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Central bank information effects and transatlantic spillovers

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Marek Jarociński Central bank information effects
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Abstract

The news about the economy contained in a central bank announcement can affect public expectations. This paper shows, using both event studies and vector autoregressions, that such central bank information effects are an important channel of the transatlantic spillover of monetary policy. They account for a part of the co-movement of German and US government bond yields around Fed policy announcements, for most of this co-movement around ECB policy announcements, and significantly affect a range of financial and macroeconomic quantities on both sides of the Atlantic. These findings shed new light on the nature of central bank information.

JEL Classification: E52, F31, F42

Keywords: International Policy Transmission, Monetary Policy Shocks, High-Frequency Identification, Structural VAR

Non-technical summary

The yields on the US and German government bonds often co-move on the days when the Fed or the ECB announce their policy decisions. This is one symptom of the transatlantic spillovers of domestic monetary policies. Because of these spillovers, it is feared, when one central bank raises rates and tightens financial conditions in its jurisdiction, they tighten on the other side of the Atlantic as well. But this paper shows that a part of the spillovers observed after Fed announcements and the bulk of those observed after ECB announcements are of entirely different nature. On average in the last 20 years, when both German and US government bond yields increase in the wake of an ECB announcement, this is typically followed by higher stock prices and lower corporate bond spreads, i.e. overall easier, not tighter, financial conditions on both sides of the Atlantic. This pattern is present both in daily and in monthly data.

Recent literature on “central bank information effects” offers an explanation of this finding. As long as there is uncertainty about the state of the economy, the information effect will emerge, meaning that people analyzing a central bank policy announcement will update their beliefs not only about monetary policy, but also about the economy. Consequently, a surprise interest rate hike makes investors pessimistic when it is perceived as hawkish monetary policy, but optimistic when it is interpreted as a proportional reaction to good economic news (i.e., when the information effect is triggered).

The strong transatlantic spillover of the ECB information effect documented in this paper is interesting for at least three reasons. First, this finding implies that transatlantic monetary policy spillovers are more complex than previously believed. In particular, observing a co-movement of German and US government bond yields is not sufficient to conclude about the economic nature of the transatlantic spillover, one needs to look at other financial data too. Second, this paper documents a case where the central bank information effect is quite clear in the data and economically significant. So far, economists agree that this effect is a theoretical possibility but continue to debate its economic significance in other datasets and samples studied before. Third, the strong transatlantic spillover of the information effect sheds new light on the nature of central bank information. It suggests that the news that investors infer from central bank announcements are more global than typically assumed.

1 Introduction

Announcements of the US Fed and the European Central Bank (ECB) are closely followed also outside their respective jurisdictions and arguably affect financial conditions there. These international spillovers are not necessarily desirable and hence highly controversial. For some voices in this high-profile debate see Miranda-Agrippino and Rey (2020); Rajan (2016); Bernanke (2015); Powell (2018).

The observers are concerned about the following scenarios. Suppose that the US interest rates rise in the wake of a Fed policy announcement. The US financial conditions tighten, and since the dollar is a major funding currency and financial markets are closely integrated, European financial conditions tighten as well. But the euro's economic weight is not negligible, so when the euro area interest rates rise in the wake of an ECB policy announcement, the question is not 'whether', but 'how much' financial conditions tighten in the US too. Some empirical results suggest that the spillover from the euro area to the US may be no weaker than from the US to the euro area (e.g. Curcuru et al., 2018).

This paper confirms that the ECB often generates significant spillovers to the US but shows that these spillovers are very different from the above scenario. Over the 20 years of the existence of the ECB, most of the time an ECB announcement that triggers interest rates increases is followed by an easing, not tightening, of the US financial conditions, driven by a compression of risk premia.

This puzzling finding can be explained by the “central bank information effect”: when the Fed or the ECB announce their policies, market participants may update their beliefs not only about monetary policy, but also about the state of the economy (see e.g. Melosi, 2017; Nakamura and Steinsson, 2018). This paper shows that the information effect can explain a non-negligible part of the transatlantic co-movement of interest rates around both central bank's announcements. In fact, for the ECB the information effect accounts for almost all the spillovers.

These findings are interesting because they document a case where the information effect is economically significant. Recent papers by Bauer and Swanson (2020); Hoesh et al. (2020) question the economic significance of the Fed information effect, but in the case of the ECB spillovers to the US the information effect actually dominates the picture

and it is hard to make sense of the data without taking it into account.

The impact of the ECB information effect on the US economy sheds new light on the nature of this effect. It is common to think about the information effect in the context of a central bank that communicates its assessment of the natural rate of interest in the domestic economy (e.g. Nakamura and Steinsson, 2018; Müller et al., 2019). This paper shows that, in the data studied here, the information effect looks like a pretty symmetric shock to the risk premia demanded by investors on both sides of the Atlantic. This calls for a rethinking of the nature of central bank information, because it is not obvious why the news about the euro area natural rate of interest, or other similar domestic news, would affect the US stock prices, corporate bond spreads, broad dollar exchange rate and eventually real activity and prices as much as shown here. Furthermore, in the cross-section of stocks, predominantly US-exposed companies respond almost as much as foreign-exposed companies. Instead, the stocks that respond the most are those that are particularly sensitive to general investor sentiment: financial stocks and small stocks (Baker and Wurgler, 2006).

It is an open question why the ECB announcements affect the risk premia so much. One possibility is that the ECB has an information advantage, relative to the public, regarding the fundamentals of the global economy. It is not obvious why this would be the case, with a notable exception. During the European Sovereign Debt Crisis the ECB is likely to have had information advantage about an important global shock: the feasibility and political will to prevent the break-up of the eurozone. Kane et al. (2020) argue that the communication of this shock explains a part of the ECB information effects (see also Wright, 2019). However, this particular information advantage may not be the whole story: I find that the ECB information effects are also present in the low-stress subsamples, when there were no concerns about the break-up of the eurozone. More work is needed on the nature of central bank information and the sources of central banks' supposed information advantage.

The empirical evidence in this paper is based on two parallel approaches: event study regressions (local projections) with daily financial variables to study the short-term effects and VARs with monthly data to study the longer-term effects. The Fed- and ECB-originated shocks are identified from high-frequency market responses to policy announce-

ments. The data come from the widely used databases of Gürkaynak et al. (2005) for the Fed and from Altavilla et al. (2019) for the ECB. I follow the sign-restriction identification approach of Jarociński and Karadi (2020) to disentangle the shocks: The monetary policy shocks are the interest rate hikes that depress stock prices on impact (and vice versa). The information shocks are the interest rate hikes that boost stock prices on impact, as if the agents inferred that the rates go up because the prospects for the economy are good (and vice versa). I use a convenient rule of thumb to implement these sign restrictions, thus simplifying the event study regression analysis and facilitating replication. Throughout, the paper focuses on the estimates of the spillovers of ECB shocks to the US, which are the most interesting. For comparison I also report the transatlantic spillovers of Fed shocks, and the domestic effects, which are consistent with the previous literature.

The empirical analysis proceeds in the following steps. The paper starts by documenting the puzzling, expansionary effect of ECB interest rate surprises on the US. It shows that no such puzzle emerges for the Fed interest rate surprises: they have a contractionary effect on the euro area.

Next, after decomposing the interest rate surprises into monetary policy and central bank information shocks, the paper shows that the ECB information shocks spill over strongly to the US, affecting a range of variables, while the ECB monetary policy shocks do not. This explains why the net effect of an ECB surprise is expansionary.

One interesting finding is that US government bond yields co-move closely with German ones when the ECB interest rate surprise is driven by an information shock, but not when it is driven by a monetary policy shock. The paper shows that this can be traced to the Fed's policy response. Subsequent changes in the federal funds target rate tend to offset the ECB monetary policy shocks but go in the same direction as the ECB information shocks. This reinforces the notion that a typical information shock is global in nature and calls for a similar policy response from the Fed as from the ECB. By contrast, the Fed shields the US from the ECB monetary policy shocks for most of the sample, although towards the end, as the ECB resorted increasingly to non-standard policies, the Treasury yields start to react to ECB monetary policy shocks too.

A cross-section of stock returns also suggests that the ECB information shock is not mainly euro area domestic news, but rather looks like a global shock. This is further con-

firmed by the strong response of the broad dollar exchange rate index to ECB information shocks, even after taking the euro/dollar exchange rate out of it. The role of the dollar as a barometer of global risk-taking capacity is documented recently e.g. by Avdjiev et al. (2019).

The paper studies also the variation of the financial spillovers across subsamples. It finds time-variation that can be related to the increasing use of non-standard monetary policies, but a remarkably stable response of the US stock prices to the ECB information shocks in all subsamples.

In the final step the same empirical analysis is repeated for the Fed shocks. In the case of the Fed the monetary policy shocks dominate in the interest rate surprises. However, similar, global information shocks show up in the VAR analysis (though they are not statistically significant in the daily event study regressions).

Other related literature. This paper builds on the large literature initiated by Kuttner (2001) that uses financial market responses to central bank policy announcements in order to isolate the unexpected component of monetary policy. For other identifications that, like Jarociński and Karadi (2020), account for the presence of information effects in these responses, see Miranda-Agrippino and Ricco (2018); Andrade and Ferroni (2020); Cieślak and Schrimpf (2019). Information effects are also called “Delphic forward guidance” following Campbell et al. (2012). Anderson and Cesa-Bianchi (2020) show that accounting for the Fed information effects is important for understanding the cross-section of US bond spreads. For Europe, Kerssenfischer (2019); Enders et al. (2019) show the role of ECB information effects for economic expectations.

Several recent papers report a strong impact of central bank information shocks on the risk premia and more broadly defined investor sentiment. Kroencke et al. (2019) identify an “FOMC risk shift”, related to the Fed information shock, and show that it triggers switches between risk-on and risk-off modes. Bekaert et al. (2020) find strong non-monetary policy-driven risk and uncertainty spillovers across countries, emanating not just from the US but also from the euro area (and Japan). In particular, consistently with this paper they find strong spillovers of ECB information shocks to the US stock prices. Franz (2020) studies a panel of exchange rates and shows that speculative currencies appreciate after positive ECB information shocks.

This paper is also related to the large literature that uses VAR methods to document strong international spillovers of the Fed’s monetary policy, such as Kim (2001); Maćkowiak (2007); Georgiadis (2016); Dedola et al. (2017); Gerko and Rey (2017); Miranda-Agrippino and Rey (2020); Ca’ Zorzi et al. (2020) and many others.

The rest of the paper is organized as follows. Section 2 explains the identification of shocks. Section 3 documents the puzzling spillovers of the ECB interest rate surprises, comparing them also with the spillovers of the Fed interest rate surprises. Section 4 decomposes the spillovers of ECB interest rate surprises into the effects of monetary policy and central bank information shocks. Section 5 does the same for the Fed, and section 6 concludes. Appendix A describes the data, Appendix B provides computational details related to shock identification and Appendix C reports detailed results of the event study regressions.

2 Identification of shocks

Monetary policy reacts to the state of the economy, reflecting a variety of global and domestic shocks. Any of these shocks can generate international spillovers on its own. For the study of the transatlantic spillovers of central bank policies it is crucial to separate the effects of these other shocks from the effect of central bank policy.

This section explains the construction of proxies for exogenous, central bank-originated shocks using the high-frequency identification. This approach, originated by Kuttner (2001), uses the high-frequency financial market reactions to central bank announcements, called “surprises”.

2.1 Central bank announcement surprises

A central bank announcement surprise is defined as the change in a financial asset price in a narrow time window around a central bank policy announcement. When the central bank begins to announce its policy, markets have already priced in the systematic response to the state of the economy. Therefore, the surprise is exogenous to this response and, hence, useful for isolating the causal effects of the central bank communication and action.

2.1.1 Data on central bank announcement surprises

The ECB surprises come from the Euro Area Monetary Policy Event-Study Database (EA-MPD) of Altavilla et al. (2019). The EA-MPD includes all the announcements of monetary policy decisions that follow ECB Governing Council meetings. The present paper uses the surprises in the “Monetary Event” window: a half-hour window around the press release, extended until 15 minutes after the end of the press conference whenever there is one. As of writing this paper the EA-MPD contained 264 announcements from 7 January 1999 to 6 June 2019. I drop three coordinated, same-day policy announcements by the Fed and the ECB: on 13 and 17 September 2001 and on 8 October 2008, as for obvious reasons such joint announcements not useful for isolating the transatlantic spillovers. This leaves 261 ECB announcements.¹

The Fed surprises come from the updated Gürkaynak et al. (2005) (GSS) database. For comparability with the ECB I start the sample in 1999. I drop three coordinated, same-day policy announcements by the Fed and the ECB: on 17 September 2001, 11 March 2008 and 8 October 2008 (note that the second one is not present in the EA-MPD). Since the EA-MPD does not include any speeches, I omit the two speeches, on 28 November and 1 December 2008, and the unusually large surprise from 18 April 2001.² This leaves 167 Fed announcements.

For each database I compute the summary **interest rate surprises**, i^{Total} and **stock price surprises**, s . The interest rate surprise is the first principal component of the surprises in several interest rate derivatives. For the Fed I use the first principal component of the surprises in the current month and 3-month fed funds futures and 2-, 3-, and 4- quarters ahead 3-month eurodollar futures. This follows Gürkaynak et al. (2005); Nakamura and Steinsson (2018) and many others. For the ECB I use the first principal component of the surprises in the Overnight Index Swaps (OIS) with maturities 1-, 3- and 6-months and 1-year. For the Fed stock price surprises I use the S&P500 index and

¹I check the robustness of the results with the Jarociński and Karadi (2020) database. This database includes on top of the EA-MPD announcements also 34 additional policy-related announcements that did not directly follow the ECB Governing Council meetings (and hence are not in the EA-MPD). 24 of these announcements are about USD swaps with the Fed and 10 are about nonstandard policies, such as unusual refinancing operations or changes in the collateral rules for the refinancing operations. All the results are very similar, so I stick to the EA-MPD database to facilitate replicating this paper’s results.

²On this day some interest rate surprises dropped by more than 40 basis points, which is by some distance the largest drop in the sample.

for the ECB stock price surprises I use the Euro Stoxx 50 index.

2.1.2 Statistical properties of the surprises

Table 1 reports the summary statistics of the surprises. Since the principal components have no unit, I rescale them to equate variance of the ECB interest rate surprise to that of the 1-year OIS swap surprise and the Fed interest rate surprise to the 1-year Eurodollar swap surprise. Consequently, the ECB interest rate surprises have the standard deviation of 4.18 basis points and the Fed interest rate surprises are slightly larger at 6.49 basis points. The ECB and Fed stock price surprises have similar standard deviations of 64 and 63 basis points. Interestingly, the ECB interest rate and stock price surprises are barely correlated, while for the Fed they have a fairly strong negative correlation of almost -0.5. This suggests that the Fed and ECB announcements convey a somewhat different mix of economic shocks, as discussed in the next subsection.

Table 1: Summary statistics of the surprises (in basis points)

	Total interest rate surprise, i^{Total}	Stock price surprise, s
<i>ECB surprises</i>		
Mean (std. err.)	0.00 (0.26)	-8.43 (3.98)
Standard deviation	4.18	64.38
Correlation (i^{Total}, s)	-0.13	
N. of observations	261	
<i>Fed surprises</i>		
Mean (std. err.)	-0.00 (0.50)	0.95 (4.87)
Standard deviation	6.46	62.98
Correlation (i^{Total}, s)	-0.49	
N. of observations	167	

The interest rate and stock price surprises satisfy the basic unpredictability properties that can be expected from the true “surprises”. First, the consecutive ECB and Fed surprises are not correlated. This is important, because this guarantees that we don’t mistake the effects of domestic shocks for transatlantic spillovers. Second, the surprises are not autocorrelated. Finally, they are approximately zero-mean, except for the ECB stock price surprises which have a statistically significant negative mean.

Table 2: Auto-correlations and cross-correlations of the surprises

	Total interest rate surprise, i^{Total}		Stock price surprise, s		N. of pairs
auto-correlation of the ECB surprises	-0.08	(0.22)	-0.05	(0.40)	260
auto-correlation of the Fed surprises	-0.03	(0.71)	-0.07	(0.35)	166
correlation between the Fed surprise and the most recent ECB surprise	0.07	(0.38)	0.09	(0.28)	161
correlation between the Fed surprise and the subsequent ECB surprise	-0.10	(0.23)	0.10	(0.22)	161

Note. P-values in parentheses. There are only 161 pairs of consecutive Fed and ECB surprises because sometimes there are two Fed surprises in a row or two or more ECB surprises in a row.

Figure 1: Cumulated surprises

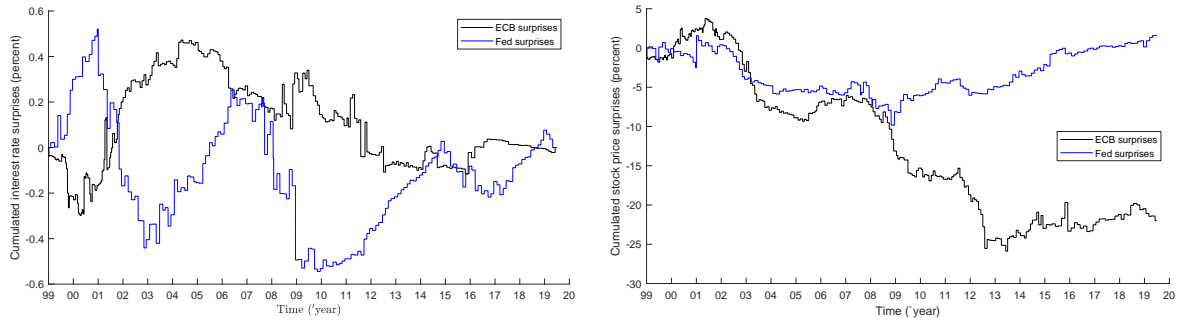


Table 2 reports the autocorrelations and cross-correlations of consecutive ECB and Fed surprises. Figure 1 plots the cumulated surprises of both central banks, interest rate surprises in the left panel and stock price surprises in the right panel. This figure shows that also at lower frequencies there is no correlation between the two central banks's surprises. The statistical properties of the ECB and Fed surprises in isolation are known and reported here for completeness, but the correlation between the Fed and ECB surprises has not been reported before, to my knowledge.

2.2 Decomposing interest rate surprises into monetary policy and information shocks

Traditionally, the literature since Kuttner (2001) has used the total interest rate surprises as proxies for monetary policy shocks. However, recent papers, such as Melosi (2017) and Nakamura and Steinsson (2018) highlight that central bank announcements can also

engender information effects (or ‘Delphic forward guidance’ in the language of Campbell et al. (2012)), whose effects are very different from monetary policy shocks. In a nutshell, what the central bank says or does affects also public beliefs about the state of the economy. These changes in beliefs affect the financial asset prices and the economy very differently from monetary policy. To disentangle these effects I decompose the interest rate surprises into monetary policy shocks and information effects, following the approach of Jarociński and Karadi (2020).³ If i^{MP} denotes the monetary policy shock and i^{CBI} denotes the central bank information shock, the decomposition satisfies

$$i^{Total} = i^{MP} + i^{CBI}. \quad (1)$$

The decomposition is based on the co-movement of the interest rate surprise with the stock price surprises. According to a textbook asset pricing model, monetary policy shocks generate a negative co-movement between the interest rate and stock price surprises. For example, an expansionary monetary policy shock reduces the discount rate and increases the expected future dividends, so the stock price, which reflects the present discounted value of future dividends, increases. By contrast, the information effects is assumed to generate a positive co-movement between the interest rate and stock price surprises. In this case, the markets interpret a surprise interest rate cut as a signal that the central bank is more worried about the economy than previously thought, become more pessimistic and stock prices fall. The scatter plots in Figure 2 show the interest rate surprises and stock price surprises for all Fed and ECB announcements and motivate the need for these two shocks to explain the data: a single monetary policy shock could not explain all the cases when the surprises have the same sign.

Following Jarociński and Karadi (2020) I impose the above sign restrictions using two alternative approaches, “poor man’s sign restrictions” and “rotational sign restrictions”. While Jarociński and Karadi (2020) aggregate the surprises to the monthly frequency, here I perform the decompositions for each announcement, in order to study also financial spillovers at the daily frequency, which have attracted much attention in the literature. When applying the rotational sign restrictions I deviate from Jarociński and Karadi (2020)

³Other papers that propose related decompositions include Miranda-Agrippino and Ricco (2018); Andrade and Ferroni (2020); Cieślak and Schrimpf (2019); Kerssenfischer (2019).

and use a simple rule of thumb to pin down a unique decomposition.

2.2.1 Poor man's sign restrictions.

In this approach I simply classify each central bank announcement as conveying either the monetary policy shock or an information effect. If, for the central bank announcement on day t , the interest rate surprise i_t^{Total} and the stock price surprise s_t have opposite signs, I classify the interest rate surprise as a monetary policy shock, i.e. I set $i_t^{MP} = i_t^{Total}$ and $i_t^{CBI} = 0$. When they have the same signs, I classify the interest rate surprise as an information effect, i.e. I set $i_t^{MP} = 0$ and $i_t^{CBI} = i_t^{Total}$.

In the data, the poor man's monetary policy surprises account for 68% of the variance of the ECB's total interest rate surprises and for 85% of the variance of the Fed's total interest rate surprises. That is, we have $\text{var}(i^{MP}) / \text{var}(i^{Total}) = 0.68$ for the ECB and 0.85 for the Fed. (The information effects i^{CBI} account for the remaining variance of i^{Total} , since by construction $\text{var}(i^{Total}) = \text{var}(i^{MP}) + \text{var}(i^{CBI})$.) These proportions intuitively relate to the correlations between interest rate surprises and stock price surprises reported earlier: Fed announcement contain a higher share of monetary policy shocks so the correlation between interest rate surprises and stock prices surprises is more negative.

2.2.2 Rotational sign restrictions.

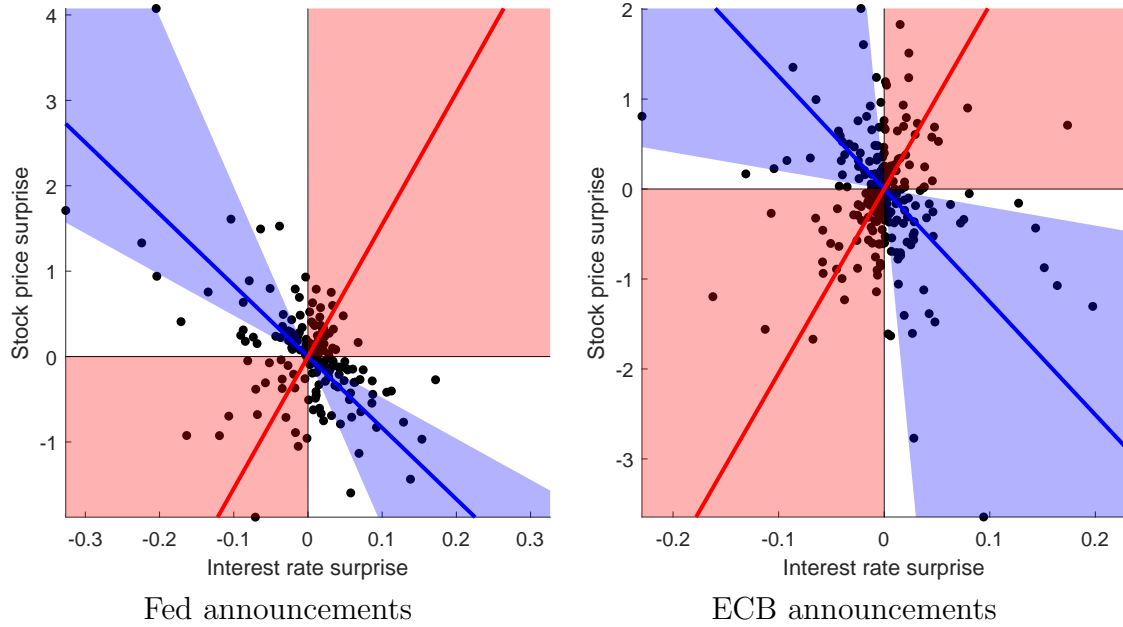
In this approach each central bank announcement may simultaneously convey a monetary policy shock and an information effect. I stack the vector of total interest rate surprises i^{Total} and the vector of stock price surprises s side-by-side into a $T \times 2$ matrix $M = (i^{Total}, s)$ (where T is the number of central bank announcements) and use the formula provided in the Appendix to decompose it as follows:

$$M = UC, \text{ where } U = (i^{MP}, i^{CBI}), \quad (i^{MP})' i^{CBI} = 0 \text{ and } C = \begin{pmatrix} 1 & c_{MP} < 0 \\ 1 & c_{CBI} > 0 \end{pmatrix}. \quad (2)$$

Above, U is a $T \times 2$ matrix with i^{MP} in the first column and i^{CBI} in the second column. The monetary policy shock and the central bank information shock are two independent shocks, hence the decomposition imposes their orthogonality. Matrix C captures how i^{MP}

and i^{CBI} translate into financial market surprises. The 1's in the first column of C reflect a normalization ensuring that i^{MP} and i^{CBI} add up to the total interest rate surprise i^{Total} . The second column of C contains the elasticities of stock prices to i^{MP} and i^{CBI} , $c_{MP} < 0$ and $c_{CBI} > 0$.

Figure 2: Alternative sign restriction-based decompositions of central bank surprises.



Note. Each dot corresponds to one announcement. Blue, negatively sloped, lines show the relationship $s = c_{MP} * i^{MP}$ and red, positively sloped, lines show the relationship $s = c_{CBI} * i^{CBI}$ for the decomposition used in this paper. Blue and red ranges represent the slopes of these relations for all the admissible decompositions.

The decomposition in (2) is not unique. There is a range of “rotations” of U and C that all satisfy the sign restrictions $c_{MP} < 0$ and $c_{CBI} > 0$. Figure 2 illustrates this non-uniqueness. The blue regions indicate all the admissible negative relations between i^{Total} and s conditionally on the monetary policy shock, i.e. all the admissible lines $s = c_{MP} i^{MP}$. The red regions indicate all the corresponding positive relations between i^{Total} and s conditionally on the central bank shock, i.e. all the admissible lines $s = c_{CBI} i^{CBI}$.

Previous papers have chosen different approaches to this non-uniqueness. Jarociński and Karadi (2020) include the surprises in their Bayesian VAR and specify an agnostic Bayesian prior covering the space of all admissible rotations (Rubio-Ramirez et al., 2010; Arias et al., 2018). That is, they treat all these decompositions as equally plausible. Andrade and Ferroni (2020), in a related decomposition, take the average across all ro-

tations, thus also essentially treating them as equally plausible. For another example, Kroencke et al. (2019) define the FOMC risk shift shock (similar to the Central Bank Information effect) that explains the stock price surprises but none of the interest rates surprises. Hence, they a priori pick the decomposition in which the line $s = c_{CBI} i^{CBI}$ is vertical.

In this paper I a priori pick the unique decomposition that implies *the same variance decomposition of the interest rate surprises as the poor-man's sign restriction approach*. That is, as in the poor man's case, we have $\text{var}(i^{MP})/\text{var}(i^{Total}) = 0.68$ for the ECB and 0.85 for the Fed. I use the poor man's analysis as a rough, but reasonable guide to what happens in the announcements. In the poor man's case most of the variance of interest rate surprises comes from the monetary policy shocks, so in this light a decomposition that implies the opposite would not be intuitive, even though such a decomposition is possible to construct. Similarly, in the poor man's analysis Fed announcements contain more monetary policy shocks than the ECB announcements, so in this light decompositions that imply the opposite would not be intuitive, even though possible to construct. The Appendix shows how to compute the decomposition matching the desired variance shares in one step, without Monte Carlo simulation or optimization.^{4,5}

3 The puzzling spillovers of the ECB interest rate surprises

I begin by estimating the effects of total ECB interest rate surprises. This section serves to motivate the interest in the decompositions discussed above. Namely, it shows that when one does not decompose the surprises, two puzzling results emerge: the effects of

⁴I show in the Appendix that the variance share of the monetary policy shocks can be anywhere in the following range:

$$\frac{\text{var}(i^{MP})}{\text{var}(i^{Total})} \in \begin{cases} (\rho^2, 1) & \text{if } \rho < 0, \\ (0, 1 - \rho^2) & \text{if } \rho \geq 0, \end{cases} \quad (3)$$

where ρ is the correlation between i^{Total} and s . I also show how to obtain the decomposition for any desired variance share within the attainable range. The numbers 0.68 and 0.85 are within the attainable ranges for the ECB and Fed datasets respectively.

⁵The results in this paper are not very sensitive to the choice of the rotation and one obtains the same lessons using e.g. the median rotation in the spirit of Andrade and Ferroni (2020), but I stick to the rule of thumb proposed above for its convenience.

ECB interest rate surprises are either very weak and insignificant, or have puzzling signs. That is, the point estimates consistently suggest that a positive ECB surprise is followed by an easing of the financial conditions in the US (as well as in the euro area). In the rest of the paper I argue that information effects rationalize these otherwise puzzling findings.

I first study the effect over short horizons, of one up to 30 days after the announcement, on financial variables that are measured daily. I study these effects with “event study regressions” (local projections). Then I turn to the effect over longer horizons, of several months. For this I embed the surprises in a monthly VAR.

3.1 Event study regressions with ECB interest rate surprises

To study the responses of financial variables in the first days and weeks after ECB monetary policy announcements I run the following event study regressions (local projections):

$$y_{t+h} - y_{t-1} = \alpha + \beta_h i_t^{Total} + u_t. \quad (4)$$

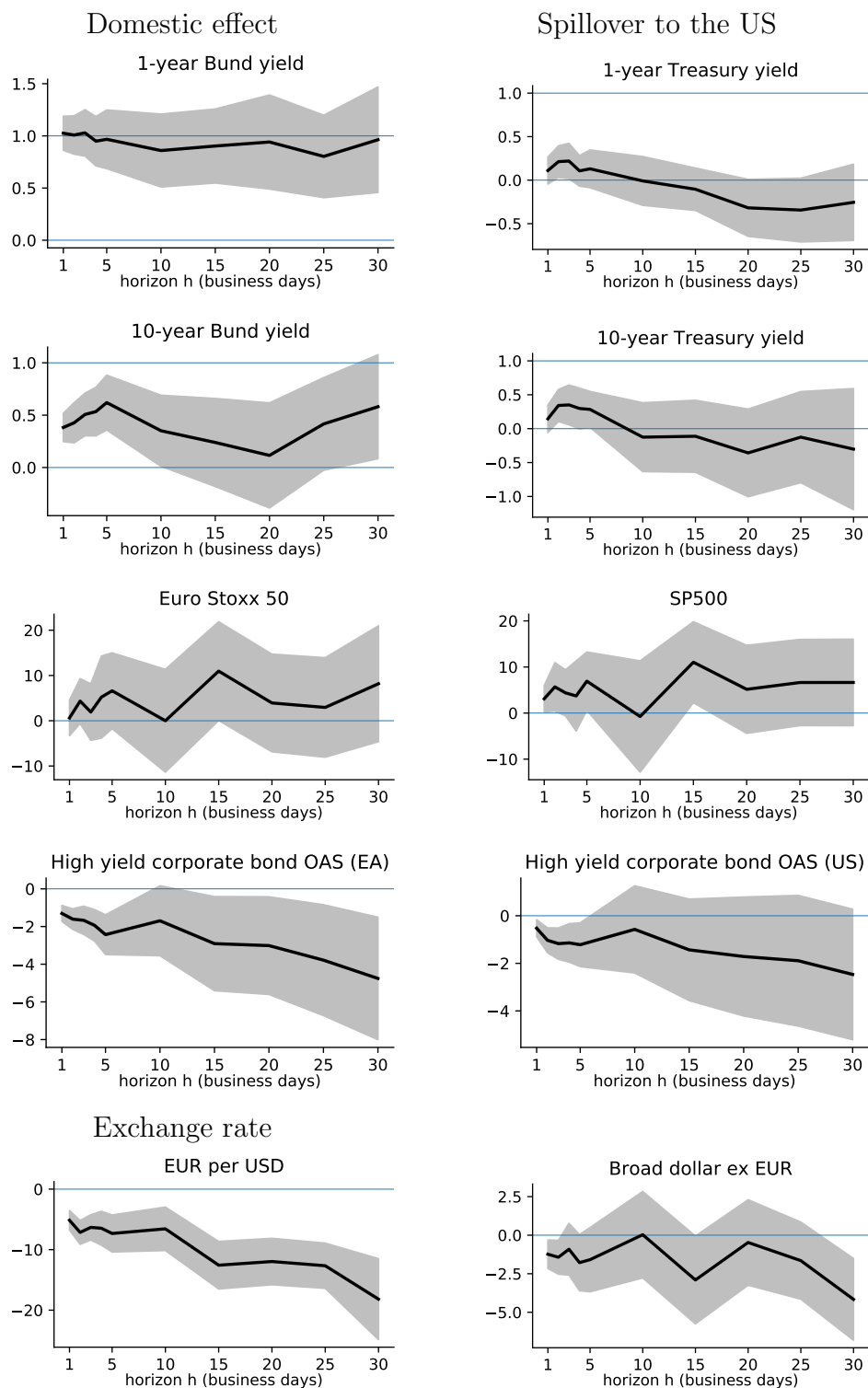
t runs over the dates of ECB monetary policy announcements (261 dates in the EA-MPD, from 7 January 1999 to 6 June 2019). y denotes a financial variable, such as a 1-year German bund yield or the log of the S&P500. h is the horizon, in business days. I run the regressions for $h = 1, 2, 3, 4, 5, 10, 15, 20, 25, 30$. β_h is the coefficient of interest, showing by how many basis points a financial variable changes over h days per one basis point positive ECB interest rate surprise.⁶ Figure 3 illustrates the results and the details are provided in the Appendix Table C.1.

The results shown in Figure 3 pass the basic sanity check: a positive ECB interest rate surprise in the high-frequency data is, as expected, followed by higher German Bund yields and a stronger euro exchange rate. However, most of the other responses are insignificant. This is puzzling: the ECB policy announcements are closely followed by investors and widely covered in the news, could they be as irrelevant as these estimates suggest?

⁶Throughout the paper I use the Eicker-White heteroskedasticity-robust standard deviations. In most of the sample ECB announcements are separated by about a month and Fed announcements by about seven weeks, so the horizons rarely overlap, thus obviating the need to use autocorrelation-robust standard deviations.

Figure 3: The effects of ECB total interest rate surprises: elasticities β_h from local projections.

$$y_{t+h} - y_{t-1} = \alpha + \beta_h i_t^{Tot, ECB} + u_t$$



Note. The solid lines connect the OLS estimates of β_h at different horizons h . The grey areas show heteroskedasticity-robust one standard deviation bands. All regressions have 261 observations.

More in detail, an ECB interest rate surprise has a one-to-one effect on the 1-year German Bund yield that persists also after 30 business days, and a pass-through of about 0.5 to the 10-year German bund yields. However, there is no significant spillover to the 1-year and 10-year US Treasury yields. The missing transatlantic spillover reported in Figure 3 is interesting for two reasons. First, it is well known that US Treasury yields and German Bund yields are highly correlated unconditionally. The reported results imply that this high unconditional correlation must come from shocks other than the ECB monetary policy surprises. Second, we know from research on high-frequency futures prices (Curcucu et al., 2018) that US and German yields are highly correlated in the narrow time-window around ECB announcements. The results in Figure 3 imply that the *average* response of the US Treasury yields to ECB announcements is not persistent enough to survive in daily data. Finally, there is anecdotal evidence of US Treasury yields responding strongly to ECB monetary policy surprises on some occasions. The reported results show that this is not the case *on average*. However, in the next section I identify the conditions under which the response of the US Treasury yields is indeed very strong.

For corporate bond spreads and stock prices, both in the euro area and in the US, the point estimates suggest an easing of financial conditions. The point estimates of the responses of the Euro Stoxx and the S&P500 are consistently nonnegative (but insignificant). The high-yield corporate bond spreads decline significantly at horizons up to 5 days in the US and at all horizons in the euro area. Assuming some inertia in the yields, European corporate bond yields might fail to catch up with the rising Bund yields, at least in the first weeks, thus generating the shrinking bond spread, but the Treasury yields do not increase and hence the response of the US corporate bond spreads presents an even greater puzzle.

The last plots in Figure 3 show that the dollar depreciates against the euro (as is to be expected after a positive ECB interest rate surprise) and does not move significantly against the broad basket of currencies excluding the euro.⁷

⁷The Broad dollar index, calculated by the Federal Reserve, is a trade-weighted exchange rate with respect to 26 most important trading partners by volume of the bilateral trade. I have recalculated this index taking the euro out of it. See Appendix A for details.

3.2 VAR with ECB interest rate surprises

Next, to study the longer term dynamics, I embed the ECB interest rate surprises in two monthly VARs: one for the euro area and one for the US. The VARs include the same variables as before plus proxies for real activity and prices. Again, we observe the same puzzle: positive ECB interest rate surprises ease US financial conditions and have an expansionary effect on the US economy.

Monthly variables. I aggregate the surprises to the monthly frequency by adding them up. The variable is zero in the months in which there were no announcements. The VAR includes monthly averages of the daily variables used above, plus the real GDP and GDP deflator interpolated to the monthly frequency as in Stock and Watson (2010). The sample runs from January 1999 to March 2019. The US VAR includes the US variables, and the euro area VAR includes the euro area variables. I run two separate VARs to conserve the degrees of freedom and to be close to the typical VAR specifications in the literature.

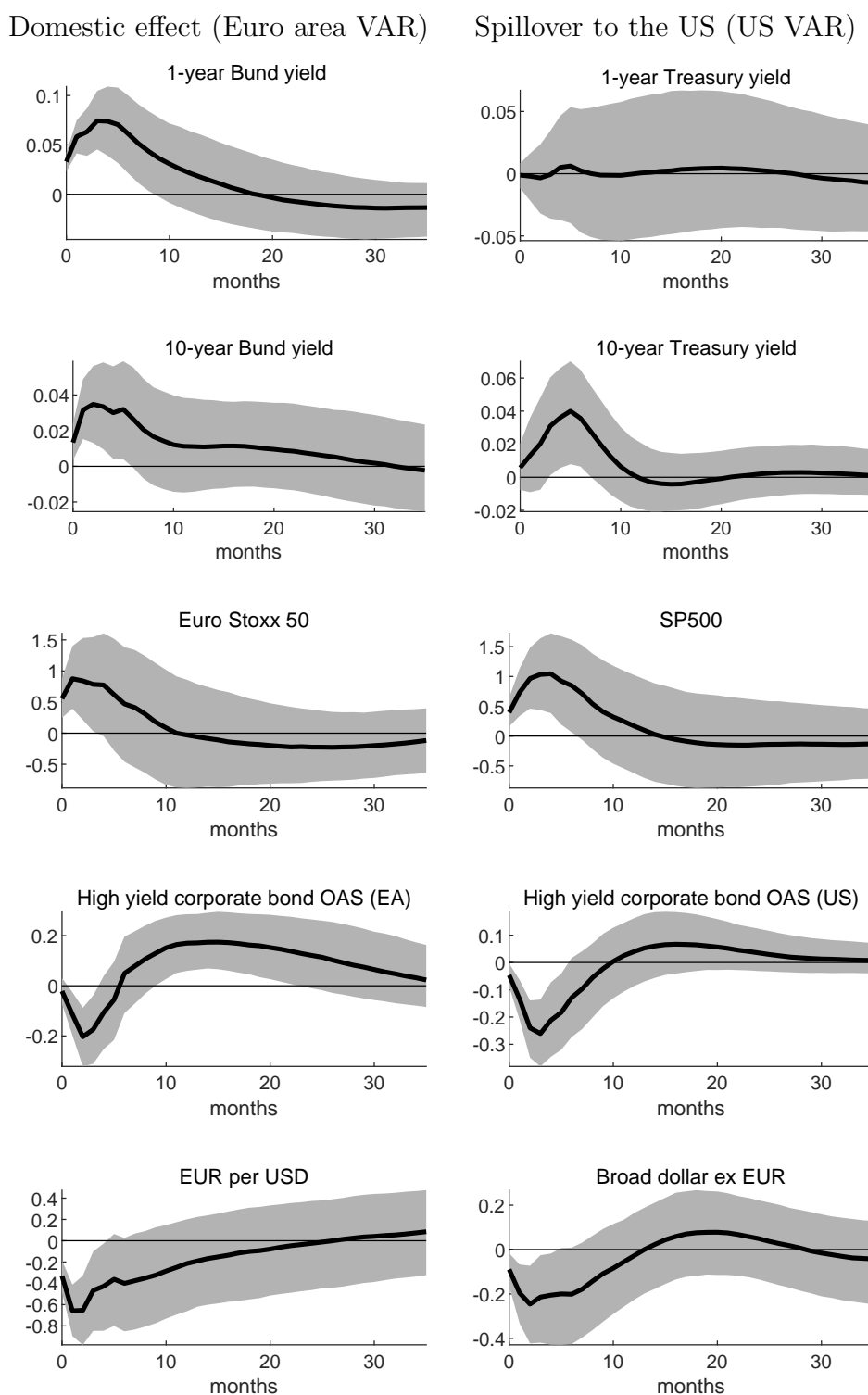
VAR specification. Following Jarociński and Karadi (2020) I restrict the VAR coefficients of the surprise to be zero, reflecting with the fact that it is an i.i.d. variable unpredictable from the past values of other variable. If m_t is the monthly surprise and y_t a vector of macroeconomic and financial variables observed in month t , the restricted VAR is

$$\begin{pmatrix} m_t \\ y_t \end{pmatrix} = \sum_{p=1}^P \begin{pmatrix} 0 & 0 \\ B_{YM}^p & B_{YY}^p \end{pmatrix} \begin{pmatrix} m_{t-p} \\ y_{t-p} \end{pmatrix} + \begin{pmatrix} 0 \\ c_Y \end{pmatrix} + \begin{pmatrix} u_t^m \\ u_t^y \end{pmatrix}, \quad \begin{pmatrix} u_t^m \\ u_t^y \end{pmatrix} \sim \mathcal{N}(0, \Sigma), \quad (5)$$

where \mathcal{N} denotes the normal distribution, u_t^m and u_t^y are shocks and the remaining symbols are parameters to be estimated. The estimation is Bayesian. The priors on the parameters of the above model follow Litterman (1979) and the ensuing Bayesian VAR literature, with standard hyperparameter values. See Jarociński and Karadi (2020) for details. The VARs in the present paper include six lags ($P = 6$).

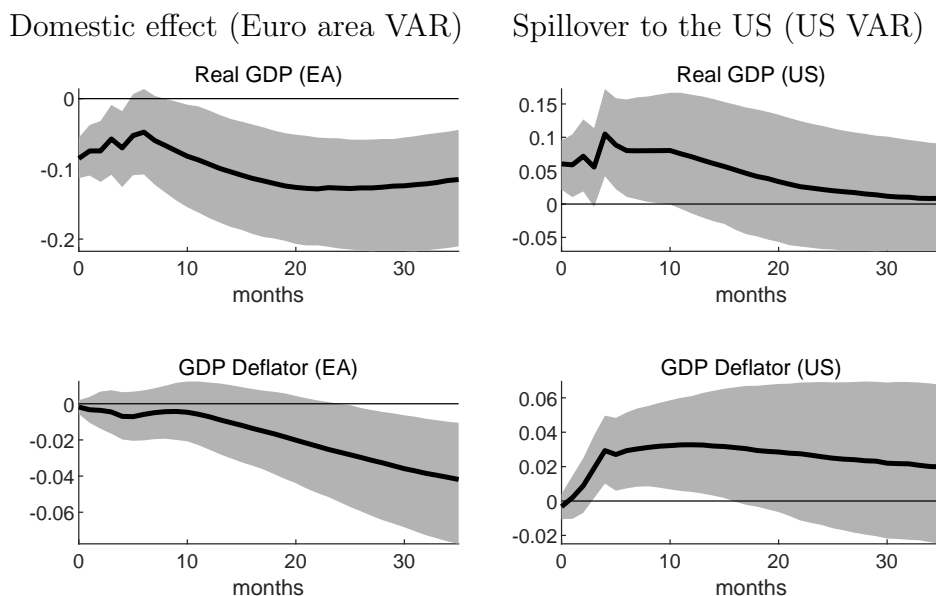
Identification. As argued before it is plausible to consider the surprises to be exogenous. Therefore, I track their effect on the other variables by placing them first and identifying the VAR with the Choleski decomposition of Σ .

Figure 4: The effects of ECB interest rate surprises: impulse responses to a one standard deviation surprise in monthly VARs.



Note: The black solid lines represent the point-wise posterior medians of the impulse responses. The grey areas show the pointwise 16-18 percentile bands. The figure is based on 10,000 draws from the Gibbs sampler.

Figure 4: Continued



Note: The black solid lines represent the point-wise posterior medians of the impulse responses. The grey areas show the pointwise 16-18 percentile bands. The figure is based on 10,000 draws from the Gibbs sampler.

Figure 4 reveals a similar puzzle as in the event study regressions. The figure shows the impulse responses to a one standard deviation ECB total interest rate surprise. While the US 1-year Treasury yields do not respond much to the surprise and the 10-year Treasury yields increase somewhat in the first year, the other variables show an easing of financial conditions and an economic expansion. The S&P500 index increases by about 1 percent. The US corporate bond spread falls by more than 0.2 percent. These responses are strikingly similar to the domestic effects on the Euro Stoxx 50 and the euro area corporate bond spread. So the financial spillover is very strong. The real economy responses are quite different in the two jurisdictions: the US Real GDP and the GDP deflator increase by about 0.07 percent and 0.03 percent respectively, while the euro area real GDP and GDP deflator both decline. Overall, a positive ECB interest rate surprise has a mixed effect on the euro area but an unambiguously expansionary effect on the US.

3.3 Are the surprising effects of ECB announcements an artefact of the methodology?

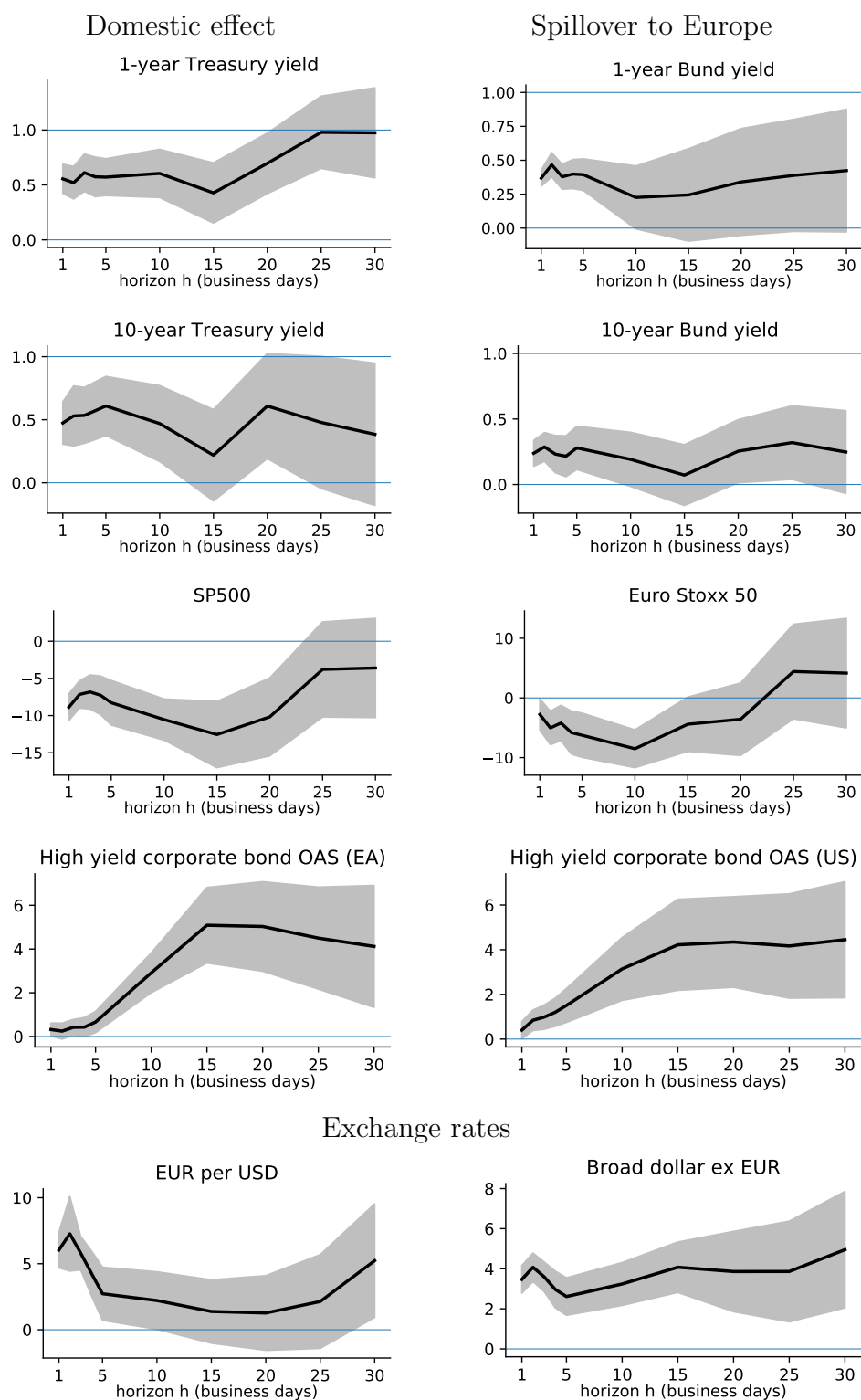
They are not. I run analogous event study regressions and VARs with the Fed interest rate surprises and the findings are not at all surprising. The effects of a positive Fed interest rate surprise look like the usual effects of a contractionary monetary policy shock. There is also a sizeable, almost one-to-one spillover to the euro area, consistent with the findings of the large literature on US monetary policy spillovers.

More in detail, first, I run the analogous regressions for the 167 Fed surprises observed over the same period, 1999-2019. Figure 5 illustrates the results and Appendix Table C.2 provides details. A positive Fed interest rate surprise is followed by significantly and persistently higher government bond yields, lower stock prices and higher corporate bond spreads on both sides of the Atlantic, as can be seen comparing the left and the right column. The dollar appreciates against the euro and other currencies.

Next, I estimate the effects of the Fed surprises with the same VARs. Figure 6 reports the impulse responses. We can see that the effects captured by the event study regressions persist in the subsequent months and that the effect on the real activity and prices is contractionary.

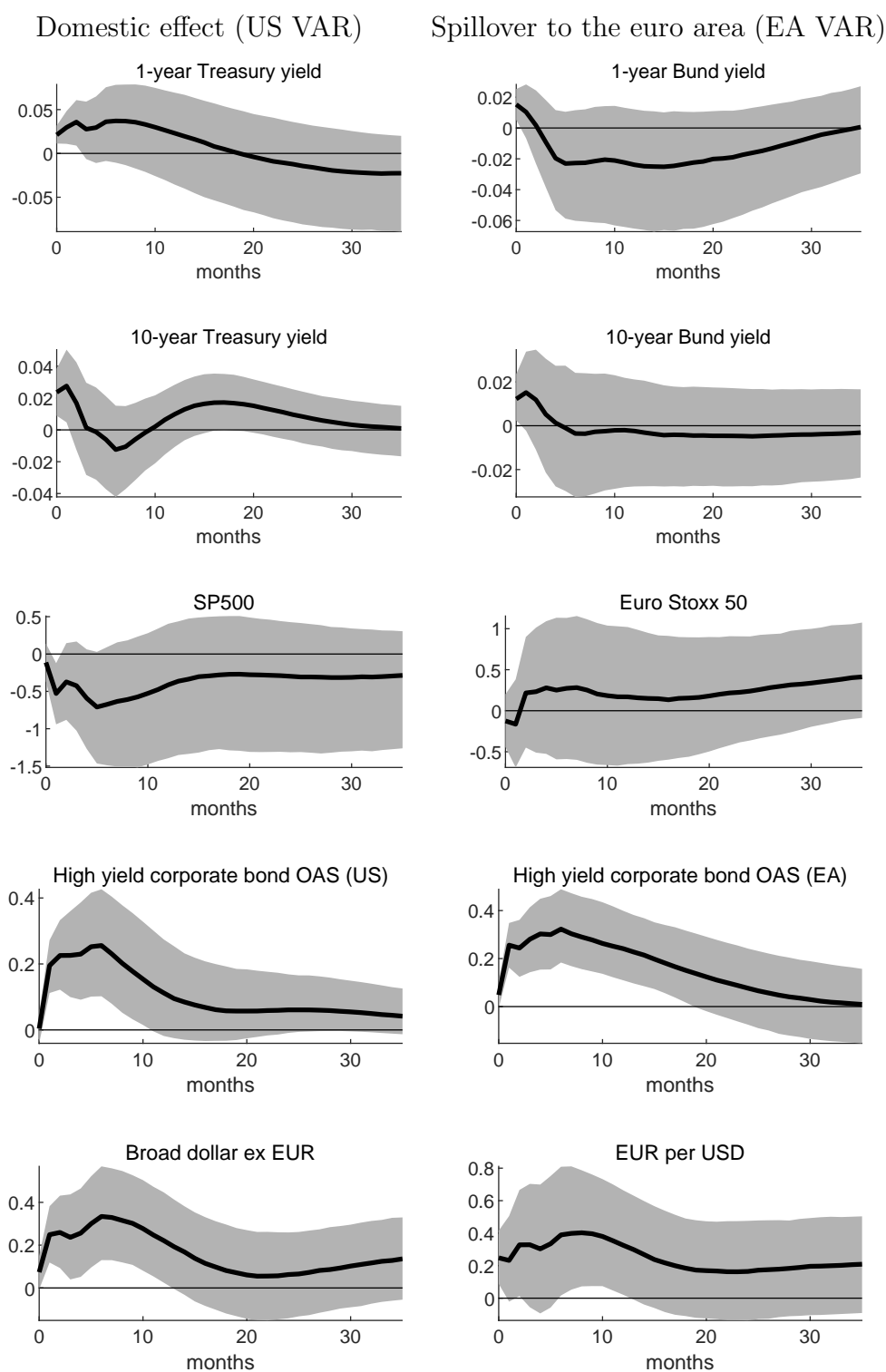
Figure 5: The effects of Fed total interest rate surprises: elasticities β_h from local projections.

$$y_{t+h} - y_{t-1} = \alpha + \beta_h i_t^{Tot, Fed} + u_t$$



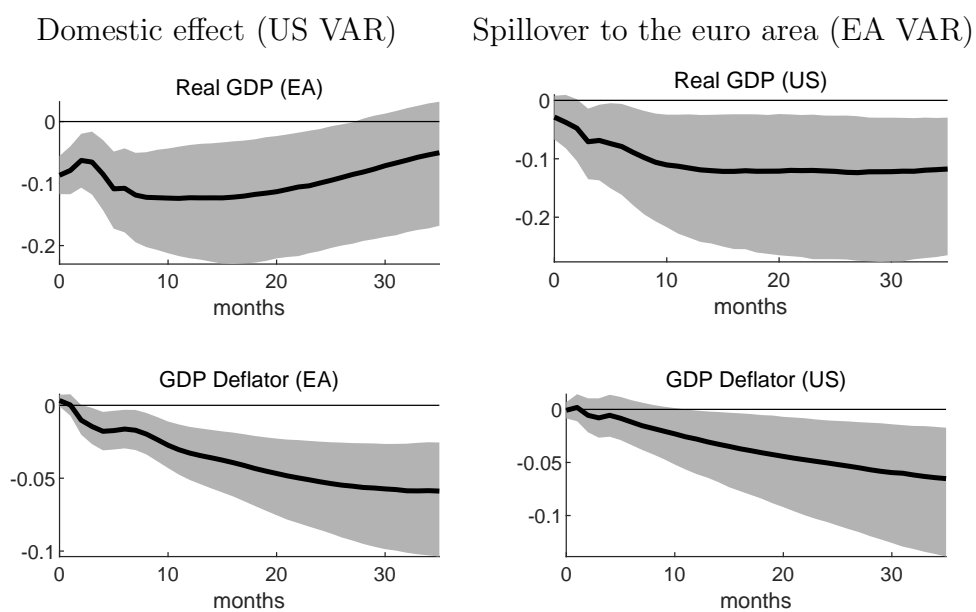
Note. The solid line connects the OLS estimates of β_h at different horizons h . The grey area shows heteroskedasticity-robust one standard deviation bands. All regressions have 167 observations.

Figure 6: The effects of Fed interest rate surprises: impulse responses to a one standard deviation surprise in monthly VARs.



Note: The black solid lines represent the point-wise posterior medians of the impulse responses. The grey areas show the pointwise 16-18 percentile bands. The figure is based on 10,000 draws from the Gibbs sampler.

Figure 6: Continued



Note: The black solid lines represent the point-wise posterior medians of the impulse responses. The grey areas show the pointwise 16-18 percentile bands. The figure is based on 10,000 draws from the Gibbs sampler.

4 Decomposing the spillovers of the ECB surprises

The results so far suggest that the ECB interest rate surprises have either insignificant or expansionary effects on the US, depending on whether one places more weight on the event study regressions or on the VAR evidence. This paper's proposed explanation of this finding is that the ECB surprises often reflect information shocks. Jarociński and Karadi (2020) show that after decomposing the ECB surprises into standard monetary policy shocks and information shocks one finds plausible domestic effects of ECB policies. In this section I show that the decomposition allows to rationalize also the puzzling spillovers of ECB policies to the US. In addition, this exercise sheds a new light on the nature of the information effects.

4.1 Event study regressions with ECB shocks

I now run a variant of regression (4) where the total ECB interest rate surprise i_t^{Total} is replaced with its two components, i_t^{MP} and i_t^{CBI} .

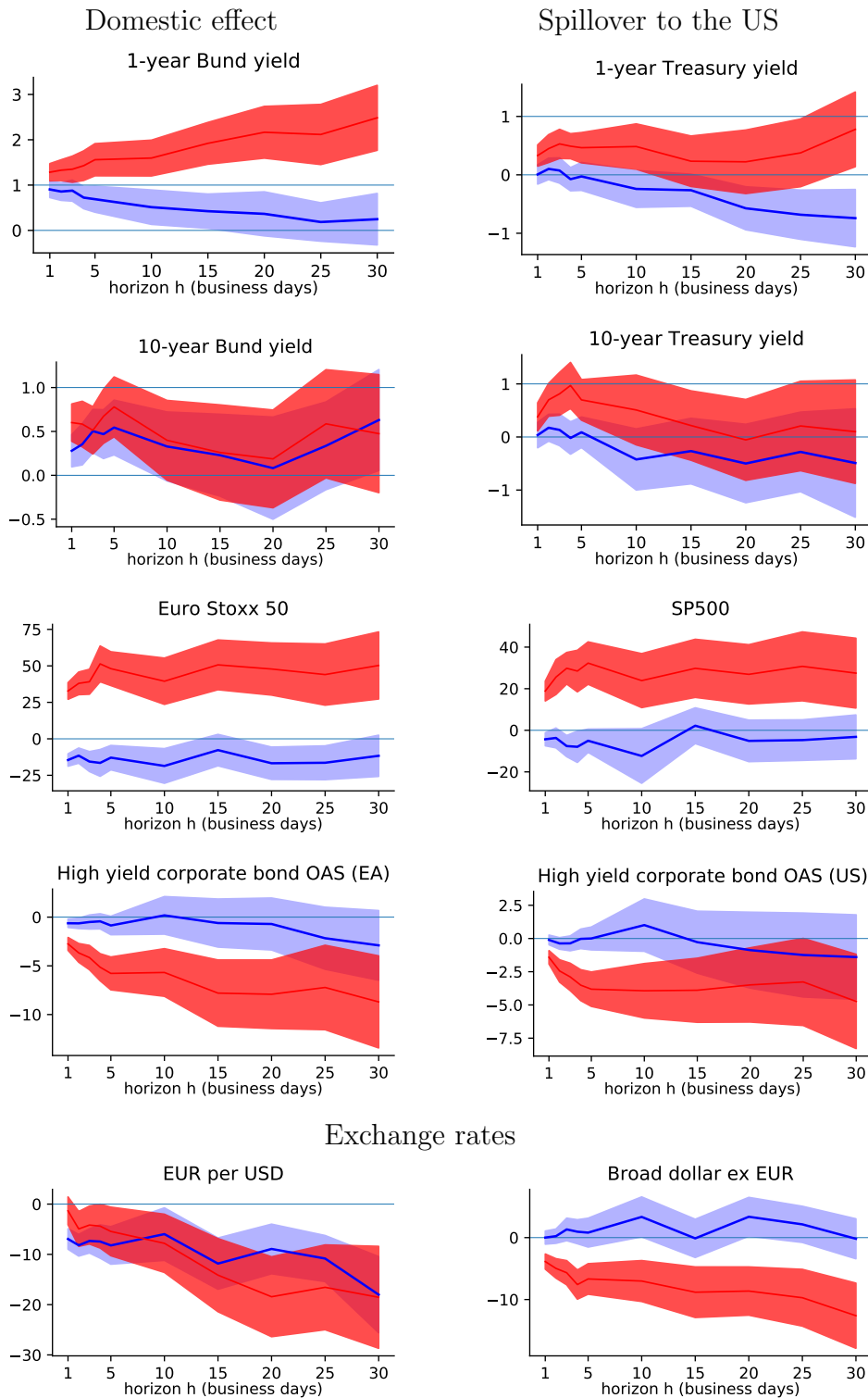
$$y_{t+h} - y_{t-1} = \alpha + \beta_h^{MP} i_t^{MP} + \beta_h^{CBI} i_t^{CBI} + u_t. \quad (6)$$

I include i_t^{MP} and i_t^{CBI} simultaneously, but they are mutually orthogonal so their estimated coefficients would be the same if estimated one by one. Figure 7 illustrates the results for the rotational sign restriction decomposition. Appendix Table C.3 provides the detailed results for both the rotational and the poor-man decomposition. Many findings in this section are robust to using the poor-man decomposition.

Figure 7 makes it clear that the two shocks, i_t^{MP} and i_t^{CBI} , have *very different effects*. ECB information shocks are followed by higher government bond yields, but also easier financial conditions: higher stock prices and lower bond spreads. See the red impulse responses in the left column. These effects spill over strongly to the US, as can be seen comparing the red responses in the left and the right column. By contrast, ECB monetary policy shocks have mostly domestic effects, which don't spill over. The blue impulse responses in the left column show that these shocks are followed by higher German bund yields and, overall, tighter European financial conditions: lower European stock prices

Figure 7: The effects of ECB shocks: elasticities β_h^{MP} and β_h^{CBI} from local projections.

$$y_{t+h} - y_{t-1} = \alpha + \beta_h^{MP} i_t^{MP, ECB} + \beta_h^{CBI} i_t^{CBI, ECB} + u_t$$



Note. The solid lines connect the OLS estimates of $\beta_h^{j \in \{MP, CBI\}}$ at different horizons h . The shaded areas show heteroskedasticity-robust one standard deviation bands. Blue lines and blue bands (lighter grey on black-and-white) show the effects of monetary policy shocks, β_h^{MP} . Red lines and red bands (darker grey on black-and-white) show the central bank information effects, β_h^{CBI} . All regressions have 261 observations. Appendix Table C.3 reports detailed estimation results.

and no significant change in the European corporate bond spreads. But in the blue US responses in right column do not deviate significantly from zero. Let us discuss these estimates in more detail.

4.1.1 Government bond yields

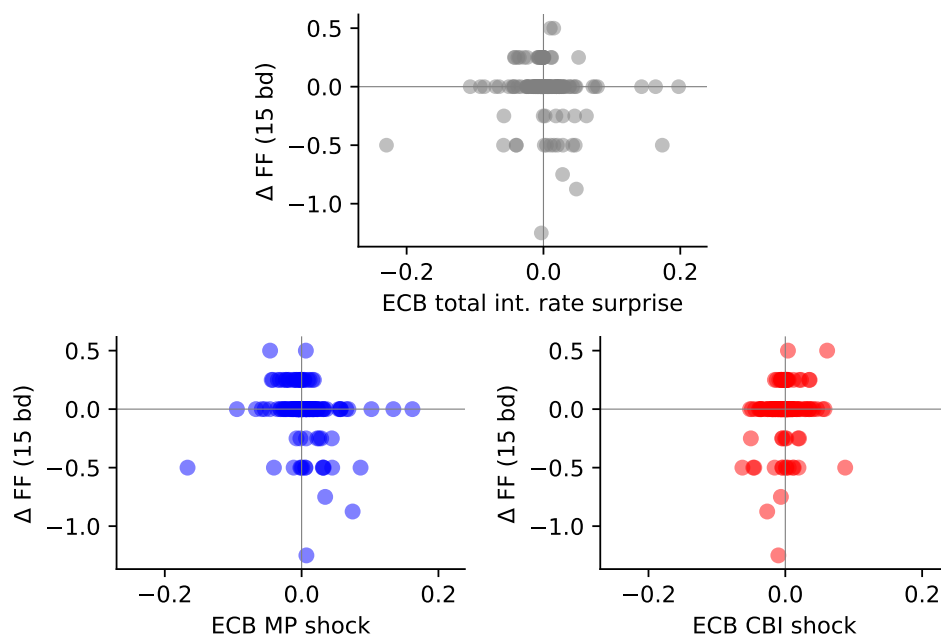
The top two rows of Figure 7 show that the ECB interest rate surprises spill over strongly (and significantly, as shown in Appendix Table C.3) to the US Treasury yields to the extent that they are triggered by information shocks. Those triggered by monetary policy shocks do not spill over.

The different responses of the US Treasury yields to different ECB shocks can be rationalized in light of how the Fed policy responds to these shocks. I now show evidence suggesting that the Fed accommodates ECB monetary policy shocks, but shadows the ECB information shocks. To make this point I regress the Federal Funds Target Rate on the ECB shocks, as in (6). I omit the period when the fed funds rate was constrained by the Zero Lower Bound (ZLB), i.e. from December 16, 2008 to December 15, 2015, which leaves 181 ECB announcements. After the Fed switched from a single target rate to a target range I take the mean of the lower and the upper limit of the target range. I only use longer horizons in these regressions, because the median time from an ECB announcement to the next MPC meeting, when the Fed has a chance to adjust its rates, is 14 business days.

Figure 8 illustrates the fed funds target rate regressions. Each point represents one ECB announcement and shows the ECB surprise (or monetary policy or information shock) against the change in the fed funds target rate between the day before the ECB announcement and 15 business days after the announcement. The Fed changes the target rate infrequently, so many changes are zero. When the Fed does change the target rate, this is almost always by a multiple of 25 basis points. The top scatter plot shows no significant relation. However, in the bottom plots, which decompose the ECB surprises, we can see that the fed funds rate target tends to move in the opposite direction to the ECB monetary policy shocks and in the same direction as the ECB information shocks.

Table 3 reports the regressions for the horizons $h = 10, 15, 20, 25, 30$ business days. The coefficients of the ECB monetary policy shocks are negative and significant, except

Figure 8: ECB shocks and the changes of the Federal Funds Target Rate over the subsequent 15 business days.



Note: For each ECB monetary policy announcement, ΔFF (15 bd) is the change of the Federal Funds Target Rate between the day before and 15 business days after the ECB monetary policy announcement. The ECB MP and CBI shocks are obtained with the “rotational” sign restrictions.

Table 3: The response of the Federal Funds Target Rate to ECB shocks: event study regressions (6).

	$h = 10$	$h = 15$	$h = 20$	$h = 25$	$h = 30$
β_h^{MP}	-0.88 (0.69)	-1.32* (0.74)	-1.41* (0.78)	-1.79** (0.89)	-2.72*** (1.05)
β_h^{CBI}	1.58* (0.96)	1.82* (1.01)	1.44 (1.20)	1.23 (1.60)	1.46 (1.63)
Constant	-0.01 (0.01)	-0.01 (0.02)	-0.02 (0.02)	-0.03 (0.02)	-0.03 (0.02)
$p(\beta_h^{MP} = \beta_h^{CBI})$	0.03	0.01	0.04	0.07	0.01
R-sq	0.05	0.06	0.04	0.04	0.08
N.obs.	181	181	181	181	181

Note: Heteroskedasticity-robust standard errors in parentheses. $p(\beta_h^{MP} = \beta_h^{CBI})$ is the p-value of the F-test of the null hypothesis that $\beta_h^{MP} = \beta_h^{CBI}$.

for the 10 days horizon. The coefficients of the ECB information shocks are positive and significant at 10 and 15 days horizons. In all cases I reject the null that the coefficients of the two ECB shocks are the same.

The Fed's policy responses to the ECB shocks found above make a lot of sense. An ECB monetary policy shock is an external demand shock from the point of view of the US economy and in a standard open economy macro models it is optimal for the Fed to offset such a shock. On the other hand, if the ECB information shock is a response to the state of the global economy, the Fed may want to respond to it similarly as the ECB. Furthermore, the Fed policy responses are consistent with the responses of the Treasury yields. In particular, the finding that the Fed offsets ECB monetary policy shocks explains why Treasury yields and other US financial variables do not respond to these shocks, the in spite of the tight integration of the global capital markets.

4.1.2 US stock prices and their cross-sectional heterogeneity

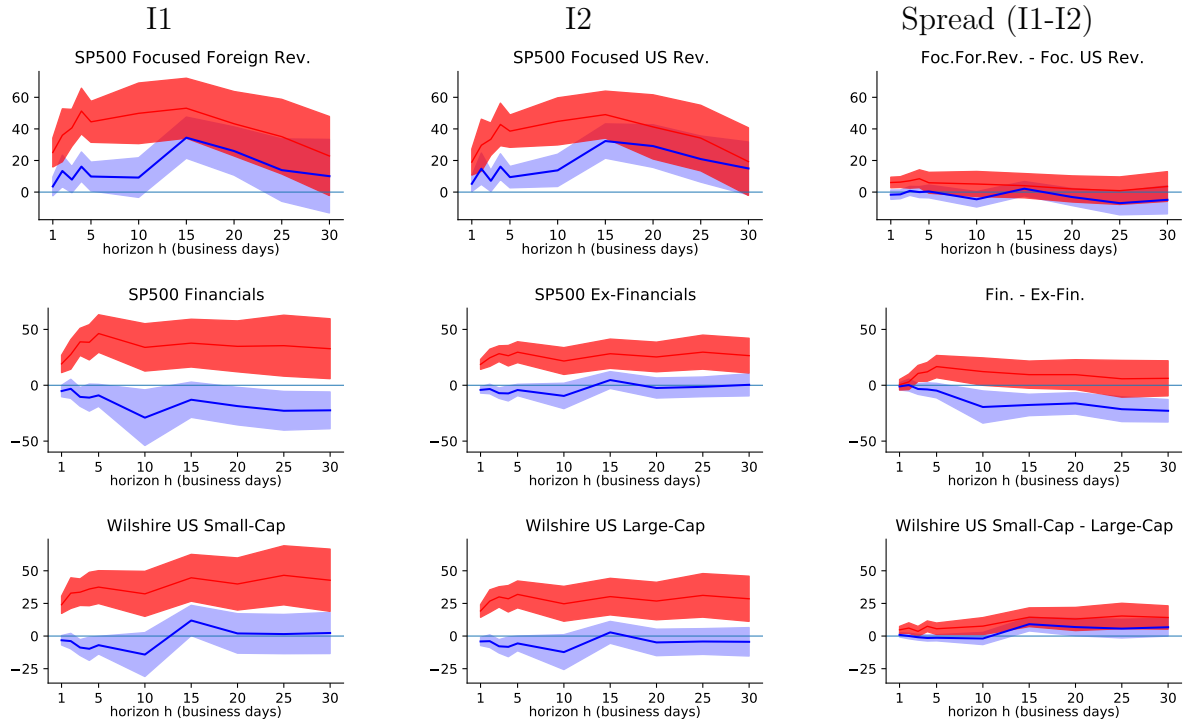
Figure 7 shows that the S&P500 index responds strongly and significantly to the ECB information shock: a one basis point $i^{CBI, ECB}$ moves the S&P500 by about 20 basis points on the first day and even more later on, explaining from 7% to 9% of the S&P500 change in the first two weeks after the ECB announcement. The R-squared are reported in Appendix Table C.3. This table reports also the significant drop in the VIX at all horizons. Could these responses be driven by the ECB conveying news about the euro area that are relevant for US companies exposed to Europe?⁸ The next set of results, reported in Figure 9, shows that the response of the S&P500 is not driven by US companies exposed to Europe.

The first row of Figure 9 shows that the stocks of US companies with revenue exposure to the US respond to ECB information shocks significantly, and quantitatively no less than the stocks of the US companies with revenue exposure outside the US. The figure compares the S&P500 Focused Foreign Revenue Index and the S&P500 Focused US Revenue Index. Both indices are designed to measure the performance of companies in the S&P500 with relatively focused revenue exposure to non-US or to the US respectively. (Unfortunately,

⁸The S&P500 companies derive about 30% of their revenues outside of the US, according to Brzenk, Phillip (March 19, 2018). "The Impact of the Global Economy on the S&P 500". S&P Global.

Figure 9: The effects of ECB shocks across stock sub-indices: elasticities β_h^{MP} and β_h^{CBI} from local projections.

$$y_{t+h} - y_{t-1} = \alpha + \beta_h^{MP} i_t^{MP, ECB} + \beta_h^{CBI} i_t^{CBI, ECB} + u_t$$



Note. The solid lines connect the OLS estimates of $\beta_h^{j \in \{MP, CBI\}}$ at different horizons h . The shaded areas show heteroskedasticity-robust one standard deviation bands. Blue lines and blue bands (lighter grey on black-and-white) show the effects of monetary policy shocks, β_h^{MP} . Red lines and red bands (darker grey on black-and-white) show the central bank information effects, β_h^{CBI} . The regressions with the SP500 focused indices (top row) have 109 observations and the remaining regressions have 261 observations. Appendix Table C.4 reports detailed estimation results.

the S&P500 does not provide an index of euro area-exposed US companies.) The indices are only available since November 2008, which explains why the time profiles of their estimated impulse responses are different from those of all the other indices, estimated on the full sample. The plot in the second column shows that the Focused US Revenue index responds significantly to the ECB information shock, and the plot in the third column shows that the difference between the US and Foreign Revenue indices is small and not significant. Thus, either the

The rest of Figure 9 digs further into the cross-sectional heterogeneity of the US stock price responses. It shows that the ECB information shocks have a stronger impact on financial stocks and on small stocks. The second row of Figure 9 compares the S&P500

Financials and the S&P500 Ex-Financials. The third row compares the Wilshire small-cap with the Wilshire large-cap index.⁹ All four indices respond significantly to ECB information shocks, but financials and small-cap stocks respond somewhat more. This pattern of responses suggests that ECB information shocks affect general investor sentiment. A classic paper by Baker and Wurgler (2006) on the cross-section of stock returns argues that investor sentiment has larger effects on stocks that are more difficult to value and arbitrage. Among others, they show that small stocks are more affected. Financial stocks are also particularly difficult to value, as suggested e.g. by the patterns of disagreement in bond ratings (Morgan, 2002). For recent evidence that financial stocks respond more than others to general investor sentiment see also Hvid and Kristiansen (2020).

Summing up, the ECB information shocks affect the US-exposed stocks no less than foreign-exposed stocks, and they particularly affect financial stocks and small stocks, which tend to be more difficult to value and hence more sensitive to investor sentiment. This pattern of cross-sectional responses does not agree well with the notion that the ECB information is about euro area fundamentals, such as the natural rate of interest. Instead, it suggests that the ECB information shocks affect general investor sentiment.

4.1.3 Exchange rates

The responses of the dollar exchange rate (see the bottom row of Figure 7) are consistent with the dollar's traditional safe haven status and its recently highlighted role of a barometer of risk-taking capacity in global capital markets.

The bilateral exchange rate of the dollar against the euro responds very similarly to both ECB shocks. It is unsurprising that the dollar depreciates against the euro in response to a contractionary ECB monetary policy shock. We have seen in the top row of Figure 7 that this shock opens a spread between the Euro and the US safe interest rates, so the dollar depreciation is consistent with the uncovered interest rate parity.

More interestingly, the dollar depreciates in response to a positive ECB information shock, and not only against the euro, but also against other currencies. The final plot of Figure 7 shows the response of the Fed's Broad dollar index, in the foreign currency

⁹S&P500 is a Blue Chip index so for the small-cap-large-cap comparison the broader Wilshire index is more useful. The flagship Wilshire 5000 index responds to ECB shocks very similarly as the S&P500 so it is omitted here for brevity.

units per US dollar, from which the euro has been removed (see footnote 7). The Broad dollar ex-euro does not move much after an ECB monetary policy shock, but weakens significantly after an ECB information shock.

The dollar has traditionally held the role of a global safe haven currency that appreciates on bad global news and depreciates on good global news (e.g. Habib and Stracca, 2015). Furthermore, several recent papers argue that the Broad dollar index is a key barometer of risk-taking capacity in global financial markets, so the broad dollar depreciation paints a consistent picture together with the compression of the corporate bond spread.¹⁰ These observations reinforce the interpretation of the ECB information shock as a shock to global investor sentiment.

4.2 Rolling window estimates

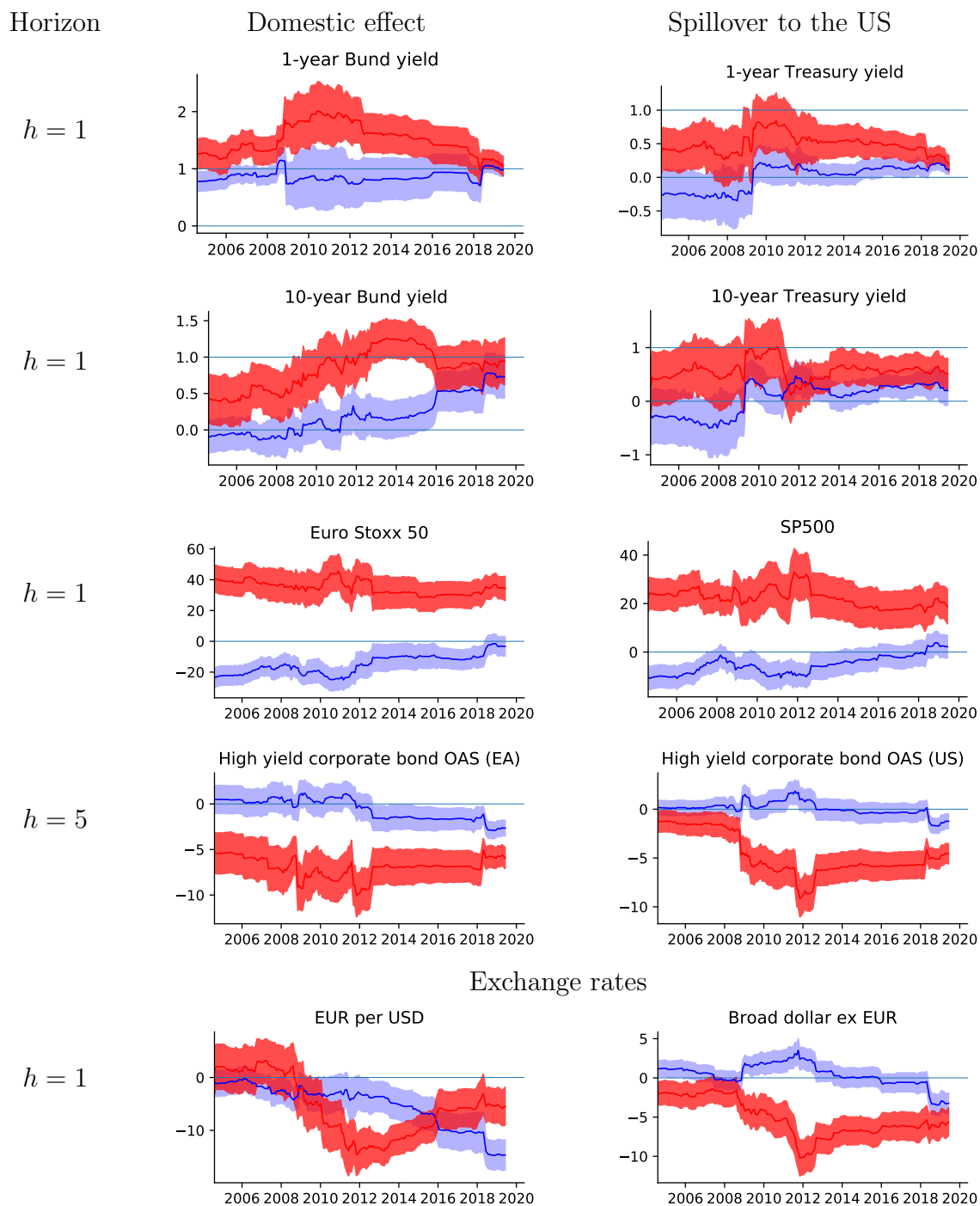
Do the effects of the ECB shocks vary over time? To answer this question I re-estimate equation (6) on rolling samples containing 100 announcements each. Figure 10 shows the results for selected horizons ($h = 1$ in most cases, the lessons are similar for other horizons). Three main lessons follow from this figure. First, the estimates reflect the changing nature of the ECB monetary policy: as the ECB resorted more to non-standard policies, the effects of ECB shocks on the long term rates increase. Second, this coincided with the increasing spillover of the ECB information shocks to the US corporate bond spreads and exchange rates. However, third, the spillovers of the ECB information shocks to the US stock prices are present throughout the studied period and quite stable over time.

More in detail, the response of the 10-year German bund to the ECB monetary policy shocks became positive and significant towards the end of the sample, as the ECB resorted increasingly to non-standard policies directed at the longer interest rates. The response of the 10-year German bund yield to the information shock also increases over time. See the left plot in the second row.

¹⁰For example, Avdjiev et al. (2019) find that a weaker dollar exchange is associated with smaller covered interest parity deviations and more cross-border bank lending. Lilley et al. (2019) find that a weaker dollar is associated with larger US holdings of foreign bonds. Niepmann and Schmidt-Eisenlohr (2019) find that a weaker dollar is associated with a stronger demand for loans in the secondary market and, consequently, more domestic corporate lending by US banks.

Figure 10: Rolling window estimates of the effects of ECB shocks: elasticities β_h^{MP} and β_h^{CBI} from local projections.

$$y_{t+h} - y_{t-1} = \alpha + \beta_h^{MP} i_t^{MP, ECB} + \beta_h^{CBI} i_t^{CBI, ECB} + u_t$$



Note. All rolling windows have 100 observations. The horizontal axis shows the end date of the rolling window. Blue lines and lighter, blue bands show the effects of monetary policy shocks, β_h^{MP} for the rolling window ending at the given date. Red lines and darker, red bands show the central bank information effects, β_h^{CBI} for the rolling window ending at the given date.

Second, we see large time variation in the responses of the exchange rates and corporate bond spreads. See the last two rows. The effect of the ECB monetary policy shocks on the dollar-euro exchange rate becomes stronger (more negative) steadily over time. The effect of the ECB information shocks on both the dollar-euro as well as the broad dollar initially becomes stronger, peaking in the samples ending in 2012, and weakens somewhat thereafter but remains significant. The effect of the ECB information shocks on the US corporate bond spreads is always zero on impact, and only shows up at longer horizons, so for this variable Figure 10 shows the coefficients for $h = 5$ (but the pattern is similar for longer horizons). In the pre-crisis samples there is no effect of the ECB information shocks on the US corporate bond spreads, the effect becomes significant starting in 2009 and remains very significant thereafter.

Third, the response of the US stock prices to the ECB information shocks has remained remarkably stable throughout the studied period, so we cannot conclude that the international spillovers of these shocks are limited to only some subperiod.

4.3 Is the ECB information about the probability of the eurozone break-up?

Not only, it seems. One possible interpretation of the ECB information shocks is that they reflect the cases when ECB Presidents reveal somehow to the markets their unique knowledge about the probability of the eurozone break-up. Such a break-up would have been a major global shock and during the European Sovereign Debt Crisis the concern about such a break-up was an important source of global uncertainty. Kane et al. (2020) argue that this specific ECB information advantage explains a large part of the ECB information shocks. However, if the ECB information were predominantly about the eurozone break-up probability, one could expect the information effects to vanish when the concerns about the eurozone break-up subside. This is not what happens. First, we have seen in the rolling sample exercise that the information effects were also present in the calm period before the 2008 Financial crisis, before any concerns about the eurozone break-up emerged. Second, the present section finds similar ECB information effects also in the low eurozone stress subsample. In this subsample I retain only the 183 announcements

occurring when the Composite Indicator of Systemic Stress (CISS) for Europe was below the threshold of 0.2. As shown in Figure 11, this leaves out most of the period from late 2007 until the summer of 2012, as well as several other announcements. Figure 12 reports the effects of both ECB shocks in this subsample. Comparing Figure 12 with Figure 7, plot by plot, we can see that the information effects are somewhat less precisely estimated, which is not surprising given the less informative sample, but overall quite similar to those observed in the full sample.

Figure 11: Composite Index of Systemic Stress (CISS) for the euro area on the days of ECB announcements.

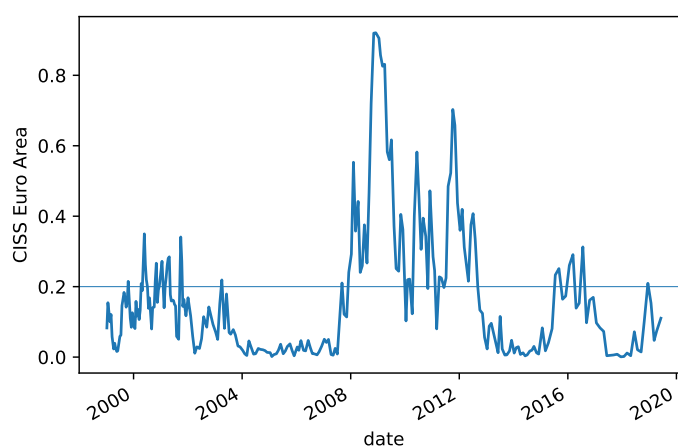
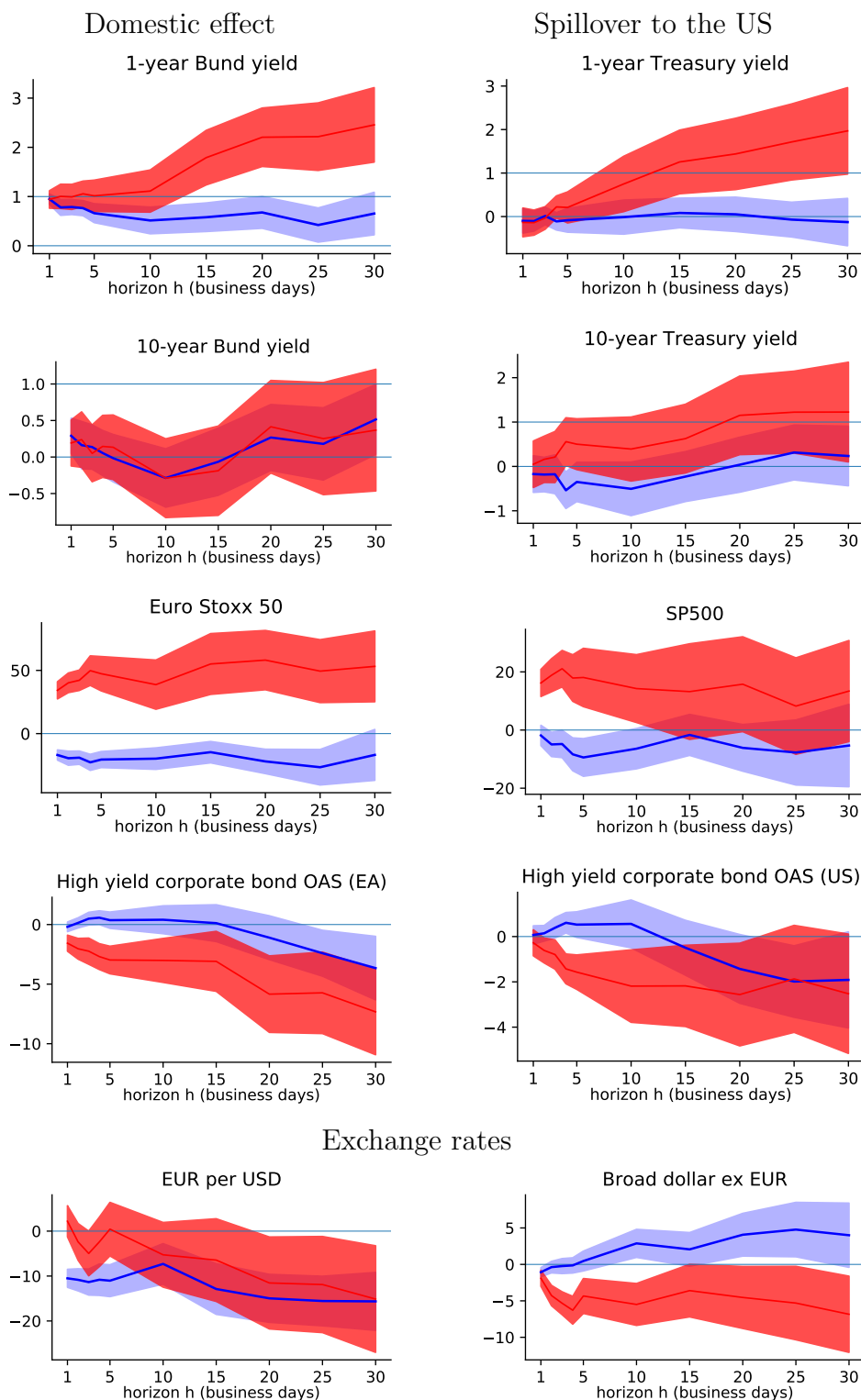


Figure 12: Low eurozone stress period (CISS < 0.2) The effects of ECB shocks: elasticities β_h^{MP} and β_h^{CBI} from local projections.

$$y_{t+h} - y_{t-1} = \alpha + \beta_h^{MP} i_t^{MP, ECB} + \beta_h^{CBI} i_t^{CBI, ECB} + u_t$$



Note. The solid lines connect the OLS estimates of $\beta_h^{j \in \{MP, CBI\}}$ at different horizons h . The shaded areas show heteroskedasticity-robust one standard deviation bands. Blue lines and blue bands (lighter grey on black-and-white) show the effects of monetary policy shocks, β_h^{MP} . Red lines and red bands (darker grey on black-and-white) show the central bank information effects, β_h^{CBI} . All regressions have 183 observations.

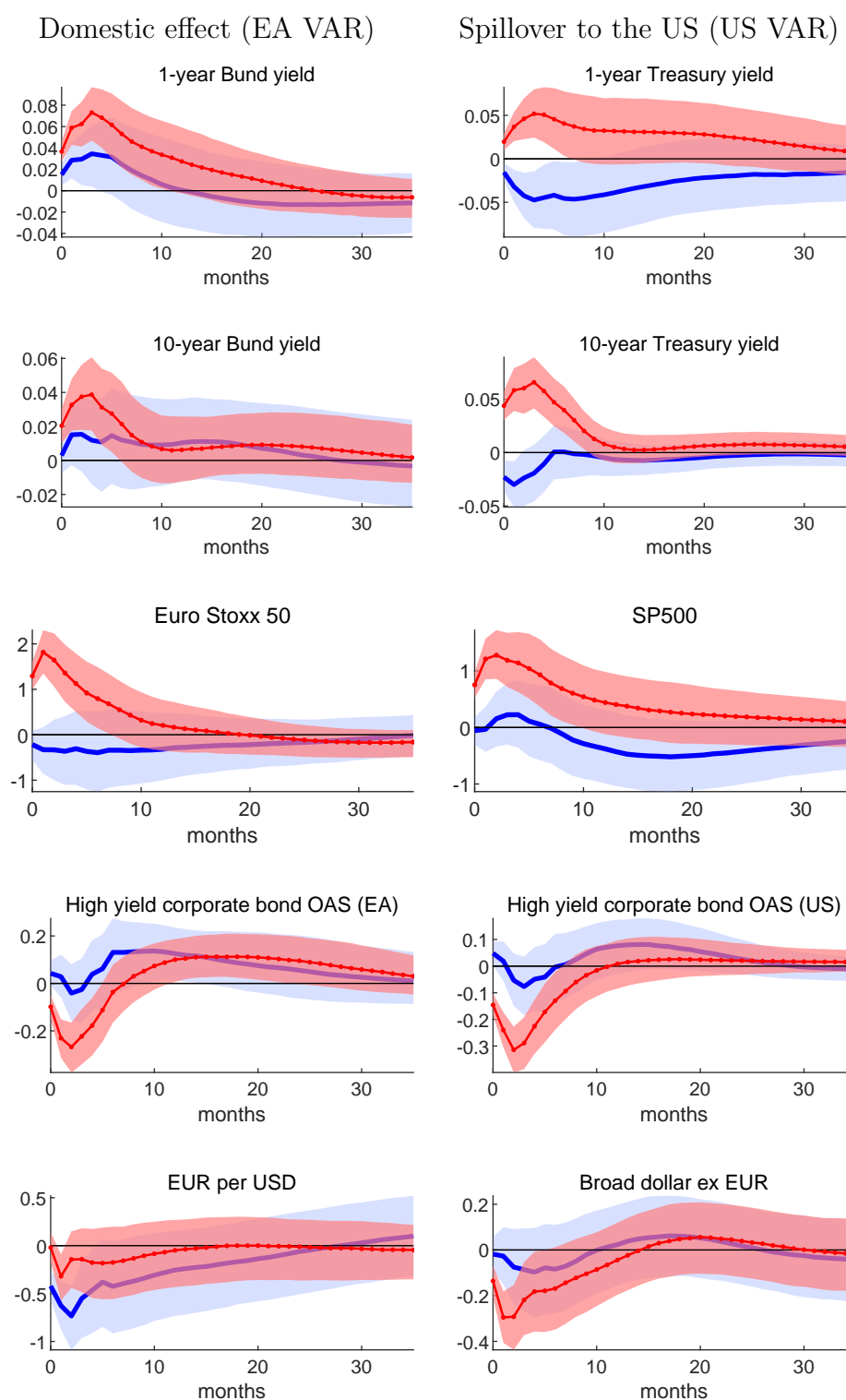
4.4 VAR estimates of the effects of ECB shocks

VAR analysis shows that the effects found in the event study regressions persist in the subsequent months. I introduce the same ECB shocks, aggregated to the monthly frequency, into the monthly VARs for the euro area and for the US. As before, the shocks are ordered first and the VAR is identified with the Choleski factorization. Since the shocks are almost exactly orthogonal, their ordering does not matter. Figure 13 reports the impulse responses for the rotational sign restriction decomposition (the results for the poor man's decomposition are similar and are omitted here for brevity).

As shown in the first column, the ECB monetary policy shock tightens euro area financial conditions and has a contractionary effect. The ECB information shock increases stock prices, depresses corporate bond spreads, and has a weak, but if anything positive effect on the economy. These results are similar to those reported in Jarociński and Karadi (2020), with small differences due to the different sample and variable definitions.

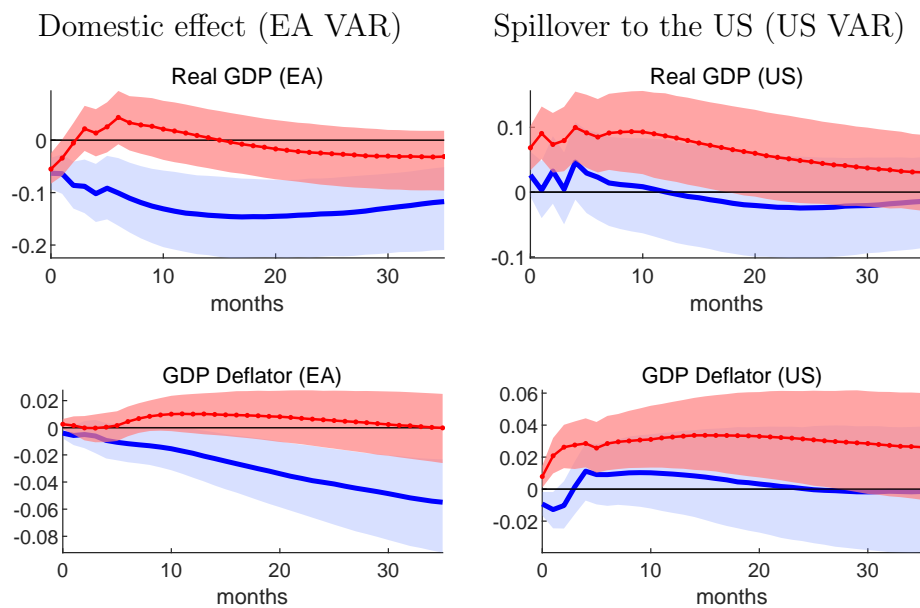
The new results, on the spillovers to the US, are in the second column. Again, the spillovers of the two shocks are very different. The ECB monetary policy shocks fail to move the US variables much, either because they are fundamentally less relevant for the US or because the Fed offsets them. By contrast, the ECB information effects spill over similarly as they do in the daily data. Furthermore, these spillovers last for several months in financial variables and for more than a year in real activity and prices.

Figure 13: The effects of ECB shocks: Impulse responses to one standard deviation MP and CBI shocks in monthly VARs.



Note: The red solid-dotted lines represent the point-wise posterior medians of the impulse responses to the monetary policy shock. The red areas show the pointwise 16-18 percentile bands. The blue solid lines and blue areas show the same objects for the central bank information shock. The figure is based on 10,000 draws from the Gibbs sampler.

Figure 13: Continued



Note: The red solid-dotted lines represent the point-wise posterior medians of the impulse responses to the monetary policy shock. The red areas show the pointwise 16-18 percentile bands. The blue solid lines and blue areas show the same objects for the central bank information shock. The figure is based on 10,000 draws from the Gibbs sampler.

5 Is the information effect also present after the Fed announcements?

In light of the VAR analysis the answer is yes. Even though monetary policy shocks dominate the responses to Fed announcements, the information effects are present there as well. This can be seen by running the analogous exercises, but this time with the 167 Fed announcements decomposed into monetary policy shocks and information effects. Figure 14 reports the event study regressions, with the details provided in Appendix Table C.5. Figure 15 reports the VAR impulse responses.

The VAR results in Figure 15 show a clearly expansionary domestic effect of a positive Fed information shock, reported in red in the left column.¹¹ Furthermore, this effect spills over basically one-for-one to the European financial variables, as can be seen comparing the red impulse responses in the left and the right column. So, just like the ECB information shocks, the Fed information shocks have a very similar impact on financial variables on both sides of the Atlantic.

The Fed information shock depreciates the dollar somewhat against the euro and even more against the broad basket of other currencies (see the fifth row of Figure 15). This is similar to the effect of the ECB information shocks on the same exchange rates (cf. Figure 13). In spite of the higher Treasury yields, the dollar weakens as investors increase their demand for riskier and, apparently, also non-dollar denominated assets.

The Fed monetary policy shocks, reported in blue in Figure 15, are contractionary and, unlike the ECB monetary policy shocks, also spill over quite strongly across the Atlantic. This can be seen by comparing the blue impulse responses in the left and the right column. The euro area bond spreads tighten almost one-for-one with the US bond spreads, while euro area stock prices, real GDP and its deflator contract approximately half as much as their US counterparts. German bund yields actually fall, instead of following the increase in the US Treasury yields. One interpretation of this finding is that German government bonds are a safe haven for the European investors and hence their yields fall after an adverse global shocks, such as the Fed's contractionary monetary

¹¹This confirms the findings of Jarociński and Karadi (2020) with small differences due to a different sample (starting here in 1999 instead of 1979) and variable definitions.

policy shock. The decrease in German bund yields is also consistent with the ECB trying to offset the other central bank's monetary policy shocks, though less successfully than the Fed, judging by the responses of other variables.

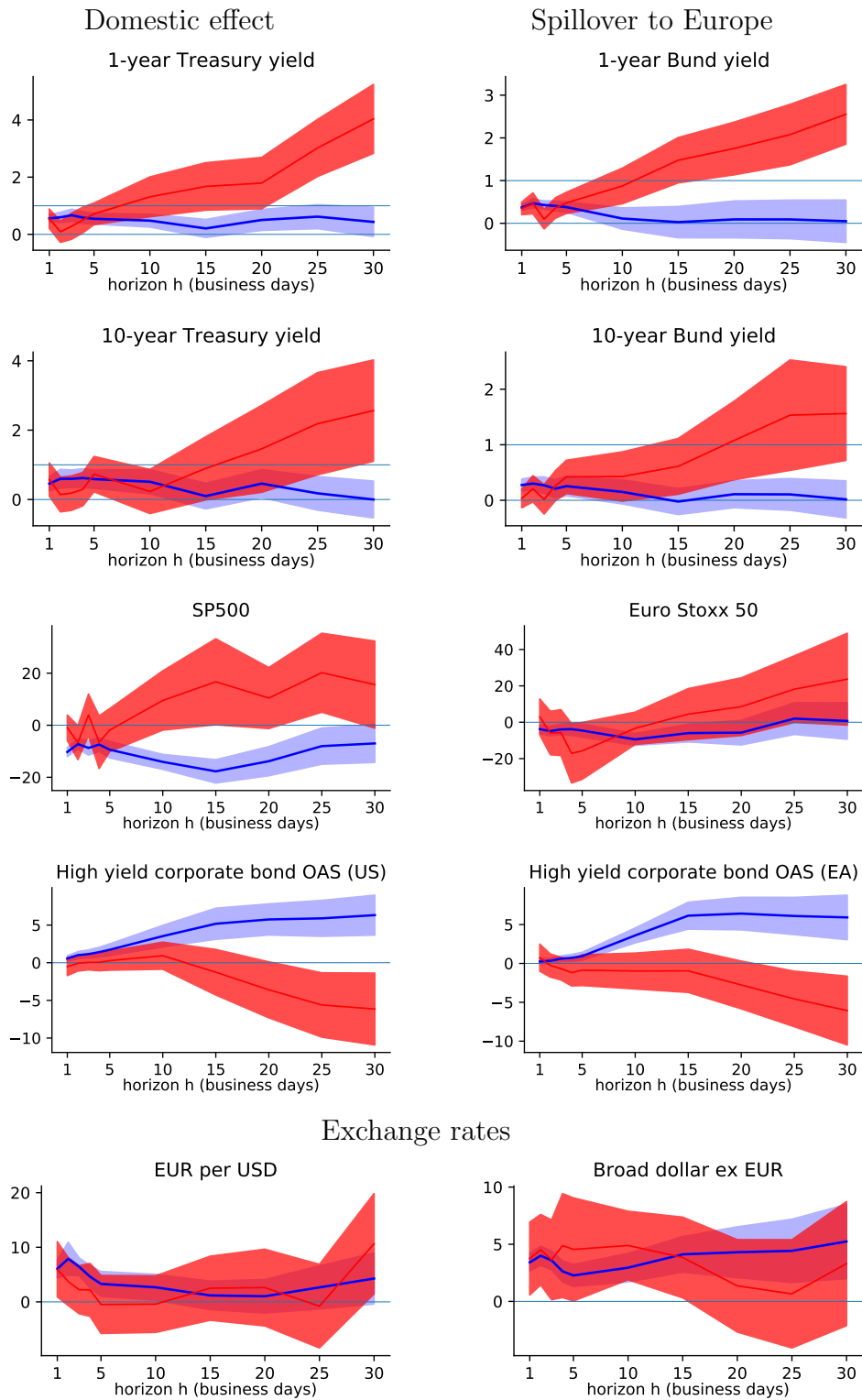
Significant spillovers of Fed monetary policy show up also in the event study regressions (Figure 14). At the daily frequency we can see that the German bund yields initially increase, following the Fed tightening (see the blue impulse responses in the top-right of Figure 14). This is consistent with the findings of Curcuru et al. (2018) who primarily use intraday data. However, here I track the yields also in the days that follow and we can see that the response vanishes within two weeks. The euro area corporate bond spreads increase basically one-for-one with their US counterparts, while the Euro Stoxx 50 falls significantly, but much less than the S&P500, similarly to what we see in the monthly VAR.

The Fed information effects are much less precisely estimated in daily data. The signs of the red responses in Figure 14 are mostly consistent with the expansionary effect, but they are not significant. We can only conclude that after the interest rate hikes identified here as Fed information shocks the stock prices don't fall, bond spreads don't increase, and the dollar does not appreciate significantly, unlike after the Fed monetary policy shocks.

Overall, the VAR results strongly suggest, and the event study regressions don't contradict, that the spillovers of Fed policies to the euro area are also in part driven by the information effects.

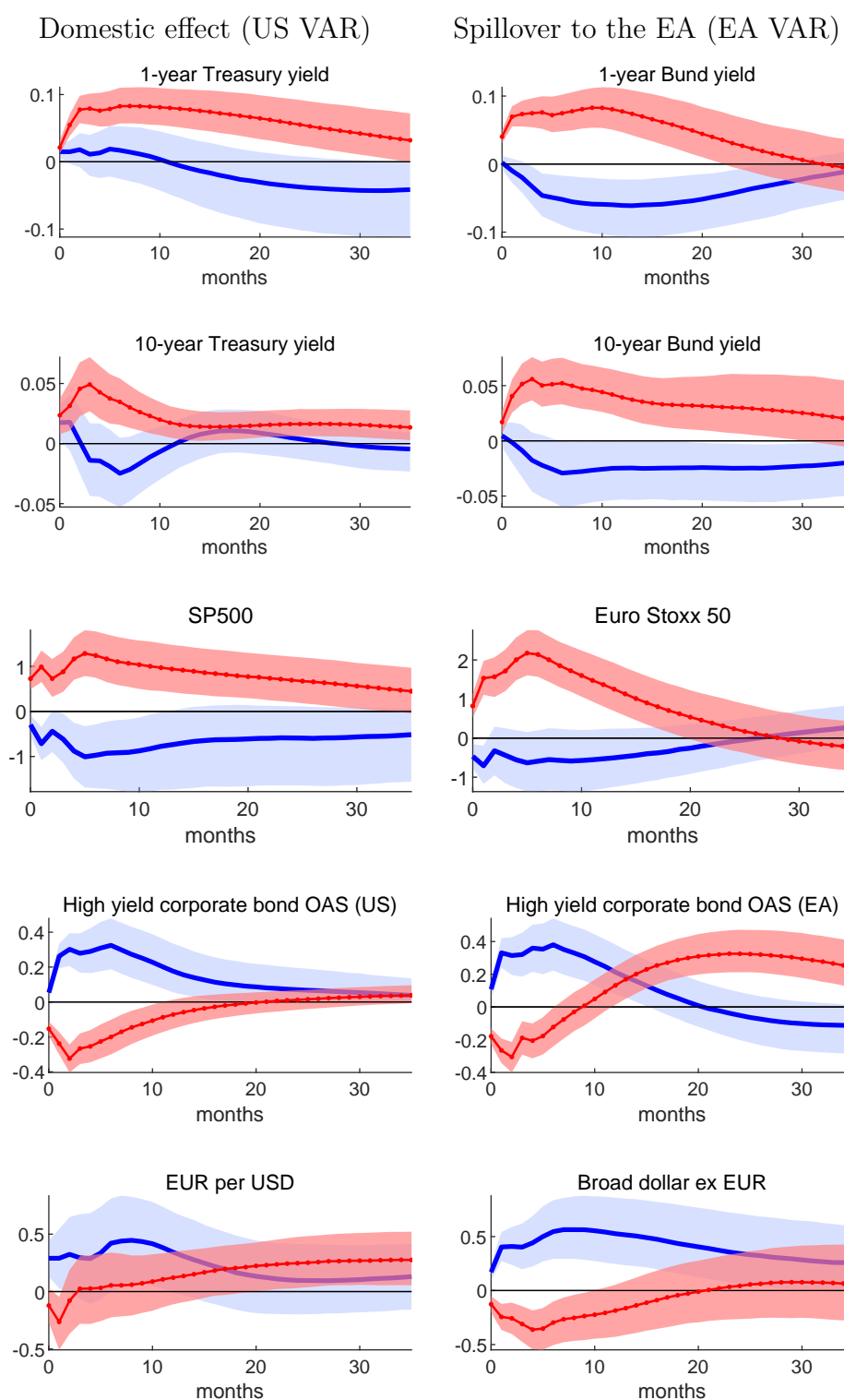
Figure 14: The effects of Fed shocks: elasticities β_h^{MP} and β_h^{CBI} from local projections.

$$y_{t+h} - y_{t-1} = \alpha + \beta_h^{MP} i_t^{MP,Fed} + \beta_h^{CBI} i_t^{CBI,Fed} + u_t$$



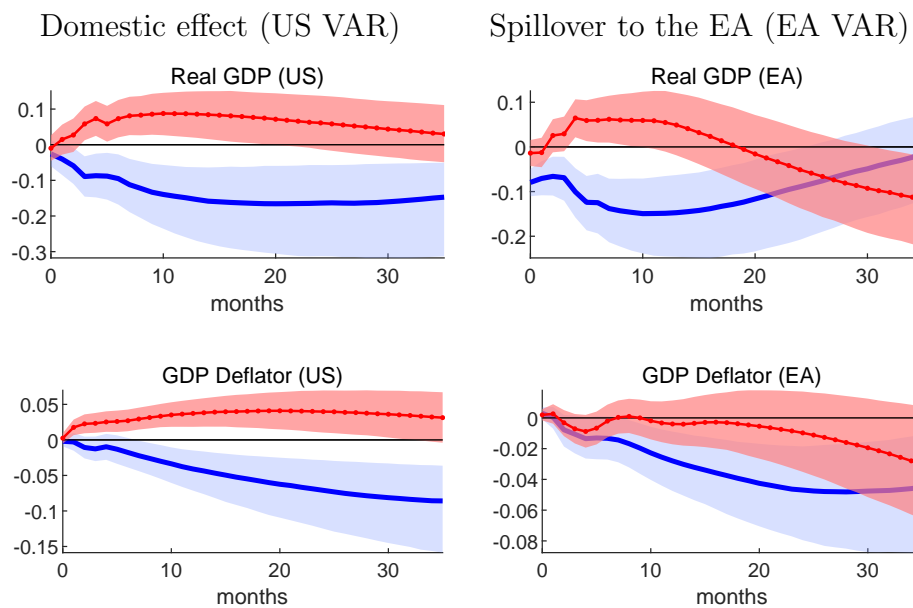
Note. The solid lines connect the OLS estimates of $\beta_h^{j \in \{MP, CBI\}}$ at different horizons h . The shaded areas show heteroskedasticity-robust one standard deviation bands. Blue lines and blue bands (lighter grey on black-and-white) show the effects of monetary policy shocks, β_h^{MP} . Red lines and red bands (darker grey on black-and-white) show the central bank information effects, β_h^{CBI} . All regressions have 167 observations. Appendix Table C.5 reports detailed estimation results.

Figure 15: The effects of Fed shocks: Impulse responses to one standard deviation MP and CBI shocks in monthly VARs.



Note: The red solid-dotted lines represent the point-wise posterior medians of the impulse responses to the monetary policy shock. The red areas show the pointwise 16-18 percentile bands. The blue solid lines and blue areas show the same objects for the central bank information shock. The figure is based on 10,000 draws from the Gibbs sampler.

Figure 15: Continued



Note: The red solid-dotted lines represent the point-wise posterior medians of the impulse responses to the monetary policy shock. The red areas show the pointwise 16-18 percentile bands. The blue solid lines and blue areas show the same objects for the central bank information shock. The figure is based on 10,000 draws from the Gibbs sampler.

6 Conclusions

This paper reports a variety of evidence on the transatlantic spillovers generated by the Fed and the ECB. The ECB spillovers present a puzzle: surprise interest rate hikes by the ECB have expansionary effects on the US. To rationalize this puzzle, this paper decomposes the interest rate surprises into monetary policy and information shocks. It finds that the ECB information shocks spill over strongly to the US, while the ECB monetary policy shocks do not. As a result, the transatlantic impact of ECB policy announcements provides a compelling example of an empirically relevant central bank information effect.

The results in this paper suggest the need to rethink the nature of central bank information. Standard models assume that the central bank information is about domestic fundamentals, such as the natural rate of interest. However, a range of results in this paper suggests that the news that investors infer from central bank announcements are more global than that and affect their risk premia. Further work is needed to understand why this happens, either using models of rational agents or behavioral finance explanations.

Appendix

Appendix A Data

A.1 High-frequency financial data

- **ECB interest rate surprise** - The first principal component of the Monetary Event window changes in overnight index swaps (OIS) with maturities 1-, 3- and 6-months and 1-year (Identifiers: OIS1M, OIS3M, OIS6M, OIS1Y). *Source:* EA-MPD of Altavilla et al. (2019). The Monetary Event window change is the change in the median quote from the window 13:25-13:35 before the press release to the median quote in the window 15:40-15:50 after the press conference. The first principal component is rescaled so that its variance equals that of 1 year OIS rate changes in

the Monetary Event window.

- **ECB stock price surprise** - Euro Stoxx 50 index change in the Monetary Event window in percentage points. Identifier: STOXX50E. *Source*: EA-MPD of Altavilla et al. (2019).
- **Fed interest rate surprise** - The first principal component of the Tight Window changes in the current-month and three-month-ahead federal funds futures contracts and changes in price of the second, third, and fourth eurodollar futures contracts, which have 1.5, 2.5, and 3.5 quarters to expiration on average. Identifiers: MP1, FF4, ED2, ED3, ED4. *Source*: Gürkaynak et al. (2005) database updated till May 2019. The tight window is the 30-minute window from 10 minutes before the FOMC announcement to 20 minutes after it. The first principal component is rescaled so that its variance equals that of the changes in the fourth eurodollar futures contract in the tight window.
- **Fed stock price surprise** - S&P500 index change in the tight window, in percentage points. Identifier: SP500. *Source*: Gürkaynak et al. (2005) database updated till May 2019.

A.2 Daily financial data

- **1-year Bund yield, 10-year Bund yield** - *Source*: Deutsche Bundesbank: Term structure of interest rates on listed Federal securities (method by Svensson) https://www.bundesbank.de/dynamic/action/en/statistics/time-series-databases/time-series-databases/759784/759784?listId=www_skms_it03a. *Units*: percent. *Transformation*: none.
- **1-year Treasury bond yield, 10-year Treasury bond yield** - Zero-coupon yield, Continuously Compounded. *Source*: <https://www.federalreserve.gov/pubs/feds/2006/200628/200628abs.html> Identifiers: SVENY01, SVENY10. Reference: Gürkaynak et al. (2007) *Units*: percent. *Transformation*: none.
- **S&P500** - Standard and Poors 500 Composite Index *Source*: Datastream. *Units*: index. *Transformation*: $100 \cdot \log$.

- **Euro Stoxx 50** - Dow Jones Euro Stoxx 50 EUR Price Index - *Source*: Bloomberg. *Units*: index. *Transformation*: $100 \cdot \log$.
- **High yield corporate bond OAS (US)** - ICE BofA US High Yield Index Option-Adjusted Spread (OAS). US dollar denominated below investment grade rated corporate debt publicly issued in the US domestic market. *Source*: Fred, after Ice Data Indices, LLC. Identifier: bamlh0a0hym2. *Units*: percent. *Transformation*: none.
- **High yield corporate bond OAS (EA)** - ICE BofA Euro High Yield Index Option-Adjusted Spread (OAS). Euro denominated below investment grade corporate debt publicly issued in the euro domestic or eurobond markets. *Source*: Fred, after Ice Data Indices, LLC. Identifier: bamlhe00ehyioas. *Units*: percent. *Transformation*: none.
- **EUR per USD** - Exchange rate. *Source*: ECB. *Units*: Euros per one US dollar. *Transformation*: $100 \cdot \log$.
- **Broad dollar ex EUR** - The Broad dollar index, calculated by the Federal Reserve, is a trade-weighted exchange rate with respect to 26 most important trading partners by volume of the bilateral trade. I have recalculated this index taking the euro out of it. The construction of the Broad dollar index is explained in von Beschwitz et al. (2019), <https://www.federalreserve.gov/econres/notes/feds-notes/revisions-to-the-federal-reserve-dollar-indexes-20190115.htm>. The Broad dollar index back to 2006 was downloaded from the Federal Reserve website <https://www.federalreserve.gov/datadownload/Build.aspx?rel=H10> and the euro's weights back to 2006 was downloaded from <https://www.federalreserve.gov/releases/h10/weights/default.htm>. The Broad dollar index and the euro's weights before 2006 were taken from the data appendix of von Beschwitz et al. (2019), https://www.federalreserve.gov/econres/notes/ifdp-notes/IFDP_Note_Data_Appendix.xlsx. I have removed the euro from the Broad dollar index and rescaled so that the weights of the remaining currencies add up to 1. *Units*: Index, foreign currency per one US dollar. *Transformation*: $100 \cdot \log$.

More in detail, the Broad dollar index at time t (I_t) is $I_t = I_{t-1} \prod_j^N (e_{j,t}/e_{j,t-1})^{w_{j,t}}$,

where $e_{j,t}$ is the price of the dollar in terms of the foreign currency j at time t and $w_{j,t}$ is its weight (von Beschwitz et al., 2019). Let the euro be the N th currency, let $\Delta i_t = \ln(I_t/I_{t-1})$ be the log change of the broad dollar index and let $c_{N,t} = w_{N,t} \ln(e_{N,t}/e_{N,t-1})$ be the euro's contribution to it. The log change of the Broad dollar ex EUR is computed as $\Delta i_t^{\text{exEUR}} = 1/(1 - w_{N,t})(\Delta i_t - c_{N,t})$.

- **Federal Funds Target Rate** - *Source*: Fred, after Board of Governors of the Federal Reserve System. Identifier: DFEDTAR. Effective December 16, 2008, target rate is reported as a range. Therefore, from December 16 on the variable is computed as the average of the Federal Funds Target Range - Lower Limit (Identifier: DFEDTARL) and the Federal Funds Target Range - Upper Limit (Identifier: DFEDTARU) *Units*: percent. *Transformation*: none.
- **S&P 500 Focused US Revenue Exposure** - The S&P 500 Focused U.S. Revenue Exposure Index is designed to measure the performance of companies in the S&P 500 with relatively focused revenue exposure to the U.S. Number of companies: 124. Total Return index. Ticker: SPXRFUT. First value date: November 21, 2008. *Source*: Bloomberg. *Units*: index. *Transformation*: $100 \cdot \log$.
- **S&P 500 Focused Foreign Revenue Exposure** - The S&P 500 Focused Foreign Revenue Exposure Index is designed to measure the performance of companies in the S&P 500 with relatively focused revenue exposure to regions outside the U.S. Number of companies: 125. Total Return index. Ticker: SPXFFRUT. First value date: November 21, 2008. *Source*: Bloomberg. *Units*: index. *Transformation*: $100 \cdot \log$.
- **S&P500 Financials** - The S&P 500 Financials comprises those companies included in the S&P 500 that are classified as members of the GICS financials sector. Number of companies: 66. Total Return index. Ticker: SPTRFINL. *Source*: Bloomberg. *Units*: index. *Transformation*: $100 \cdot \log$.
- **S&P500 Ex-Financials** - The S&P 500 Ex-Financials is designed to provide broad market exposure except for members of the financials sector. Number of companies:

439. Total Return index. Ticker: SPXXFIST. *Source*: Bloomberg. *Units*: index. *Transformation*: $100 \cdot \log$.

- **Wilshire US Small-Cap** - The Wilshire US Small-Cap is a float-adjusted, market capitalization-weighted index of the issues ranked between 750 and 2,500 by market capitalization of the Wilshire 5000 Total Market Index. Number of companies: 1745. Fred identifier: WILLSMLCAP. *Source*: Fred after Wilshire Associates. *Units*: index. *Transformation*: $100 \cdot \log$.
- **Wilshire US Large-Cap** - The Wilshire US Large-Cap Index is a float-adjusted, market capitalization-weighted index of the issues ranked above 750 by market capitalization of the Wilshire 5000 Total Market Index. Together, the components of the Wilshire US Large-Cap, Wilshire US Small-Cap Index and Wilshire US Micro-Cap Index comprise the Wilshire 5000 without gaps or overlaps. Number of companies: 750. Fred identifier: WILLLRGCAP. *Source*: Fred after Wilshire Associates. *Units*: index. *Transformation*: $100 \cdot \log$.
- **CISS** - Composite Index of Systemic Stress in the euro area, constructed by Hollo et al. (2012). The index is a nonlinear aggregation of 15 individual financial stress indicators in the equity, bond, money and foreign exchange rate markets. *Source*: ECB Statistical Data Warehouse. *Units*: index. *Transformation*: none.

A.3 Interpolated monthly variables

- **US Real GDP and GDP Deflator** - Interpolation by Stock and Watson (2010) updated to 2019Q1. See the replication files for Jarociński and Karadi (2020).
- **Euro area Real GDP and GDP Deflator** - Own interpolation following Stock and Watson (2010). See the replication files for Jarociński and Karadi (2020).

Appendix B Rotational sign restrictions

This section explains the details of rotational sign restrictions. Recall that the goal is to decompose the interest rate surprises into a sum of two orthogonal components, such that the first one is associated with a negative co-movement of the interest rate and stock price surprises and the second is associated with their positive co-movement.

Recall also that i^{Total} is a vector of interest rate surprises, s is a vector of stock price surprises, i^{MP} is a vector of monetary policy shock proxies and i^{CBI} is a vector of central bank information shock proxies. Each of the four vectors has length T , where T is the number of central bank announcements in the dataset. Let $M = (i^{Total}, s)$ be a $T \times 2$ matrix with columns i^{Total} and s . I decompose M as

$$M = UC, \quad \text{where} \quad U = (i^{MP}, i^{CBI}), \quad (i^{MP})'i^{CBI} = 0 \quad \text{and} \quad C = \begin{pmatrix} 1 & c_{MP} < 0 \\ 1 & c_{CBI} > 0 \end{pmatrix}. \quad (\text{B.1})$$

B.1 Computing the decomposition

U and C are computed as

$$U = QPD \quad \text{and} \quad C = D^{-1}P'R \quad (\text{B.2})$$

where the matrices Q, P, D, R are obtained in three steps.

1. *Decompose M into two orthogonal components* using the QR decomposition,

$$M = QR, \quad \text{where} \quad Q'Q = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \quad \text{and} \quad R = \begin{pmatrix} r_{11} > 0 & r_{12} \\ 0 & r_{22} > 0 \end{pmatrix}. \quad (\text{B.3})$$

Note that in many software packages do not impose the normalization that the diagonal elements of R are positive, in this case this has to be imposed ex post.

2. *Rotate* these orthogonal components using the rotation matrix P ,

$$P = \begin{pmatrix} \cos(\alpha) & \sin(\alpha) \\ -\sin(\alpha) & \cos(\alpha) \end{pmatrix}. \quad (\text{B.4})$$

- To satisfy the sign restrictions use any angle α in the following range

$$\alpha \in \left(0, \arctan \frac{-r_{22}}{r_{12}}\right) \quad \text{if } r_{12} < 0, \quad (\text{B.5a})$$

$$\alpha \in \left(\arctan \frac{r_{12}}{r_{22}}, \frac{\pi}{2}\right) \quad \text{if } r_{12} \geq 0. \quad (\text{B.5b})$$

- To obtain the desired variance share $\text{var}(i^{MP})/\text{var}(i^{Total})$ use

$$\alpha = \arccos \sqrt{\frac{\text{var}(i^{MP})}{\text{var}(i^{Total})}}. \quad (\text{B.6})$$

3. *Rescale* the resulting orthogonal components with a diagonal matrix D to ensure that they add up to the interest rate surprises i^{Total} . It is straightforward to show that

$$D = \begin{pmatrix} r_{11} \cos(\alpha) & 0 \\ 0 & r_{11} \sin(\alpha) \end{pmatrix}. \quad (\text{B.7})$$

B.2 Properties and derivations

Result 1. The variance shares implied by the above decomposition are

$$\frac{\text{var}(i^{MP})}{\text{var}(i^{Total})} = \cos^2(\alpha) \quad \text{and} \quad \frac{\text{var}(i^{CBI})}{\text{var}(i^{Total})} = \sin^2(\alpha). \quad (\text{B.8})$$

Proof This is the straightforward implication of using the matrix D given in (B.7) in $U = QPD$. ■

Result 2. Considering $\alpha \in (-\pi, \pi)$, the sign restrictions $c_{MP} < 0$ and $c_{CBI} > 0$ are satisfied if and only if α satisfies (B.5a)-(B.5b).

Proof. Consider the “unscaled” decomposition $M = \tilde{U}\tilde{C}$ where $\tilde{U} = QP$ and $\tilde{C} = P'R$. \tilde{C} contains the impact of the two “unscaled” shocks in \tilde{U} on the interest rate and stock

price surprises, so \tilde{C} should satisfy

$$\tilde{C} = \begin{pmatrix} \tilde{c}_{11} > 0 & \tilde{c}_{12} < 0 \\ \tilde{c}_{21} > 0 & \tilde{c}_{22} > 0 \end{pmatrix}$$

$\tilde{C} = P'R$ implies the following system of inequalities

$$r_{11} \cos \alpha > 0 \quad (\text{B.9})$$

$$r_{12} \cos \alpha - r_{22} \sin \alpha < 0 \quad (\text{B.10})$$

$$r_{11} \sin \alpha > 0 \quad (\text{B.11})$$

$$r_{12} \sin \alpha + r_{22} \cos \alpha > 0 \quad (\text{B.12})$$

Assume without loss of generality that $\alpha \in (-\pi, \pi)$. (B.9) and (B.11) imply that $\alpha \in (0, \pi/2)$. If $r_{12} < 0$, (B.10) is slack and (B.12) implies (B.5a). If $r_{12} > 0$, (B.12) is slack and (B.10) implies (B.5b). ■

Result 3. The variance share of the monetary policy shock must be within the following bounds:

$$\frac{\text{var}(i^{MP})}{\text{var}(i^{Total})} \in \begin{cases} (\rho^2, 1) & \text{if } \rho < 0, \\ (0, 1 - \rho^2) & \text{if } \rho \geq 0. \end{cases} \quad (\text{B.13})$$

Proof. This follows from (B.5a), (B.5b) and (B.8). To simplify the expressions use the fact that $\cos(\arctan(x)) = 1/\sqrt{1+x^2}$. This implies

$$\frac{\text{var}(i^{MP})}{\text{var}(i^{Total})} \in \left(\frac{r_{12}^2}{r_{22}^2 + r_{12}^2}, 1 \right) \text{ if } r_{12} < 0 \text{ and } \frac{\text{var}(i^{MP})}{\text{var}(i^{Total})} \in \left(0, \frac{r_{22}^2}{r_{12}^2 + r_{22}^2} \right) \text{ if } r_{12} \geq 0. \quad (\text{B.14})$$

To simplify further notice that $M'M = R'Q'QR = R'R$, and hence

$$\begin{pmatrix} i^{Total'} i^{Total} & i^{Total'} s \\ \dots & s' s \end{pmatrix} = \begin{pmatrix} r_{11}^2 & r_{11} r_{12} \\ \dots & r_{12}^2 + r_{22}^2 \end{pmatrix}. \blacksquare \quad (\text{B.15})$$

Appendix C Detailed local projection results

Table C.1: The impact of ECB total interest rate surprises on financial variables

$$y_{t+h} - y_{t-1} = \alpha + \beta_h i_t^{Total, ECB} + u_t.$$

	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$	$h = 10$	$h = 15$	$h = 20$	$h = 25$	$h = 30$
<hr/>										
1-year Bund yield										
β_h	1.03*** (0.16)	1.01*** (0.18)	1.03*** (0.22)	0.95*** (0.24)	0.97*** (0.28)	0.86** (0.35)	0.90** (0.35)	0.94** (0.45)	0.80** (0.40)	0.96* (0.51)
R-sq	0.37	0.26	0.24	0.18	0.16	0.08	0.06	0.04	0.02	0.03
N.obs.	261	261	261	261	261	261	261	261	261	261
<hr/>										
1-year Treasury yield										
β_h	0.11 (0.16)	0.21 (0.18)	0.22 (0.20)	0.11 (0.18)	0.13 (0.22)	-0.01 (0.28)	-0.10 (0.24)	-0.32 (0.33)	-0.34 (0.37)	-0.26 (0.44)
R-sq	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N.obs.	261	261	261	261	261	261	261	261	261	261
<hr/>										
10-year Bund yield										
β_h	0.38*** (0.14)	0.43** (0.19)	0.51** (0.20)	0.53** (0.23)	0.62** (0.26)	0.35 (0.34)	0.24 (0.42)	0.12 (0.50)	0.42 (0.44)	0.58 (0.50)
R-sq	0.04	0.04	0.04	0.04	0.04	0.01	0.00	0.00	0.01	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261
<hr/>										
10-year Treasury yield										
β_h	0.15 (0.20)	0.34 (0.24)	0.35 (0.29)	0.30 (0.30)	0.28 (0.27)	-0.13 (0.51)	-0.11 (0.53)	-0.36 (0.65)	-0.12 (0.67)	-0.30 (0.89)
R-sq	0.00	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
N.obs.	261	261	261	261	261	261	261	261	261	261
<hr/>										
Euro Stoxx 50										
β_h	0.61 (3.94)	4.34 (4.97)	1.92 (6.25)	5.22 (9.07)	6.62 (8.39)	-0.00 (11.37)	10.96 (10.92)	3.93 (10.80)	2.94 (11.00)	8.18 (12.81)
R-sq	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00
N.obs.	261	261	261	261	261	261	261	261	261	261
<hr/>										
SP500										
β_h	3.10 (2.86)	5.69 (5.26)	4.38 (5.01)	3.72 (7.61)	6.92 (6.33)	-0.75 (12.09)	11.03 (8.79)	5.15 (9.55)	6.63 (9.36)	6.64 (9.39)
R-sq	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.00
N.obs.	261	261	261	261	261	261	261	261	261	261
<hr/>										
High yield corporate bond OAS (EA)										
β_h	-1.31*** (0.43)	-1.61*** (0.55)	-1.67** (0.75)	-1.94** (0.84)	-2.43** (1.06)	-1.69 (1.86)	-2.91 (2.50)	-3.01 (2.59)	-3.78 (2.94)	-4.76 (3.25)
R-sq	0.07	0.06	0.04	0.04	0.05	0.01	0.02	0.02	0.02	0.02
N.obs.	261	261	261	261	261	261	261	261	261	261
<hr/>										
High yield corporate bond OAS (US)										
β_h	-0.52 (0.36)	-1.03** (0.53)	-1.17* (0.66)	-1.14 (0.81)	-1.22 (0.92)	-0.57 (1.83)	-1.43 (2.14)	-1.71 (2.50)	-1.89 (2.75)	-2.47 (2.74)
R-sq	0.02	0.05	0.05	0.03	0.03	0.00	0.01	0.01	0.01	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261
<hr/>										
EUR per USD										
β_h	-5.15*** (1.61)	-7.15*** (1.97)	-6.32*** (2.10)	-6.47** (2.81)	-7.33** (3.06)	-6.56* (3.59)	-12.57*** (3.93)	-11.96*** (3.84)	-12.66*** (3.74)	-18.18*** (6.69)
R-sq	0.05	0.06	0.04	0.03	0.04	0.01	0.04	0.03	0.03	0.05
N.obs.	261	261	261	261	261	261	261	261	261	261
<hr/>										
Broad dollar ex EUR										
β_h	-1.23 (0.93)	-1.43 (1.10)	-0.91 (1.68)	-1.78 (1.83)	-1.59 (2.08)	0.03 (2.80)	-2.90 (2.85)	-0.47 (2.77)	-1.65 (2.50)	-4.16 (2.65)
R-sq	0.02	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.01
N.obs.	261	261	260	261	261	261	261	261	261	261

Notes: Heteroskedasticity robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Constant terms are not reported for brevity.

Table C.2: The impact of Fed total interest rate surprises on financial variables

$$y_{t+h} - y_{t-1} = \alpha + \beta_h i_t^{Total, Fed} + u_t.$$

	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$	$h = 10$	$h = 15$	$h = 20$	$h = 25$	$h = 30$
1-year Bund yield										
β_h	0.37*** (0.06)	0.47*** (0.09)	0.38*** (0.09)	0.40*** (0.11)	0.39*** (0.12)	0.23 (0.23)	0.24 (0.34)	0.34 (0.39)	0.39 (0.41)	0.42 (0.45)
R-sq	0.28	0.20	0.14	0.13	0.11	0.01	0.01	0.01	0.02	0.01
N.obs.	167	167	167	167	167	167	167	167	167	167
1-year Treasury yield										
β_h	0.56*** (0.13)	0.52*** (0.15)	0.61*** (0.17)	0.57*** (0.18)	0.57*** (0.17)	0.60*** (0.22)	0.43 (0.27)	0.70** (0.28)	0.98*** (0.33)	0.97** (0.41)
R-sq	0.28	0.21	0.19	0.14	0.15	0.08	0.03	0.06	0.07	0.05
N.obs.	167	167	167	167	167	167	167	167	167	167
10-year Bund yield										
β_h	0.24** (0.10)	0.29*** (0.11)	0.23 (0.14)	0.22 (0.16)	0.28* (0.17)	0.19 (0.21)	0.07 (0.23)	0.25 (0.24)	0.32 (0.28)	0.25 (0.32)
R-sq	0.07	0.06	0.03	0.02	0.03	0.01	0.00	0.01	0.01	0.00
N.obs.	167	167	167	167	167	167	167	167	167	167
10-year Treasury yield										
β_h	0.47*** (0.17)	0.53** (0.24)	0.53** (0.22)	0.57** (0.23)	0.61*** (0.23)	0.47 (0.30)	0.22 (0.36)	0.61 (0.42)	0.48 (0.52)	0.38 (0.56)
R-sq	0.08	0.09	0.08	0.07	0.08	0.03	0.00	0.02	0.01	0.01
N.obs.	167	167	167	167	167	167	167	167	167	167
Euro Stoxx 50										
β_h	-2.78 (2.62)	-5.02* (2.82)	-4.20 (2.98)	-5.83 (3.61)	-6.25* (3.71)	-8.52*** (3.18)	-4.41 (4.55)	-3.57 (6.07)	4.42 (7.93)	4.15 (9.17)
R-sq	0.01	0.02	0.01	0.02	0.02	0.03	0.00	0.00	0.00	0.00
N.obs.	167	167	167	167	167	167	167	167	167	167
SP500										
β_h	-8.87*** (1.80)	-7.16*** (1.84)	-6.82*** (2.30)	-7.28*** (2.60)	-8.27*** (3.00)	-10.54*** (2.78)	-12.55*** (4.46)	-10.18* (5.25)	-3.79 (6.41)	-3.60 (6.68)
R-sq	0.12	0.06	0.04	0.04	0.05	0.06	0.05	0.03	0.00	0.00
N.obs.	167	167	167	167	167	167	167	167	167	167
High yield corporate bond OAS (EA)										
β_h	0.32 (0.30)	0.25 (0.36)	0.42 (0.36)	0.43 (0.44)	0.66 (0.48)	2.91*** (0.91)	5.09*** (1.73)	5.03** (2.05)	4.50* (2.33)	4.12 (2.79)
R-sq	0.01	0.00	0.01	0.01	0.01	0.11	0.16	0.11	0.06	0.04
N.obs.	167	167	167	167	167	167	166	167	167	167
High yield corporate bond OAS (US)										
β_h	0.40 (0.38)	0.84* (0.46)	0.98* (0.54)	1.20* (0.63)	1.50** (0.76)	3.14** (1.41)	4.22** (2.04)	4.34** (2.03)	4.17* (2.33)	4.45* (2.60)
R-sq	0.02	0.05	0.07	0.08	0.09	0.16	0.15	0.11	0.08	0.07
N.obs.	167	167	167	167	167	167	166	167	167	167
EUR per USD										
β_h	6.04*** (1.35)	7.27** (2.82)	5.80*** (1.27)	4.25** (1.71)	2.73 (2.01)	2.21 (2.18)	1.38 (2.40)	1.27 (2.83)	2.14 (3.55)	5.23 (4.31)
R-sq	0.13	0.13	0.08	0.04	0.01	0.01	0.00	0.00	0.00	0.01
N.obs.	167	167	167	167	167	167	167	167	167	167
Broad dollar ex EUR										
β_h	3.47*** (0.69)	4.07*** (0.71)	3.60*** (0.74)	2.97*** (0.92)	2.61*** (0.94)	3.24*** (1.07)	4.08*** (1.26)	3.86* (2.00)	3.86 (2.51)	4.95* (2.90)
R-sq	0.14	0.17	0.11	0.06	0.05	0.05	0.05	0.03	0.02	0.03
N.obs.	166	166	166	166	166	166	166	166	165	166

Notes: Heteroskedasticity robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Constant terms are not reported for brevity.

Table C.3: The impact of ECB monetary policy and information shocks on financial variables

$$y_{t+h} - y_{t-1} = \alpha + \beta_h^{MP} i_t^{MP} + \beta_h^{CBI} i_t^{CBI} + u_t.$$

	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$	$h = 10$	$h = 15$	$h = 20$	$h = 25$	$h = 30$
1-year Bund yield										
β_h^{MP} (rotation)	0.90*** (0.18)	0.86*** (0.19)	0.88*** (0.23)	0.72*** (0.24)	0.69** (0.29)	0.51 (0.38)	0.42 (0.38)	0.37 (0.49)	0.19 (0.42)	0.25 (0.57)
β_h^{CBI} (rotation)	1.28*** (0.19)	1.33*** (0.23)	1.35*** (0.29)	1.43*** (0.33)	1.56*** (0.35)	1.60*** (0.39)	1.92*** (0.46)	2.17*** (0.57)	2.12*** (0.66)	2.48*** (0.72)
Ftest	0.04	0.03	0.08	0.03	0.01	0.01	0.00	0.00	0.01	0.01
R-sq	0.38	0.28	0.25	0.20	0.19	0.11	0.10	0.08	0.05	0.06
N.obs.	261	261	261	261	261	261	261	261	261	261
β_h^{MP} (poor man)	0.93*** (0.21)	0.88*** (0.22)	0.86*** (0.25)	0.72*** (0.27)	0.65** (0.30)	0.53 (0.42)	0.48 (0.41)	0.49 (0.56)	0.34 (0.43)	0.38 (0.62)
β_h^{CBI} (poor man)	1.22*** (0.20)	1.28*** (0.26)	1.38*** (0.35)	1.44*** (0.38)	1.64*** (0.43)	1.55*** (0.46)	1.79*** (0.51)	1.90*** (0.60)	1.79** (0.71)	2.19*** (0.70)
Ftest	0.32	0.24	0.24	0.12	0.06	0.10	0.04	0.09	0.08	0.05
R-sq	0.38	0.27	0.25	0.20	0.20	0.10	0.09	0.07	0.04	0.05
N.obs.	261	261	261	261	261	261	261	261	261	261
1-year Treasury yield										
β_h^{MP} (rotation)	0.01 (0.17)	0.10 (0.18)	0.07 (0.22)	-0.07 (0.20)	-0.03 (0.24)	-0.24 (0.32)	-0.26 (0.27)	-0.57 (0.37)	-0.68 (0.42)	-0.74 (0.49)
β_h^{CBI} (rotation)	0.33* (0.18)	0.45* (0.24)	0.53** (0.25)	0.49** (0.21)	0.46* (0.26)	0.48 (0.39)	0.23 (0.43)	0.22 (0.54)	0.38 (0.58)	0.78 (0.64)
Ftest	0.05	0.10	0.06	0.02	0.05	0.09	0.31	0.19	0.11	0.03
R-sq	0.01	0.02	0.02	0.02	0.01	0.01	0.00	0.01	0.01	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261
β_h^{MP} (poor man)	-0.08 (0.18)	0.03 (0.20)	0.00 (0.24)	-0.11 (0.22)	-0.02 (0.29)	-0.26 (0.35)	-0.32 (0.29)	-0.61 (0.38)	-0.69 (0.46)	-0.75 (0.57)
β_h^{CBI} (poor man)	0.52*** (0.16)	0.59** (0.26)	0.68*** (0.23)	0.56*** (0.18)	0.44* (0.26)	0.53 (0.43)	0.36 (0.44)	0.30 (0.64)	0.40 (0.60)	0.80 (0.70)
Ftest	0.01	0.09	0.04	0.02	0.24	0.15	0.19	0.22	0.15	0.08
R-sq	0.03	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261

Notes: Heteroskedasticity robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Constant terms are not reported for brevity. Ftest: p-value of the F-test for $H_0: \beta_h^{MP} = \beta_h^{CBI}$.

Table C.3: Continued

	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$	$h = 10$	$h = 15$	$h = 20$	$h = 25$	$h = 30$
10-year Bund yield										
β_h^{MP} (rotation)	0.28 (0.18)	0.35 (0.24)	0.50** (0.25)	0.47* (0.28)	0.54* (0.31)	0.33 (0.39)	0.23 (0.47)	0.08 (0.58)	0.34 (0.50)	0.63 (0.58)
β_h^{CBI} (rotation)	0.60*** (0.21)	0.58** (0.26)	0.51* (0.27)	0.67** (0.31)	0.78** (0.34)	0.40 (0.45)	0.26 (0.54)	0.19 (0.56)	0.59 (0.62)	0.47 (0.67)
Ftest	0.28	0.48	0.98	0.58	0.56	0.89	0.95	0.86	0.71	0.83
R-sq	0.05	0.04	0.04	0.04	0.04	0.01	0.00	0.00	0.01	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261
β_h^{MP} (poor man)	0.33* (0.18)	0.42 (0.26)	0.53* (0.28)	0.52 (0.32)	0.57* (0.34)	0.27 (0.43)	0.00 (0.52)	-0.13 (0.66)	0.03 (0.50)	0.24 (0.59)
β_h^{CBI} (poor man)	0.48*** (0.16)	0.45** (0.23)	0.45* (0.24)	0.57** (0.27)	0.72** (0.33)	0.52 (0.49)	0.74 (0.54)	0.65 (0.48)	1.24** (0.55)	1.31** (0.63)
Ftest	0.52	0.91	0.82	0.90	0.76	0.70	0.33	0.34	0.11	0.21
R-sq	0.05	0.04	0.04	0.04	0.04	0.01	0.01	0.01	0.02	0.02
N.obs.	261	261	261	261	261	261	261	261	261	261
10-year Treasury yield										
β_h^{MP} (rotation)	0.04 (0.24)	0.17 (0.25)	0.13 (0.30)	-0.02 (0.31)	0.09 (0.29)	-0.42 (0.58)	-0.27 (0.62)	-0.50 (0.74)	-0.28 (0.75)	-0.49 (1.02)
β_h^{CBI} (rotation)	0.38 (0.26)	0.70** (0.31)	0.81** (0.40)	0.97** (0.43)	0.70* (0.38)	0.51 (0.66)	0.22 (0.65)	-0.06 (0.76)	0.21 (0.84)	0.10 (0.97)
Ftest	0.27	0.09	0.08	0.02	0.13	0.21	0.52	0.59	0.58	0.56
R-sq	0.01	0.02	0.03	0.03	0.01	0.01	0.00	0.00	0.00	0.00
N.obs.	261	261	261	261	261	261	261	261	261	261
β_h^{MP} (poor man)	0.11 (0.28)	0.22 (0.29)	0.08 (0.32)	0.03 (0.32)	0.18 (0.32)	-0.52 (0.59)	-0.40 (0.68)	-0.70 (0.83)	-0.57 (0.82)	-0.79 (1.17)
β_h^{CBI} (poor man)	0.22 (0.19)	0.61** (0.30)	0.93** (0.43)	0.86* (0.51)	0.51 (0.42)	0.71 (0.69)	0.49 (0.61)	0.36 (0.72)	0.83 (0.81)	0.72 (0.86)
Ftest	0.76	0.36	0.11	0.16	0.52	0.17	0.33	0.33	0.22	0.30
R-sq	0.00	0.02	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261

Notes: Heteroskedasticity robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Constant terms are not reported for brevity. Ftest: p -value of the F-test for $H_0: \beta_h^{MP} = \beta_h^{CBI}$.

Table C.3: Continued

	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$	$h = 10$	$h = 15$	$h = 20$	$h = 25$	$h = 30$
Euro Stoxx 50										
β_h^{MP} (rotation)	-14.52*** (4.24)	-11.50** (5.22)	-15.58** (6.84)	-16.51* (9.18)	-12.89 (8.36)	-18.58 (11.87)	-7.73 (10.78)	-16.74 (11.10)	-16.40 (11.60)	-11.64 (14.14)
β_h^{CBI} (rotation)	32.79*** (5.69)	38.02*** (7.76)	39.11*** (8.56)	51.38*** (12.26)	48.09*** (11.59)	39.48** (15.87)	50.69*** (17.05)	47.85*** (17.88)	44.04** (20.99)	50.29** (23.01)
Ftest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02
R-sq	0.17	0.14	0.14	0.15	0.12	0.06	0.06	0.05	0.03	0.03
N.obs.	261	261	261	261	261	261	261	261	261	261
β_h^{MP} (poor man)	-7.16* (4.30)	-5.07 (5.01)	-8.86 (6.91)	-10.22 (9.45)	-9.41 (8.43)	-17.16 (12.15)	-3.21 (12.07)	-9.66 (11.58)	-6.92 (11.08)	-3.75 (13.87)
β_h^{CBI} (poor man)	17.08*** (5.55)	24.30** (9.60)	24.76*** (9.35)	37.92** (14.75)	40.58*** (11.66)	36.36** (15.93)	41.00** (17.36)	32.71* (18.68)	23.82 (22.57)	33.45 (24.50)
Ftest	0.00	0.01	0.00	0.01	0.00	0.01	0.04	0.05	0.22	0.18
R-sq	0.04	0.05	0.05	0.08	0.08	0.05	0.04	0.02	0.01	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261
SP500										
β_h^{MP} (rotation)	-4.32 (3.13)	-3.67 (4.78)	-7.59 (5.11)	-7.94 (7.52)	-5.02 (5.60)	-12.34 (13.13)	2.21 (8.60)	-5.09 (9.99)	-4.72 (9.76)	-3.17 (10.56)
β_h^{CBI} (rotation)	18.87*** (4.78)	25.58*** (8.38)	29.82*** (7.60)	28.48*** (10.00)	32.31*** (10.20)	23.89* (12.99)	29.79** (13.98)	26.91* (14.26)	30.74* (16.57)	27.48 (16.79)
Ftest	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.03	0.05	0.12
R-sq	0.07	0.08	0.09	0.07	0.07	0.04	0.03	0.02	0.02	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261
β_h^{MP} (poor man)	-1.58 (2.67)	-2.33 (3.95)	-5.43 (5.01)	-8.48 (7.50)	-5.67 (5.12)	-16.68 (14.28)	-0.25 (9.42)	-6.15 (10.54)	-2.10 (10.34)	-0.41 (10.43)
β_h^{CBI} (poor man)	13.01** (5.15)	22.68** (11.05)	25.18*** (8.43)	29.56*** (11.06)	33.62*** (10.60)	33.02*** (11.42)	34.95** (13.96)	29.08** (14.43)	25.12 (16.17)	21.57 (16.78)
Ftest	0.01	0.03	0.00	0.00	0.00	0.01	0.04	0.05	0.15	0.26
R-sq	0.03	0.06	0.06	0.08	0.07	0.07	0.04	0.02	0.01	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261

Notes: Heteroskedasticity robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Constant terms are not reported for brevity. Ftest: p-value of the F-test for $H_0: \beta_h^{MP} = \beta_h^{CBI}$.

Table C.3: Continued

	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$	$h = 10$	$h = 15$	$h = 20$	$h = 25$	$h = 30$
High yield corporate bond OAS (EA)										
β_h^{MP} (rotation)	-0.63 (0.43)	-0.64 (0.54)	-0.50 (0.72)	-0.43 (0.78)	-0.86 (0.95)	0.18 (1.93)	-0.61 (2.47)	-0.70 (2.67)	-2.17 (3.18)	-2.90 (3.58)
β_h^{CBI} (rotation)	-2.75*** (0.66)	-3.67*** (0.96)	-4.15*** (1.25)	-5.14*** (1.39)	-5.78*** (1.69)	-5.68** (2.45)	-7.80** (3.40)	-7.92** (3.52)	-7.22* (4.33)	-8.70* (4.73)
Ftest	0.00	0.00	0.01	0.00	0.00	0.02	0.02	0.04	0.27	0.26
R-sq	0.12	0.10	0.08	0.10	0.09	0.04	0.04	0.04	0.02	0.03
N.obs.	261	261	261	261	261	261	261	261	261	261
β_h^{MP} (poor man)	-0.61* (0.33)	-0.69* (0.41)	-0.50 (0.60)	-0.47 (0.71)	-0.64 (0.88)	0.78 (2.10)	0.70 (2.58)	0.39 (2.82)	-0.87 (3.37)	-1.70 (3.91)
β_h^{CBI} (poor man)	-2.79*** (0.68)	-3.55*** (1.03)	-4.16*** (1.37)	-5.06*** (1.57)	-6.23*** (1.92)	-6.94*** (2.51)	-10.56*** (3.41)	-10.22*** (3.43)	-9.95** (4.06)	-11.23*** (4.34)
Ftest	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.08	0.10
R-sq	0.12	0.10	0.08	0.10	0.11	0.06	0.08	0.06	0.04	0.04
N.obs.	261	261	261	261	261	261	261	261	261	261
High yield corporate bond OAS (US)										
β_h^{MP} (rotation)	-0.11 (0.37)	-0.37 (0.44)	-0.36 (0.56)	-0.03 (0.74)	0.00 (0.86)	1.01 (1.97)	-0.28 (2.33)	-0.88 (2.86)	-1.24 (3.16)	-1.40 (3.18)
β_h^{CBI} (rotation)	-1.41*** (0.51)	-2.44*** (0.84)	-2.89*** (1.03)	-3.51*** (1.17)	-3.81*** (1.30)	-3.93* (2.05)	-3.89 (2.41)	-3.49 (2.80)	-3.27 (3.28)	-4.74 (3.55)
Ftest	0.01	0.01	0.01	0.00	0.00	0.01	0.12	0.38	0.57	0.41
R-sq	0.05	0.08	0.09	0.09	0.08	0.03	0.02	0.01	0.01	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261
β_h^{MP} (poor man)	-0.13 (0.40)	-0.26 (0.41)	-0.24 (0.53)	-0.01 (0.76)	0.02 (0.89)	1.31 (2.25)	0.59 (2.65)	0.34 (3.20)	0.10 (3.55)	-0.12 (3.47)
β_h^{CBI} (poor man)	-1.35** (0.54)	-2.67** (1.04)	-3.15** (1.32)	-3.53** (1.51)	-3.85** (1.68)	-4.57** (2.12)	-5.72** (2.35)	-6.06** (2.47)	-6.11** (2.76)	-7.44** (3.06)
Ftest	0.07	0.03	0.04	0.04	0.04	0.06	0.07	0.11	0.16	0.11
R-sq	0.04	0.10	0.11	0.10	0.08	0.05	0.05	0.03	0.03	0.03
N.obs.	261	261	261	261	261	261	261	261	261	261

Notes: Heteroskedasticity robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Constant terms are not reported for brevity. Ftest: p-value of the F-test for $H_0: \beta_h^{MP} = \beta_h^{CBI}$.

Table C.3: Continued

	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$	$h = 10$	$h = 15$	$h = 20$	$h = 25$	$h = 30$
log VSTOXX										
β_h^{MP} (rotation)	0.33* (0.18)	0.22 (0.21)	0.35 (0.23)	0.30 (0.26)	0.24 (0.25)	0.54 (0.34)	-0.10 (0.29)	0.28 (0.27)	0.15 (0.30)	-0.04 (0.42)
β_h^{CBI} (rotation)	-0.99*** (0.28)	-1.06*** (0.37)	-1.09*** (0.39)	-1.21*** (0.43)	-1.01** (0.44)	-1.08* (0.59)	-1.35*** (0.50)	-1.25*** (0.45)	-1.14** (0.53)	-1.58** (0.63)
Ftest	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.01	0.06	0.06
R-sq	0.09	0.07	0.07	0.07	0.04	0.03	0.04	0.03	0.02	0.02
N.obs.	261	261	261	261	261	261	261	261	261	261
β_h^{MP} (poor man)	0.24* (0.13)	0.14 (0.16)	0.22 (0.20)	0.19 (0.25)	0.20 (0.21)	0.51** (0.25)	-0.22 (0.27)	0.10 (0.23)	-0.07 (0.25)	-0.24 (0.39)
β_h^{CBI} (poor man)	-0.80*** (0.29)	-0.89* (0.48)	-0.81 (0.50)	-0.97* (0.55)	-0.92* (0.53)	-1.02* (0.59)	-1.09** (0.50)	-0.87** (0.38)	-0.67 (0.47)	-1.15** (0.52)
Ftest	0.00	0.04	0.05	0.06	0.05	0.02	0.13	0.03	0.25	0.16
R-sq	0.05	0.05	0.04	0.04	0.03	0.03	0.03	0.01	0.01	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261
log VIX										
β_h^{MP} (rotation)	0.12 (0.18)	0.06 (0.22)	0.24 (0.21)	0.17 (0.27)	0.21 (0.26)	0.37 (0.36)	-0.48 (0.31)	0.06 (0.35)	-0.04 (0.38)	-0.29 (0.51)
β_h^{CBI} (rotation)	-0.83*** (0.30)	-1.20** (0.48)	-1.15*** (0.34)	-1.34*** (0.48)	-1.26*** (0.48)	-1.28** (0.61)	-1.11** (0.52)	-1.14** (0.49)	-1.21** (0.61)	-1.13* (0.67)
Ftest	0.01	0.00	0.00	0.00	0.01	0.02	0.27	0.06	0.16	0.36
R-sq	0.05	0.07	0.06	0.07	0.05	0.03	0.03	0.02	0.02	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261
β_h^{MP} (poor man)	0.06 (0.11)	0.08 (0.14)	0.16 (0.18)	0.15 (0.22)	0.20 (0.21)	0.39 (0.28)	-0.39 (0.29)	0.03 (0.31)	-0.10 (0.29)	-0.34 (0.49)
β_h^{CBI} (poor man)	-0.71** (0.31)	-1.24* (0.65)	-0.99*** (0.35)	-1.29** (0.53)	-1.24*** (0.47)	-1.33** (0.61)	-1.30** (0.54)	-1.07*** (0.36)	-1.07** (0.46)	-1.03** (0.49)
Ftest	0.02	0.05	0.00	0.01	0.01	0.01	0.14	0.02	0.08	0.32
R-sq	0.03	0.08	0.05	0.06	0.05	0.04	0.04	0.02	0.01	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261

Notes: Heteroskedasticity robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Constant terms are not reported for brevity. Ftest: p-value of the F-test for $H_0: \beta_h^{MP} = \beta_h^{CBI}$.

Table C.3: Continued

	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$	$h = 10$	$h = 15$	$h = 20$	$h = 25$	$h = 30$
EUR per USD										
β_h^{MP} (rotation)	-6.94*** (2.04)	-8.19*** (2.16)	-7.33*** (2.41)	-7.45** (3.31)	-8.22** (3.74)	-5.97 (5.23)	-11.83** (5.09)	-8.92* (4.93)	-10.83** (4.58)	-18.01** (7.57)
β_h^{CBI} (rotation)	-1.34 (2.77)	-4.94 (3.47)	-4.17 (3.78)	-4.38 (4.36)	-5.44 (4.84)	-7.80 (5.79)	-14.13* (7.28)	-18.43** (7.95)	-16.55** (8.44)	-18.54* (10.14)
Ftest	0.11	0.39	0.47	0.55	0.64	0.83	0.81	0.34	0.58	0.96
R-sq	0.06	0.06	0.04	0.04	0.04	0.01	0.04	0.03	0.03	0.05
N.obs.	261	261	261	261	261	261	261	261	261	261
β_h^{MP} (poor man)	-5.76*** (2.02)	-8.44*** (2.18)	-6.87*** (2.34)	-7.42** (3.55)	-7.27* (3.83)	-7.14 (4.77)	-13.30*** (4.59)	-11.54*** (4.32)	-12.64*** (3.67)	-22.63*** (7.88)
β_h^{CBI} (poor man)	-3.84 (2.76)	-4.41 (3.99)	-5.15 (4.28)	-4.44 (4.52)	-7.45 (5.11)	-5.33 (4.66)	-11.02 (7.15)	-12.86 (7.87)	-12.70 (8.66)	-8.76 (11.10)
Ftest	0.58	0.38	0.73	0.61	0.98	0.78	0.79	0.88	0.99	0.31
R-sq	0.05	0.07	0.04	0.04	0.04	0.01	0.04	0.03	0.03	0.05
N.obs.	261	261	261	261	261	261	261	261	261	261
Broad dollar ex EUR										
β_h^{MP} (rotation)	0.00 (1.06)	0.23 (1.16)	1.33 (1.82)	0.95 (1.94)	0.80 (2.33)	3.35 (3.23)	-0.12 (3.09)	3.37 (3.13)	2.14 (2.92)	-0.19 (3.23)
β_h^{CBI} (rotation)	-3.87*** (1.22)	-4.97*** (1.57)	-5.67*** (1.96)	-7.59*** (2.36)	-6.68*** (2.47)	-7.01** (3.31)	-8.82** (4.09)	-8.63** (3.90)	-9.71** (4.58)	-12.61** (5.26)
Ftest	0.01	0.00	0.00	0.00	0.01	0.01	0.05	0.01	0.04	0.06
R-sq	0.05	0.05	0.05	0.06	0.04	0.03	0.03	0.03	0.02	0.03
N.obs.	261	261	260	261	261	261	261	261	261	261
β_h^{MP} (poor man)	-0.23 (1.09)	-0.41 (1.23)	0.92 (2.03)	0.36 (2.14)	1.16 (2.47)	2.56 (3.58)	-0.83 (3.50)	2.36 (3.39)	0.54 (2.82)	-2.43 (2.86)
β_h^{CBI} (poor man)	-3.36*** (1.25)	-3.59* (1.88)	-4.80** (2.26)	-6.32** (2.64)	-7.42*** (2.45)	-5.33* (3.13)	-7.31* (4.13)	-6.47* (3.87)	-6.29 (4.38)	-7.84 (5.13)
Ftest	0.06	0.15	0.06	0.05	0.01	0.09	0.23	0.08	0.19	0.35
R-sq	0.04	0.03	0.04	0.04	0.05	0.02	0.02	0.02	0.01	0.01
N.obs.	261	261	260	261	261	261	261	261	261	261

Notes: Heteroskedasticity robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Constant terms are not reported for brevity. Ftest: p-value of the F-test for $H_0: \beta_h^{MP} = \beta_h^{CBI}$.

Table C.4: The impact of ECB monetary policy and information shocks on stock indices.

	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$	$h = 10$	$h = 15$	$h = 20$	$h = 25$	$h = 30$
SP500 Focused Foreign Rev.										
β_h^{MP} (rotation)	3.59 (5.94)	13.36 (10.00)	7.91 (8.28)	16.12* (9.28)	9.86 (9.12)	9.19 (12.54)	34.46*** (13.04)	25.99* (15.28)	13.91 (19.76)	10.07 (23.27)
β_h^{CBI} (rotation)	25.06*** (9.17)	35.96** (16.75)	40.63*** (11.72)	51.30*** (14.47)	44.47*** (12.96)	49.87*** (19.19)	53.09*** (19.00)	43.27** (20.40)	35.09 (23.64)	22.83 (25.02)
Ftest	0.01	0.03	0.00	0.01	0.00	0.02	0.27	0.42	0.48	0.72
R-sq	0.10	0.15	0.18	0.19	0.13	0.09	0.13	0.06	0.03	0.01
N.obs.	109	109	109	109	109	109	109	109	109	109
β_h^{MP} (poor man)	3.58 (5.87)	7.10 (8.11)	1.08 (8.68)	9.25 (8.30)	6.05 (11.42)	7.20 (13.86)	36.61** (16.75)	29.22* (17.50)	25.64 (21.11)	23.26 (23.80)
β_h^{CBI} (poor man)	21.59** (11.01)	42.81** (20.80)	46.79*** (8.29)	57.14*** (13.74)	45.25*** (9.46)	46.63** (20.33)	46.47** (20.23)	35.05 (22.35)	11.98 (26.81)	-1.37 (25.64)
Ftest	0.15	0.11	0.00	0.00	0.01	0.11	0.70	0.84	0.69	0.48
R-sq	0.07	0.17	0.20	0.20	0.12	0.07	0.12	0.05	0.02	0.01
N.obs.	109	109	109	109	109	109	109	109	109	109
SP500 Focused US Rev.										
β_h^{MP} (rotation)	5.25 (4.93)	14.80 (9.90)	7.14 (6.74)	16.13** (8.16)	9.46 (6.77)	13.76 (10.22)	32.31*** (10.86)	29.12** (13.50)	20.91 (14.60)	14.97 (16.75)
β_h^{CBI} (rotation)	18.99** (8.26)	29.64* (16.51)	33.46*** (10.27)	42.84*** (13.47)	38.58*** (10.24)	44.76*** (14.91)	49.04*** (14.89)	41.27** (20.32)	34.20* (20.77)	19.29 (21.42)
Ftest	0.03	0.16	0.00	0.01	0.00	0.01	0.20	0.52	0.57	0.88
R-sq	0.08	0.14	0.18	0.21	0.16	0.10	0.15	0.07	0.04	0.01
N.obs.	109	109	109	109	109	109	109	109	109	109
β_h^{MP} (poor man)	5.21 (4.46)	8.93 (7.19)	1.28 (6.92)	11.48* (6.61)	8.69 (8.72)	15.07 (12.13)	34.75** (14.15)	30.57** (13.77)	29.07* (15.57)	21.35 (16.26)
β_h^{CBI} (poor man)	16.83 (11.03)	37.10* (22.52)	39.04*** (9.45)	46.33*** (16.58)	35.17*** (9.92)	37.54** (18.04)	42.23*** (16.37)	36.87 (27.18)	18.36 (22.92)	7.88 (22.25)
Ftest	0.33	0.23	0.00	0.05	0.04	0.30	0.73	0.83	0.70	0.62
R-sq	0.06	0.17	0.21	0.21	0.12	0.07	0.14	0.07	0.04	0.02
N.obs.	109	109	109	109	109	109	109	109	109	109
Foc.For.Rev. - Foc. US Rev.										
β_h^{MP} (rotation)	-1.66 (2.95)	-1.44 (2.78)	0.77 (2.84)	-0.01 (3.47)	0.40 (4.04)	-4.57 (4.90)	2.15 (4.53)	-3.13 (5.41)	-7.01 (7.41)	-4.90 (8.89)
β_h^{CBI} (rotation)	6.07* (3.37)	6.32* (3.42)	7.18 (4.71)	8.45 (5.66)	5.89 (6.61)	5.11 (7.96)	4.05 (7.68)	2.00 (8.28)	0.90 (8.72)	3.55 (9.41)
Ftest	0.09	0.09	0.21	0.14	0.40	0.24	0.83	0.56	0.47	0.51
R-sq	0.05	0.05	0.03	0.03	0.01	0.02	0.00	0.00	0.01	0.01
N.obs.	109	109	109	109	109	109	109	109	109	109
β_h^{MP} (poor man)	-1.62 (2.86)	-1.83 (2.42)	-0.20 (2.40)	-2.23 (3.56)	-2.63 (4.43)	-7.87* (4.32)	1.85 (4.23)	-1.35 (5.11)	-3.43 (7.44)	1.91 (9.81)
β_h^{CBI} (poor man)	4.76 (2.98)	5.71 (3.66)	7.75 (5.24)	10.81* (5.94)	10.09 (6.55)	9.09 (6.62)	4.24 (7.79)	-1.82 (10.74)	-6.39 (11.53)	-9.25 (10.28)
Ftest	0.12	0.09	0.17	0.06	0.11	0.03	0.79	0.97	0.83	0.43
R-sq	0.02	0.03	0.03	0.05	0.03	0.04	0.00	0.00	0.01	0.01
N.obs.	109	109	109	109	109	109	109	109	109	109

Notes: Heteroskedasticity robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Constant terms are not reported for brevity. Ftest: p-value of the F-test for $H_0: \beta_h^{MP} = \beta_h^{CBI}$.

Table C.4: Continued

	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$	$h = 10$	$h = 15$	$h = 20$	$h = 25$	$h = 30$
SP500 Financials										
β_h^{MP} (rotation)	-5.20 (5.14)	-3.16 (8.56)	-10.42 (8.41)	-11.06 (12.15)	-9.03 (9.86)	-29.02 (24.94)	-12.94 (15.81)	-18.67 (16.85)	-22.85 (17.37)	-22.44 (16.48)
β_h^{CBI} (rotation)	19.12** (7.78)	27.61** (13.29)	38.85*** (12.13)	38.47** (15.81)	46.30*** (16.85)	33.90 (21.23)	37.72* (21.42)	34.83 (22.82)	35.44 (27.31)	32.72 (26.84)
Ftest	0.01	0.02	0.00	0.00	0.00	0.00	0.02	0.02	0.04	0.06
R-sq	0.03	0.04	0.07	0.06	0.06	0.05	0.02	0.02	0.02	0.02
N.obs.	261	261	261	261	261	261	261	261	261	261
β_h^{MP} (poor man)	-3.56 (4.77)	-5.55 (7.34)	-11.04 (8.00)	-13.56 (12.38)	-10.17 (9.88)	-36.00 (28.19)	-14.15 (18.03)	-22.04 (18.60)	-22.22 (20.18)	-20.29 (17.22)
β_h^{CBI} (poor man)	15.60* (8.63)	32.61* (16.69)	40.06*** (13.43)	43.66** (18.07)	48.60*** (18.38)	48.58*** (18.03)	40.18* (21.35)	41.88* (24.76)	33.99 (24.28)	28.04 (26.15)
Ftest	0.05	0.04	0.00	0.01	0.00	0.01	0.05	0.04	0.07	0.12
R-sq	0.02	0.06	0.07	0.07	0.06	0.08	0.03	0.03	0.02	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261
SP500 Ex-Financials										
β_h^{MP} (rotation)	-4.15 (2.89)	-3.35 (4.29)	-7.07 (4.67)	-7.31 (6.77)	-4.24 (5.12)	-9.55 (11.40)	4.68 (7.57)	-2.45 (9.04)	-1.42 (8.84)	0.40 (9.95)
β_h^{CBI} (rotation)	18.69*** (4.46)	24.59*** (7.72)	28.27*** (7.08)	26.44*** (9.20)	29.60*** (9.38)	21.68* (12.02)	28.23** (13.13)	25.34* (13.29)	29.65* (15.29)	26.52* (15.58)
Ftest	0.00	0.00	0.00	0.00	0.00	0.01	0.07	0.05	0.07	0.16
R-sq	0.07	0.08	0.09	0.07	0.06	0.03	0.03	0.02	0.02	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261
β_h^{MP} (poor man)	-1.21 (2.42)	-1.67 (3.56)	-4.45 (4.61)	-7.55 (6.69)	-4.81 (4.65)	-13.56 (12.22)	2.11 (8.10)	-3.23 (9.37)	1.55 (9.00)	3.47 (9.65)
β_h^{CBI} (poor man)	12.40*** (4.74)	20.98** (10.17)	22.65*** (7.80)	26.88*** (10.08)	30.75*** (9.56)	30.12*** (10.70)	33.63** (13.18)	26.93** (13.35)	23.31 (15.28)	19.96 (15.69)
Ftest	0.01	0.04	0.00	0.00	0.00	0.01	0.04	0.06	0.22	0.37
R-sq	0.03	0.06	0.06	0.07	0.07	0.06	0.04	0.02	0.01	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261
Fin. - Ex-Fin.										
β_h^{MP} (rotation)	-1.04 (3.22)	0.19 (5.37)	-3.35 (4.83)	-3.75 (5.97)	-4.79 (6.53)	-19.47 (14.45)	-17.62* (9.62)	-16.21* (9.62)	-21.43* (11.12)	-22.85** (10.08)
β_h^{CBI} (rotation)	0.43 (4.72)	3.02 (6.96)	10.59 (7.19)	12.02 (8.41)	16.70* (10.00)	12.22 (12.32)	9.49 (12.19)	9.49 (13.40)	5.79 (16.49)	6.20 (15.73)
Ftest	0.78	0.71	0.08	0.05	0.03	0.01	0.03	0.05	0.10	0.09
R-sq	0.00	0.00	0.01	0.01	0.02	0.04	0.02	0.02	0.02	0.02
N.obs.	261	261	261	261	261	261	261	261	261	261
β_h^{MP} (poor man)	-2.35 (3.18)	-3.88 (5.06)	-6.58 (4.50)	-6.01 (6.21)	-5.36 (7.25)	-22.44 (16.74)	-16.26 (11.06)	-18.82* (10.86)	-23.76* (13.03)	-23.76** (10.41)
β_h^{CBI} (poor man)	3.20 (4.98)	11.63 (7.46)	17.41** (7.51)	16.78* (9.86)	17.85 (11.09)	18.46* (10.86)	6.55 (13.08)	14.96 (15.60)	10.69 (14.64)	8.08 (15.89)
Ftest	0.34	0.08	0.01	0.05	0.08	0.04	0.18	0.08	0.08	0.09
R-sq	0.00	0.02	0.04	0.03	0.02	0.05	0.02	0.03	0.02	0.02
N.obs.	261	261	261	261	261	261	261	261	261	261

Notes: Heteroskedasticity robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Constant terms are not reported for brevity. Ftest: p-value of the F-test for $H_0: \beta_h^{MP} = \beta_h^{CBI}$.

Table C.4: Continued

	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$	$h = 10$	$h = 15$	$h = 20$	$h = 25$	$h = 30$
Wilshire US Small-Cap										
β_h^{MP} (rotation)	-3.22 (3.64)	-3.86 (5.93)	-8.78 (6.07)	-9.76 (8.92)	-6.96 (6.77)	-14.19 (16.83)	11.93 (11.60)	2.01 (15.15)	1.53 (15.06)	2.35 (15.78)
β_h^{CBI} (rotation)	23.97*** (6.62)	32.88*** (11.76)	33.60*** (10.17)	36.03*** (12.81)	37.50*** (12.61)	32.32* (17.26)	44.63** (17.94)	39.88** (19.99)	46.53** (22.64)	42.76* (23.86)
Ftest	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.08	0.09	0.17
R-sq	0.07	0.08	0.09	0.07	0.06	0.04	0.04	0.02	0.02	0.02
N.obs.	261	261	261	261	261	261	261	261	261	261
β_h^{MP} (poor man)	-0.42 (3.23)	-2.38 (4.77)	-7.36 (5.85)	-10.14 (8.94)	-7.79 (6.41)	-20.98 (18.05)	6.25 (12.33)	-2.49 (15.81)	3.35 (15.42)	4.39 (14.66)
β_h^{CBI} (poor man)	17.98** (7.90)	29.66* (16.49)	30.51** (11.97)	36.77** (15.18)	39.17*** (13.32)	46.62*** (15.36)	56.60*** (17.75)	49.34*** (19.15)	42.60** (20.63)	38.36 (23.44)
Ftest	0.03	0.06	0.00	0.01	0.00	0.00	0.02	0.04	0.13	0.22
R-sq	0.04	0.07	0.07	0.08	0.07	0.08	0.06	0.03	0.02	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261
Wilshire US Large-Cap										
β_h^{MP} (rotation)	-4.12 (3.16)	-3.91 (4.86)	-7.85 (5.16)	-8.28 (7.55)	-5.63 (5.65)	-12.30 (13.38)	2.83 (8.41)	-4.88 (10.18)	-4.17 (9.89)	-4.41 (10.91)
β_h^{CBI} (rotation)	19.22*** (4.88)	26.77*** (8.64)	29.99*** (7.81)	28.56*** (10.14)	31.90*** (10.31)	24.71* (13.38)	30.22** (14.03)	26.82* (14.40)	31.16* (16.71)	28.55* (17.31)
Ftest	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.04	0.06	0.10
R-sq	0.07	0.08	0.09	0.07	0.06	0.03	0.03	0.02	0.02	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261
β_h^{MP} (poor man)	-1.46 (2.70)	-2.48 (3.99)	-5.79 (5.06)	-8.93 (7.51)	-6.36 (5.17)	-16.82 (14.53)	0.37 (9.13)	-5.92 (10.71)	-1.31 (10.41)	-1.38 (10.81)
β_h^{CBI} (poor man)	13.52** (5.32)	23.68** (11.56)	25.56*** (8.68)	29.88*** (11.19)	33.39*** (10.69)	34.22*** (11.78)	35.38** (14.24)	28.97** (14.61)	25.02 (16.47)	22.07 (17.39)
Ftest	0.01	0.03	0.00	0.00	0.00	0.01	0.04	0.05	0.17	0.25
R-sq	0.03	0.06	0.06	0.08	0.07	0.07	0.04	0.02	0.01	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261
Wilshire US Small-Cap - Large-Cap										
β_h^{MP} (rotation)	0.90 (1.63)	0.05 (2.18)	-0.93 (2.20)	-1.48 (2.37)	-1.33 (2.37)	-1.89 (4.67)	9.10* (5.22)	6.88 (6.63)	5.70 (7.17)	6.77 (6.82)
β_h^{CBI} (rotation)	4.75* (2.65)	6.11 (4.08)	3.61 (3.80)	7.47* (4.14)	5.60 (4.40)	7.61 (6.54)	14.42** (7.20)	13.06 (8.89)	15.37 (9.77)	14.21 (8.95)
Ftest	0.17	0.16	0.31	0.06	0.17	0.22	0.54	0.57	0.44	0.55
R-sq	0.02	0.02	0.00	0.02	0.01	0.01	0.03	0.02	0.01	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261
β_h^{MP} (poor man)	1.04 (1.66)	0.11 (1.89)	-1.57 (1.99)	-1.21 (2.28)	-1.43 (2.26)	-4.16 (4.64)	5.88 (5.29)	3.43 (6.79)	4.65 (7.34)	5.78 (6.11)
β_h^{CBI} (poor man)	4.46 (3.04)	5.98 (5.21)	4.95 (4.00)	6.89 (4.76)	5.78 (4.53)	12.40** (5.16)	21.22*** (5.07)	20.37*** (6.26)	17.58*** (6.40)	16.29** (7.45)
Ftest	0.32	0.29	0.15	0.13	0.16	0.02	0.04	0.07	0.19	0.28
R-sq	0.02	0.01	0.01	0.01	0.01	0.02	0.04	0.03	0.02	0.01
N.obs.	261	261	261	261	261	261	261	261	261	261

Notes: Heteroskedasticity robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Constant terms are not reported for brevity. Ftest: p-value of the F-test for $H_0: \beta_h^{MP} = \beta_h^{CBI}$.

Table C.5: The impact of Fed monetary policy and information shocks on financial variables

$$y_{t+h} - y_{t-1} = \alpha + \beta_h^{MP} i_t^{MP} + \beta_h^{CBI} i_t^{CBI} + u_t.$$

	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$	$h = 10$	$h = 15$	$h = 20$	$h = 25$	$h = 30$
1-year Bund yield										
β_h^{MP} (rotation)	0.37*** (0.07)	0.47*** (0.11)	0.43*** (0.10)	0.41*** (0.12)	0.38*** (0.12)	0.11 (0.25)	0.03 (0.37)	0.09 (0.43)	0.09 (0.45)	0.05 (0.50)
β_h^{CBI} (rotation)	0.35** (0.15)	0.47* (0.24)	0.10 (0.23)	0.36 (0.24)	0.48* (0.25)	0.87** (0.42)	1.48*** (0.53)	1.75*** (0.62)	2.08*** (0.71)	2.55*** (0.70)
Ftest	0.89	1.00	0.20	0.85	0.69	0.08	0.01	0.01	0.01	0.00
R-sq	0.28	0.20	0.15	0.13	0.11	0.03	0.05	0.06	0.07	0.08
N.obs.	167	167	167	167	167	167	167	167	167	167
1-year Treasury yield										
β_h^{MP} (rotation)	0.56*** (0.13)	0.60*** (0.18)	0.67*** (0.21)	0.59*** (0.21)	0.55*** (0.19)	0.48** (0.22)	0.21 (0.31)	0.50 (0.36)	0.62 (0.42)	0.43 (0.51)
β_h^{CBI} (rotation)	0.55 (0.34)	0.09 (0.37)	0.28 (0.46)	0.50 (0.45)	0.72* (0.38)	1.31* (0.70)	1.68** (0.83)	1.79** (0.90)	3.02*** (1.00)	4.04*** (1.20)
Ftest	0.98	0.29	0.50	0.87	0.68	0.25	0.11	0.23	0.04	0.01
R-sq	0.28	0.23	0.20	0.14	0.15	0.09	0.06	0.08	0.13	0.14
N.obs.	167	167	167	167	167	167	167	167	167	167
1-year Treasury yield (poor man)										
β_h^{MP} (poor man)	0.52*** (0.13)	0.54*** (0.17)	0.60*** (0.19)	0.54*** (0.20)	0.53*** (0.19)	0.48** (0.20)	0.18 (0.25)	0.48* (0.27)	0.74** (0.33)	0.56 (0.38)
β_h^{CBI} (poor man)	0.73* (0.40)	0.43 (0.27)	0.66* (0.35)	0.74* (0.39)	0.81*** (0.30)	1.29* (0.75)	1.78** (0.78)	1.87** (0.75)	2.32*** (0.86)	3.28*** (1.06)
Ftest	0.62	0.74	0.88	0.66	0.44	0.30	0.05	0.08	0.09	0.02
R-sq	0.28	0.21	0.19	0.14	0.15	0.09	0.07	0.09	0.10	0.10
N.obs.	167	167	167	167	167	167	167	167	167	167

Notes: Heteroskedasticity robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Constant terms are not reported for brevity. Ftest: p-value of the F-test for $H_0: \beta_h^{MP} = \beta_h^{CBI}$.

Table C.5: Continued

	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$	$h = 10$	$h = 15$	$h = 20$	$h = 25$	$h = 30$
10-year Bund yield										
β_h^{MP} (rotation)	0.27** (0.11)	0.30*** (0.12)	0.27* (0.15)	0.21 (0.16)	0.25 (0.17)	0.15 (0.22)	-0.02 (0.23)	0.11 (0.24)	0.11 (0.29)	0.02 (0.33)
β_h^{CBI} (rotation)	0.03 (0.17)	0.21 (0.24)	0.02 (0.26)	0.26 (0.27)	0.42 (0.30)	0.43 (0.44)	0.61 (0.50)	1.08 (0.71)	1.53 (0.99)	1.56* (0.84)
Ftest	0.18	0.70	0.33	0.85	0.58	0.55	0.21	0.19	0.17	0.09
R-sq	0.08	0.06	0.03	0.02	0.03	0.01	0.01	0.02	0.03	0.03
N.obs.	167	167	167	167	167	167	167	167	167	167
β_h^{MP} (poor man)	0.25** (0.11)	0.32*** (0.12)	0.28* (0.16)	0.24 (0.18)	0.30 (0.19)	0.17 (0.24)	-0.02 (0.26)	0.20 (0.26)	0.25 (0.29)	0.11 (0.34)
β_h^{CBI} (poor man)	0.17 (0.14)	0.12 (0.22)	-0.04 (0.27)	0.10 (0.26)	0.15 (0.29)	0.30 (0.40)	0.56 (0.38)	0.57 (0.64)	0.69 (0.89)	0.98 (0.74)
Ftest	0.65	0.42	0.31	0.66	0.67	0.79	0.21	0.59	0.64	0.29
R-sq	0.07	0.06	0.04	0.02	0.03	0.01	0.01	0.01	0.01	0.01
N.obs.	167	167	167	167	167	167	167	167	167	167
10-year Treasury yield										
β_h^{MP} (rotation)	0.46** (0.20)	0.60** (0.27)	0.60** (0.25)	0.62** (0.26)	0.59** (0.27)	0.51 (0.35)	0.10 (0.37)	0.46 (0.40)	0.18 (0.48)	-0.00 (0.53)
β_h^{CBI} (rotation)	0.58 (0.48)	0.14 (0.50)	0.18 (0.50)	0.30 (0.48)	0.73 (0.51)	0.23 (0.64)	0.90 (0.91)	1.46 (1.25)	2.18 (1.47)	2.56* (1.46)
Ftest	0.83	0.42	0.47	0.57	0.81	0.71	0.40	0.43	0.16	0.07
R-sq	0.08	0.10	0.09	0.08	0.08	0.03	0.01	0.03	0.04	0.04
N.obs.	167	167	167	167	167	167	167	167	167	167
β_h^{MP} (poor man)	0.47** (0.19)	0.62** (0.27)	0.62** (0.25)	0.66** (0.26)	0.66** (0.27)	0.56 (0.36)	0.19 (0.41)	0.68 (0.45)	0.46 (0.58)	0.24 (0.62)
β_h^{CBI} (poor man)	0.48* (0.29)	0.01 (0.37)	0.07 (0.38)	0.07 (0.36)	0.35 (0.40)	-0.02 (0.29)	0.36 (0.69)	0.23 (1.03)	0.59 (1.24)	1.18 (1.24)
Ftest	0.99	0.19	0.23	0.19	0.54	0.22	0.84	0.69	0.93	0.49
R-sq	0.08	0.10	0.09	0.08	0.08	0.03	0.00	0.02	0.01	0.01
N.obs.	167	167	167	167	167	167	167	167	167	167

Notes: Heteroskedasticity robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Constant terms are not reported for brevity. Ftest: p-value of the F-test for $H_0: \beta_h^{MP} = \beta_h^{CBI}$.

Table C.5: Continued

	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$	$h = 10$	$h = 15$	$h = 20$	$h = 25$	$h = 30$
Euro Stoxx 50										
β_h^{MP} (rotation)	-3.78 (2.39)	-4.86* (2.59)	-3.94 (2.95)	-3.83 (3.43)	-4.58 (3.62)	-9.43*** (3.30)	-5.97 (4.85)	-5.71 (6.77)	2.00 (8.72)	0.71 (10.07)
β_h^{CBI} (rotation)	2.93 (9.88)	-5.93 (11.98)	-5.69 (12.63)	-17.12 (16.31)	-15.76 (15.64)	-3.32 (8.90)	4.45 (14.06)	8.56 (15.87)	18.17 (18.32)	23.69 (25.27)
Ftest	0.51	0.93	0.90	0.44	0.50	0.51	0.49	0.42	0.42	0.40
R-sq	0.01	0.02	0.01	0.03	0.02	0.03	0.01	0.01	0.01	0.01
N.obs.	167	167	167	167	167	167	167	167	167	167
β_h^{MP} (poor man)	-5.12** (2.26)	-5.82** (2.49)	-4.42 (2.74)	-3.24 (3.17)	-4.17 (3.36)	-6.86** (3.30)	-4.32 (4.82)	-0.75 (6.62)	6.76 (8.67)	3.49 (9.53)
β_h^{CBI} (poor man)	10.17 (8.46)	-0.59 (11.90)	-2.99 (12.15)	-20.07 (15.15)	-17.77 (14.73)	-17.67* (10.48)	-4.89 (13.00)	-19.17 (11.76)	-8.47 (16.10)	7.80 (27.98)
Ftest	0.08	0.67	0.91	0.28	0.37	0.33	0.97	0.17	0.40	0.88
R-sq	0.04	0.02	0.01	0.03	0.03	0.04	0.00	0.01	0.01	0.00
N.obs.	167	167	167	167	167	167	167	167	167	167
SP500										
β_h^{MP} (rotation)	-10.26*** (1.76)	-7.24*** (1.96)	-8.73*** (2.74)	-7.41*** (2.71)	-9.40*** (3.19)	-14.08*** (2.86)	-17.72*** (4.49)	-13.82** (5.60)	-8.02 (6.96)	-6.99 (7.31)
β_h^{CBI} (rotation)	-0.98 (4.89)	-6.71 (6.53)	3.96 (8.02)	-6.51 (10.12)	-1.86 (8.26)	9.51 (11.39)	16.71 (16.52)	10.45 (11.73)	20.17 (15.18)	15.61 (16.72)
Ftest	0.07	0.94	0.16	0.93	0.39	0.06	0.05	0.06	0.09	0.22
R-sq	0.13	0.06	0.06	0.04	0.06	0.10	0.10	0.05	0.02	0.01
N.obs.	167	167	167	167	167	167	167	167	167	167
β_h^{MP} (poor man)	-9.85*** (1.82)	-7.36*** (1.82)	-8.28*** (2.33)	-6.81*** (2.55)	-8.53*** (3.29)	-11.72*** (2.63)	-16.30*** (4.51)	-11.06* (6.06)	-4.66 (7.24)	-5.66 (7.32)
β_h^{CBI} (poor man)	-3.46 (5.05)	-6.06 (6.50)	1.24 (7.17)	-9.84 (9.16)	-6.86 (7.82)	-4.04 (10.07)	8.14 (13.20)	-5.34 (8.64)	1.00 (13.12)	7.82 (16.23)
Ftest	0.23	0.85	0.21	0.75	0.84	0.46	0.08	0.59	0.70	0.45
R-sq	0.12	0.06	0.05	0.04	0.05	0.07	0.08	0.03	0.00	0.01
N.obs.	167	167	167	167	167	167	167	167	167	167

Notes: Heteroskedasticity robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Constant terms are not reported for brevity. Ftest: p-value of the F-test for $H_0: \beta_h^{MP} = \beta_h^{CBI}$.

Table C.5: Continued

	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$	$h = 10$	$h = 15$	$h = 20$	$h = 25$	$h = 30$
High yield corporate bond OAS (EA)										
β_h^{MP} (rotation)	0.24 (0.30)	0.34 (0.35)	0.61* (0.35)	0.71 (0.45)	0.93* (0.51)	3.60*** (0.96)	6.14*** (1.73)	6.41*** (2.10)	6.10** (2.39)	5.92** (2.86)
β_h^{CBI} (rotation)	0.74 (1.75)	-0.27 (1.49)	-0.67 (1.46)	-1.19 (1.70)	-0.87 (1.98)	-0.98 (2.31)	-0.96 (2.78)	-2.77 (3.07)	-4.57 (3.57)	-6.07 (4.42)
Ftest	0.79	0.69	0.41	0.31	0.41	0.08	0.01	0.00	0.00	0.01
R-sq	0.01	0.01	0.02	0.03	0.03	0.15	0.20	0.15	0.11	0.08
N.obs.	167	167	167	167	167	167	166	167	167	167
β_h^{MP} (poor man)	0.27 (0.25)	0.33 (0.37)	0.54 (0.37)	0.51 (0.47)	0.70 (0.52)	3.09*** (1.02)	5.91*** (1.85)	5.89*** (2.26)	5.35** (2.62)	5.26* (3.10)
β_h^{CBI} (poor man)	0.60 (1.36)	-0.24 (1.19)	-0.24 (1.06)	-0.04 (1.12)	0.44 (1.28)	1.92 (1.65)	0.53 (2.61)	0.31 (2.51)	-0.20 (2.61)	-2.19 (3.40)
Ftest	0.81	0.64	0.49	0.65	0.85	0.55	0.09	0.10	0.13	0.10
R-sq	0.01	0.01	0.01	0.01	0.01	0.12	0.18	0.12	0.08	0.05
N.obs.	167	167	167	167	167	167	166	167	167	167
High yield corporate bond OAS (US)										
β_h^{MP} (rotation)	0.56 (0.37)	1.01** (0.47)	1.15** (0.56)	1.40** (0.65)	1.72** (0.78)	3.53** (1.43)	5.18** (2.07)	5.75*** (2.07)	5.89** (2.39)	6.32** (2.65)
β_h^{CBI} (rotation)	-0.51 (1.20)	-0.08 (1.03)	0.05 (1.00)	0.06 (1.12)	0.28 (1.27)	0.93 (1.80)	-1.26 (3.03)	-3.60 (3.72)	-5.61 (4.27)	-6.15 (4.77)
Ftest	0.38	0.30	0.27	0.22	0.23	0.07	0.02	0.01	0.01	0.01
R-sq	0.03	0.06	0.08	0.09	0.10	0.17	0.19	0.18	0.15	0.13
N.obs.	167	167	167	167	167	167	166	167	167	167
β_h^{MP} (poor man)	0.63* (0.38)	1.04** (0.50)	1.18* (0.60)	1.40** (0.71)	1.68* (0.87)	3.37** (1.62)	5.03** (2.25)	5.26** (2.21)	5.27** (2.55)	5.77** (2.81)
β_h^{CBI} (poor man)	-0.88 (0.88)	-0.26 (0.65)	-0.10 (0.62)	0.10 (0.67)	0.53 (0.74)	1.86 (1.26)	-0.27 (2.23)	-0.72 (2.90)	-1.91 (3.29)	-2.87 (3.62)
Ftest	0.12	0.12	0.15	0.19	0.32	0.47	0.10	0.10	0.09	0.06
R-sq	0.04	0.07	0.08	0.09	0.10	0.17	0.18	0.14	0.10	0.10
N.obs.	167	167	167	167	167	167	166	167	167	167

Notes: Heteroskedasticity robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Constant terms are not reported for brevity. Ftest: p-value of the F-test for $H_0: \beta_h^{MP} = \beta_h^{CBI}$.

Table C.5: Continued

	$h = 1$	$h = 2$	$h = 3$	$h = 4$	$h = 5$	$h = 10$	$h = 15$	$h = 20$	$h = 25$	$h = 30$
EUR per USD										
β_h^{MP} (rotation)	6.05*** (1.64)	7.89*** (3.03)	6.43*** (1.62)	4.61** (2.05)	3.29 (2.28)	2.67 (2.37)	1.18 (2.61)	1.03 (3.06)	2.65 (3.94)	4.28 (4.67)
β_h^{CBI} (rotation)	5.98 (5.06)	3.72 (4.39)	2.23 (4.39)	2.20 (4.84)	-0.48 (5.30)	-0.41 (5.18)	2.51 (5.86)	2.62 (7.02)	-0.78 (7.65)	10.65 (9.18)
Ftest	0.99	0.36	0.42	0.67	0.53	0.58	0.84	0.83	0.69	0.53
R-sq	0.13	0.13	0.09	0.04	0.02	0.01	0.00	0.00	0.00	0.01
N.obs.	167	167	167	167	167	167	167	167	167	167
β_h^{MP} (poor man)	6.41*** (1.48)	8.16** (3.22)	6.03*** (1.43)	4.41** (1.94)	2.99 (2.25)	2.86 (2.42)	1.84 (2.75)	0.70 (3.15)	2.12 (4.05)	3.88 (4.70)
β_h^{CBI} (poor man)	4.02 (3.01)	2.35 (2.37)	4.52 (2.76)	3.39 (3.35)	1.24 (4.23)	-1.40 (4.54)	-1.15 (4.25)	4.38 (5.28)	2.23 (6.60)	12.72 (8.07)
Ftest	0.48	0.16	0.63	0.79	0.72	0.41	0.56	0.55	0.99	0.35
R-sq	0.13	0.14	0.08	0.04	0.01	0.01	0.00	0.00	0.00	0.01
N.obs.	167	167	167	167	167	167	167	167	167	167
Broad dollar ex EUR										
β_h^{MP} (rotation)	3.42*** (0.76)	4.00*** (0.83)	3.59*** (0.82)	2.63*** (0.93)	2.27** (0.96)	2.95** (1.25)	4.12*** (1.56)	4.30* (2.22)	4.42 (2.76)	5.24 (3.24)
β_h^{CBI} (rotation)	3.75 (3.19)	4.52 (3.08)	3.64 (3.49)	4.88 (4.54)	4.55 (4.51)	4.89 (3.00)	3.84 (3.53)	1.36 (4.04)	0.66 (4.73)	3.30 (5.43)
Ftest	0.92	0.88	0.99	0.64	0.64	0.58	0.95	0.51	0.46	0.75
R-sq	0.14	0.17	0.11	0.06	0.05	0.05	0.05	0.04	0.03	0.03
N.obs.	166	166	166	166	166	166	166	166	165	166
β_h^{MP} (poor man)	3.70*** (0.72)	4.19*** (0.76)	3.56*** (0.76)	2.73*** (0.90)	2.30** (0.92)	3.13*** (1.20)	4.23*** (1.43)	4.18* (2.36)	4.51 (2.95)	5.41 (3.37)
β_h^{CBI} (poor man)	2.21 (2.06)	3.42* (1.98)	3.78 (2.33)	4.30 (3.19)	4.33 (3.16)	3.87* (2.10)	3.21 (2.65)	2.12 (2.93)	0.25 (4.25)	2.43 (4.90)
Ftest	0.49	0.72	0.93	0.64	0.54	0.76	0.74	0.59	0.41	0.62
R-sq	0.14	0.17	0.11	0.06	0.05	0.05	0.05	0.03	0.03	0.03
N.obs.	166	166	166	166	166	166	166	166	165	166

Notes: Heteroskedasticity robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Constant terms are not reported for brevity. Ftest: p-value of the F-test for $H_0: \beta_h^{MP} = \beta_h^{CBI}$.

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