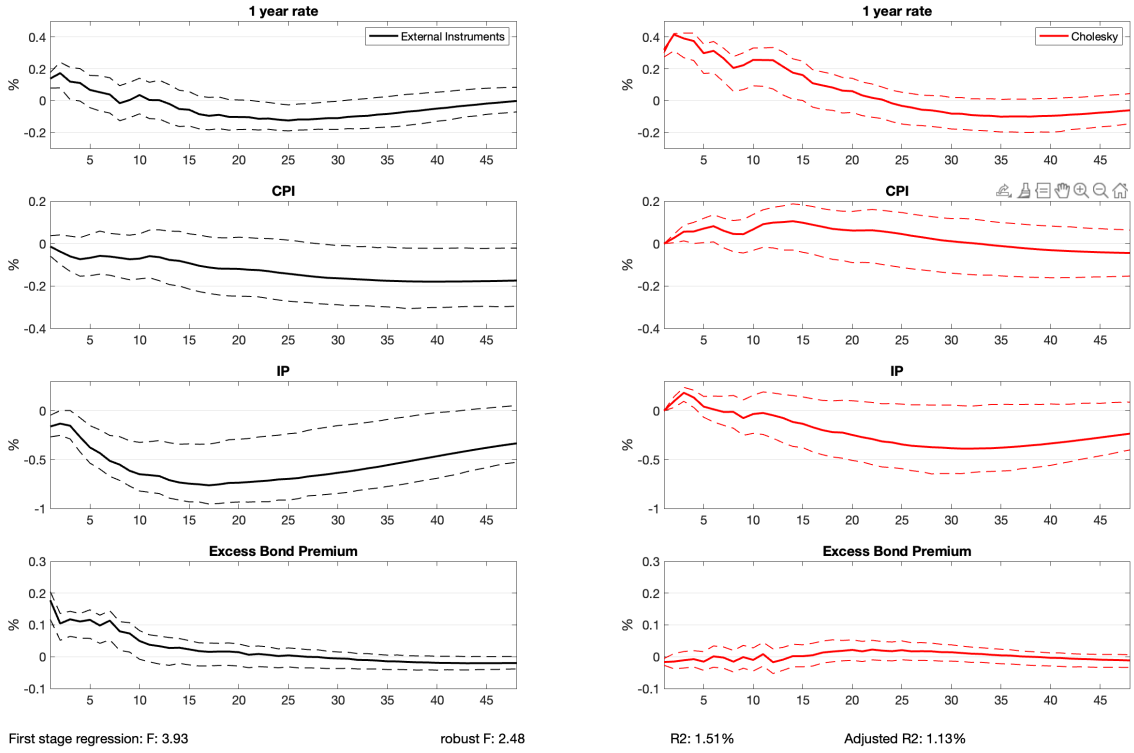
Note: Column (1) regresses the ECB monetary event surprise on the previous FF surprise. Column (2) adds as regressors the number of weeks between the ECB monetary event and the previous FF event and the interaction between the number of weeks and the FF surprise. Columns (3) and (4) evaluate the effect on the ECB press release surprise, and columns (5) and (6) the effect on the ECB press conference surprise. *,**, and *** correspond to 10-, 5-, and 1% significance level, respectively.

Table 16: Replication of Bernanke and Kuttner (2005) Results
$Ind_t = \alpha + \beta MS_t + u_t$

	Dependent variable:	
	Equity Index	
	(1)	(2)
BK shock	-0.063^{**}	
	(0.030)	
KSV shock		-0.060^{*}
		(0.031)
Constant	0.002^{*}	0.002^{**}
	(0.001)	(0.001)
Observations	151	151
R^2	0.047	0.041

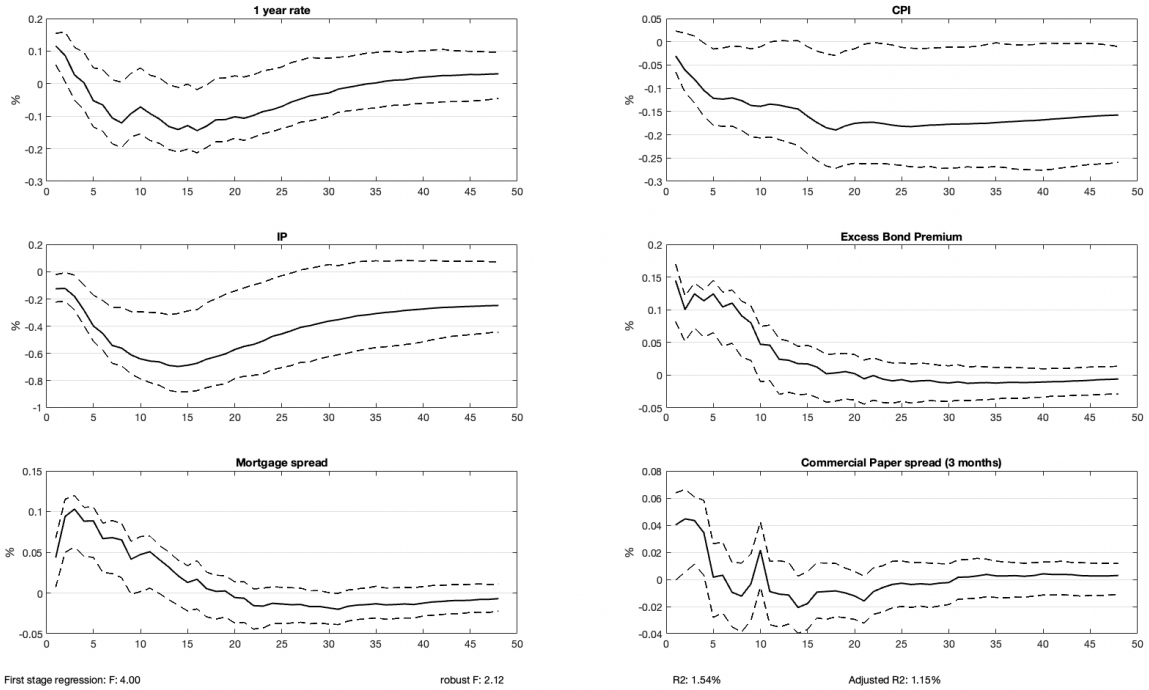
Note: This table provides results of estimation of (14). Column 1 uses classic monetary surprises as a regressor. Column 2 uses the component of FOMC surprises predicted by the previous ECB announcement surprise. Standard errors are robust and displayed in the parentheses. *,**, and *** correspond to 10-, 5-, and 1% significance level, respectively.

Figure 2: Replication of Gertler and Karadi (2015) Results



First stage regression: F: 3.93 robust F: 2.48 R2: 1.51% Adjusted R2: 1.13%

Figure 3: Replication of Gertler and Karadi (2015) Credit Cost Results



First stage regression: F: 4.00 robust F: 2.12 R2: 1.54% Adjusted R2: 1.15%