

THE FED'S FINE-TUNE: COARSE STATEMENTS AND PREDICTIVE PRESSERS*

Ryan Byun[†] Bennett Fees[‡] Margaret M. Jacobson[§] Todd B. Walker[¶]

April 2026

Abstract

Central bank communications, particularly FOMC statements and press conferences, play a crucial role in shaping financial market expectations. Using large language models to quantify central bank content, this paper demonstrates how sentiment aligns with traditional market-based monetary policy measures and quantifies the evolving nature of Federal Reserve communications, particularly the press conference. We show that the press conference correlates with future policy to a greater extent than other communications. While the FOMC statement coarsely signals the current stance of policy, the press conference fine-tunes the message, which helps market participants revise their expectations about future policy.

Keywords: central bank communication; large language models; monetary policy transmission; empirical monetary economics.

JEL Codes: E52, E58, E31, E32.

*This material reflects the views of the authors and not those of the Federal Reserve Board of Governors. The authors thank Kurt Lewis, Josh Gallin, Dan Li, Cynthia Doniger, Connor Brennan, Brent Bundick and audiences at the Federal Reserve Board and the Reserve Bank of Australia, the Federal Reserve Bank of Kansas City for helpful comments.

[†]Pukyong National University; rbyun@iu.edu

[‡]Federal Reserve Board; bennett.d.fees@frb.gov

[§]Federal Reserve Board; Margaret.M.Jacobson@frb.gov, corresponding author.

[¶]Indiana University, walkertb@iu.edu

1 INTRODUCTION

Communication from central banks to the public presents a wealth of potential identified monetary policy events to estimate the transmission of monetary policy. Because asset prices observed minutes before these events contain all available information, asset prices observed immediately after are thus the market reaction to monetary news, and their difference can identify exogenous variation in monetary policy. While previous work focused exclusively on the market reaction to FOMC statements, subsequent work—like Swanson and Jayawickrema (2024), Narain and Sangani (2026), Gordon and Lunsford (2024), and Jarocinski and Karadi (2025)—has studied speeches, press conferences, and official testimonies as types of monetary events.

Unsurprisingly, market reactions can differ by type of communications, especially the press conference.¹ For example, during the 2022 tightening cycle the market reaction to the press conference is sometimes opposite of the preceding FOMC statement. These reversals in the market reaction are puzzling because Gómez-Cram and Grotteria (2022) find that the content of the press conference is similar to that of the statement, on average.

We explain reversals in the market reaction to the press conference via content that is absent from the statement and correlates more strongly with the future policy rate—a finding we are the first to document, to our knowledge. While Narain and Sangani (2026) document reversals in the market reaction and attribute them to variation in the content of the press conference, we take their analysis a step further and show that this variation correlates with the stance of future policy. Our finding on the predictive correlations of the press conference’s content complements the predictive content of FOMC transcripts and speeches found by Cieslak et al. (2025b, 2024b) and Cieslak et al. (2025a, 2024a).

To understand why the press conference has predictive correlations above and beyond that of FOMC statements and speeches by the Chair, we compare sentiment scores from a BERT large language model fine-tuned to Fed communication. While the overall signals of the press conference match those of the statement, signals from the statement tend to be relatively coarser. Over three-fourths of sentiment scores from the press conference are either entirely hawkish, dovish, or neutral while only one-quarter of press conference scores are so stark. The variation in content of the press conference—some dovish content even though it is hawkish on net, and vice versa—is the source of predictive correlations with the future federal funds rate and helps account for market reversals. For example, in the summer of 2023, record increases in the federal funds rate were accompanied by entirely hawkish FOMC statements and positive market reactions. However, the market reaction to the press conference was often negative—opposite of the FOMC statements—with content that was hawkish on net, but contained some dovish content.

Because the current stance of policy is now largely anticipated by markets and the relationship between the federal funds rate and sentiment is highly endogenous, we also study how high-frequency market reactions about expected future policy relate to the sentiment of federal reserve communications. Among all types of communication studied, we find that the press conference stands out for the

¹Furthermore, many studies have documented the importance of speeches and press conference for the European Union (Altavilla et al., 2025) and the U.K. (Mumtaz et al., 2024).

strength of the relationship between content and market reactions. While overall hawkish content is often associated with dovish surprises, we can explain these seemingly opposite-signed responses via the press conference's predictive correlations with the future federal funds rate. Essentially markets revise their expectations about future policy in response to dovish content in the press conference that is absent from the statement.

Since the press conference is entirely forward guidance, but FOMC statements are a combination of forward guidance and policy actions, we also assess market reactions to speeches by the Federal Reserve Chair to understand if all forward guidance events have similar relationships between content and market reactions. While some speeches have a strong relationship, others do not, which results in an overall weak relationship that we interpret as noisier signal relative to that we observe from press conferences.

We formalize the distinct role of press conferences in refining the statement's message via signal-to-noise of trading volume and find that markets indeed perceive additional signal from press conferences after they were introduced in 2011. The perception of additional signal from press conferences was not immediate and occurred in 2015, a few years after their introduction, as the Fed prepared to raise interest rates from the effective lower bound (ELB). However, by the time Chair Powell implemented a press conference after every meeting in 2019, we detect that press conferences contain more signal than FOMC statements. Taken together, this evidence suggests that new communication tools evolve and it may take time for them to be understood.

Given the new central role of press conferences, we conclude by assessing how to best include them in the construction of high-frequency monetary policy shocks. Because Brennan et al. (2025) and Bundick and Smith (2020) note that different high-frequency shocks can lead to different estimates of monetary policy transmission, it is important to understand how differences arising from the inclusion of press conferences affect estimates of monetary policy transmission. While Acosta et al. (2025) and Grotteria and van Binsbergen (2025) expand the time window around FOMC statements to include press conferences, we find that this construction can sometimes benefit from including longer-term rates to capture the forward guidance signaled via the press conference.

We estimate monetary policy transmission via the vector autoregression (VAR) of Gertler and Karadi (2015) from 1973 to present (instead of ending in 2019 like in other work) and find that point estimates are largely aligned with existing empirical and theoretical evidence.² In fact, the point estimates from the Nakamura and Steinsson (2018) monetary policy shock are most stable when the press conference is included in shock construction, otherwise responses to the excess bond premium are opposite-signed or ambiguous. However, in the case of the Gürkaynak et al. (2005) monetary policy shocks where current policy and forward guidance are distinct dimensions, we find that augmenting the instrument set with longer-term rates helps assure the correctly-signed response in forward guidance when the press conference is included in shock construction.

²An et al. (2025) relatedly find little difference in estimates of monetary policy transmission in shocks constructed from intraday vs. daily data.

2 LITERATURE REVIEW

Federal Reserve press conferences are now perceived to be the single most useful channel of Fed communication, as noted in Wessel and Boocker's (2024) survey.³ Lamla and Vinogradov (2019) find that more consumers receive news about the Fed via the press conference, which could help account for its growing importance. Market reactions to central bank press conferences have been studied since inception by Rosa (2016), Ehrmann and Fratzscher (2009a), Gómez-Cram and Grotteria (2022), Narain and Sangani (2026), Gorodnichenko et al. (2023), Curti and Kazinnik (2023), Parle (2022), Altavilla et al. (2025).

To understand why market reactions to Fed press conferences are sometimes opposite those of the FOMC statements, we turn to a BERT large language model to understand if content explains these differences. Advances in large language modeling have ensured that natural language processing can capture the nuance and soft information of central bank policy communication. Hansen and Kazinnik (2024) and Dunn et al. (2024), show heightened efficiency of more sophisticated methods like BERT compared to dictionary-based predecessors such as Gati and Handlan (2023), Kypraios et al. (2024), Czudaj and Nguyen (2025), Calomiris et al. (2022), Lucca and Trebbi (2011), Apel et al. (2022), Gardner et al. (2022), and Picault and Renault (2017), Munday and Brookes (2021), Parle (2022), Cherry and Tong (2023), Tobback et al. (2017), Banerjee et al. (2025). Because dictionary-based methods often rely on keyword matching or bag-of-words models, their ability to capture the nuanced meaning and context within complex text can be limited. More specifically, these methods treat words as isolated units, ignoring crucial and orderings, which can fundamentally alter meaning.

By contrast, our BERT model (DeBERTa V3; He et al. (2020); Devlin et al. (2019); He et al. (2023) can consider all words in a sentence simultaneously when encoding the meaning of word and thus accommodate long-range dependencies. Similar to transformer-based AI chatbots like GPT, BERT models are pretrained on a massive corpus of text data and then fine-tuned to a specific task like sentiment analysis of Federal Reserve communications. With an enhanced ability to analyze Federal Reserve communications at the paragraph or sentence level, we can quantify the stance on monetary policy conveyed in the text and the proportion of content related to macroeconomic factors influencing policy decisions. BERT models are used to study Federal Reserve Communications by Alexopoulos et al. (2024), Osowska and Wojcik (2024), Shah et al. (2023), Pfeifer and Marohl (2023), Gorodnichenko et al. (2023), Gambacorta et al. (2024).⁴

Assessing how quantified content of central bank communication correlates with current and or future policy is studied by Doh et al. (2021, 2025), Aruoba and Drechsel (2026), Fischer et al. (2023), Cieslak et al. (2025b, 2024b), Cieslak et al. (2025a, 2024a), and others. Our study of the predictive correlations of the press conference complements these findings that span Fed communications such as transcripts,

³See <https://www.brookings.edu/articles/grading-fed-communications-a-2024-survey-of-fed-watchers/>

⁴Other applications of large language models include those by Aruoba and Drechsel (2026), Deng et al. (2024), Gnan et al. (2025), Silva et al. (2025), Schmanski et al. (2023), Fischer et al. (2023), Ahrens et al. (2025), Granziera et al. (2025). More specific approaches include Latent Dirichlet Allocation topic modeling by De Pooter (2021) and Hansen and McMahon (2016); Hansen et al. (2017); semantic similarity by Ehrmann and Talmi (2020), Handlan (2022a), and Acosta and Meade (2015)); topic modeling by Fraccaroli et al. (2020); universal sentence encoding by Doh et al. (2021, 2025); ChatGPT by Hansen and Kazinnik (2024); and neural networks by Handlan (2022b) and Curti and Kazinnik (2023).

speeches, the Beige Book, Tealbooks, and the minutes. Because press conferences are available immediately while transcripts are released with a five-year lag, we view our contribution as providing a real-time window into the deliberative content that transcripts eventually disclose.

Given the improved ability of large language models to accurately capture the content of central bank communication, we next ask if it can account for market reactions specifically reversals observed in the 2022s tightening cycle. Market reactions and natural language processing are featured in Handlan (2022b), Fischer et al. (2023), Parle (2022), Gnan et al. (2025), Kypraios et al. (2024), Shah et al. (2023), Osowska and Wojcik (2024). More specifically, Fischer et al. (2023) and Gnan et al. (2025) demonstrate that text-based sentiment indicators can help explain errors in market policy expectations that traditional Taylor-rule variables miss. We compare the market reaction across types of communication (statements, press conferences, and speeches) and find that the press conference stands out for having the strongest sentiment score and market reactions, particularly in the 2022-2024 tightening episode.

Finally, we assess how including the press conference in the construction of high-frequency monetary policy shocks affects estimates of monetary policy transmission. Augmenting monetary policy shocks with additional forms of communication has been studied by Swanson and Jayawickrema (2024), Altavilla et al. (2025), Mumtaz et al. (2024), and others. Like, An et al. (2025) we find that estimates of monetary policy transmission are largely stable as time windows expand, but show that including long-term rates in shock construction can add additional information when the press conference is included.

3 MARKET REACTIONS

We define market reactions as changes in asset prices around Federal Reserve communications. Specifically, we construct market reactions using high-frequency intraday changes in futures prices immediately surrounding communication events to capture the market participant's immediate updating of their beliefs about current future monetary policy. Futures prices correspond to basis point changes in implied interest rates such that positive market reactions indicate upward surprises in expected future policy rates and negative reactions indicate downward surprises.

We collect intraday futures data used in the construction of monetary policy shocks for scheduled and unscheduled fed communications: FOMC statements, post-FOMC press conferences, Federal Reserve Chair speeches, and Congressional testimonies, from 1995 through April 2025. Timing details are confirmed using Swanson and Jayawickrema (2024), Gürkaynak et al. (2005), and Gordon and Lunsford (2024), supplemented by Factiva searches.

Mathematically, the market reaction for an asset A at event time t is defined as:

$$\text{Market reaction}_{A,t} = P_{A,t+\Delta t} - P_{A,t-\Delta t}, \quad (1)$$

where $P_{A,t}$ is the price of asset A at time t , and $\text{Market reaction}_{A,t}$ captures the market reaction within a narrow window around the release of the FOMC statement $\{+\Delta t, -\Delta t\}$, which is typically 10 minutes before and 20 minutes after the event. The market reaction for each type of communication are computed separately, enabling us to assess their distinct impacts.

3.1 INTRADAY FUTURES We use the dataset of Brennan et al. (2025) which relies on intraday data from the CME Group Inc. DataMine (<https://datamine.cmegroup.com/>) at the Federal Reserve Board. Although the intraday tick data is available starting in January 1995, we restrict our sample to one that starts in June 1999 when Federal Reserve communications are available in formats more readily usable for natural language processing. Our sample ends in April 2025 and contains 259 statements after FOMC meetings (7 of which are unscheduled) 85 post-FOMC meeting press conferences, 121 Congressional testimonies, and 707 speeches by the Federal Reserve Chair.⁵ See Appendix A for more details, especially those on dates, times, and window sizes.

Intraday futures used to assess market reactions to FOMC communications are federal funds futures and Eurodollar/Secured Overnight Financing Rate (SOFR) futures. These futures represent the first year of the term structure of interest rates and are commonly used to construct high-frequency monetary policy shocks as detailed in Brennan et al. (2025).⁶ Federal fund futures are monthly contracts such that the first expiring contract, *FF1*, expires at the end of the month of a given FOMC communication. For example, for the March 19, 2014 FOMC statement *FF1* expires at the end of March. The second, third, and fourth expiring federal funds futures expire one, two, and three months after a given FOMC statement, respectively. For example, *FF4* expires at the end of June 2014 for the March 19, 2014 FOMC statement. Eurodollars/SOFR futures are quarterly contracts where the first expiring contract expires at the end of the quarter for a particular FOMC communication.

Figure 1 shows the distribution of intraday changes 10 minutes before and 20 minutes after an FOMC communication for FOMC statements, press conferences, chair speeches, and Congressional testimonies. The tightness of the distributions decreases as the maturity increases, i.e. the shortest maturity futures—*FF1*—are the least volatile and the longest maturity futures shown—*EDSR4*—are the most volatile. Changes in the former represent surprises to actual changes in the federal funds rate while changes in the latter represent surprises to forward guidance or communication about the future path of the federal funds rate.

There are two main reasons for the positive correlation between maturity and volatility. First, FOMC statements are much less likely to be surprising to markets than in previous eras. As a result, changes in *FF1*, the immediately expiring future and hence the closest market expectation to the federal funds rate, are small in magnitude. Second, communications other than FOMC statements are unlikely to have surprises in *FF1* or shorter maturities because the federal funds rate cannot possibly change on these other events. Therefore, these events can only be forward guidance.

We also note that market reactions to speeches, as shown in panel 1c are much more muted—and

⁵Although there are 707 speeches by a Federal Reserve Chair available in our sample, we restrict our sample to the 226 Chair speeches since 2009 that are obtainable in a format accessible to our model. Swanson and Jayawickrema (2024) show that the chair speeches are more likely to move intraday futures than those of other officials. In contrast to Swanson and Jayawickrema (2024) and Sekkel and Zhan (2024) who filter their sample of chair speeches to those that relate to monetary policy, we keep all chair speeches in our sample for two reasons. First, the text of Chair Speeches is typically unreleased beforehand leaving few ways besides the topic and location for markets to know the contents of a speech. Second, texts with no monetary policy content should simply have a sentiment score of zero and no market reaction.

⁶Because Eurodollars were discontinued in 2023 and SOFR futures introduced in 2018, we switch to SOFR futures January 2022, as advocated by Acosta et al. (2024). We note that the switch date has little material effect on the series of intraday changes in asset prices.

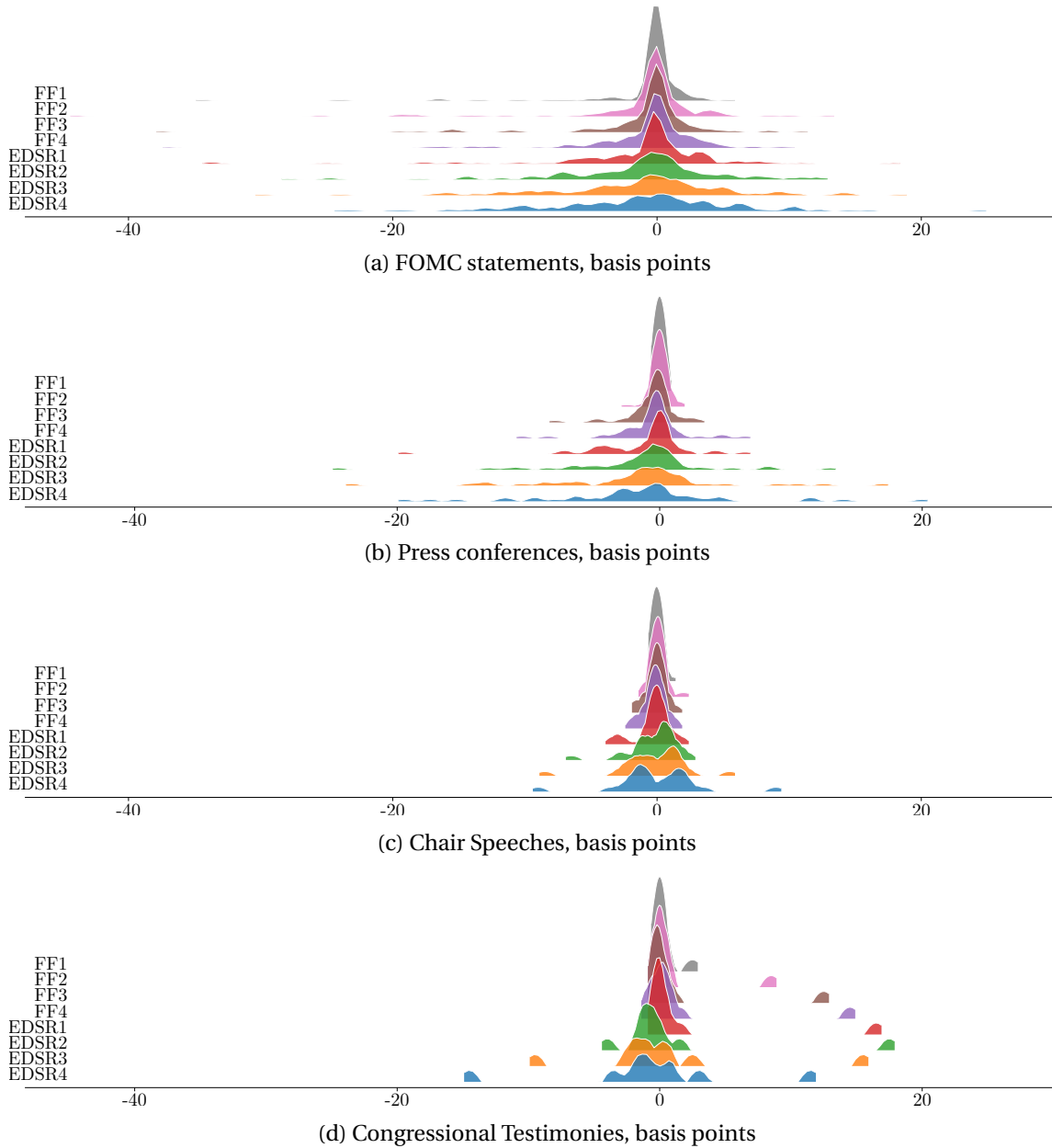


Figure 1: Distributions of intraday changes in futures prices around Federal Reserve communications, June 1999 to April 2025.

Intraday changes are calculated 10 minutes before and 20 minutes after an FOMC communication. See Appendix A for more details on time window sizes. FFj denotes the $j^{th} \in \{1, 2, 3, 4\}$ expiring federal funds future relative to the date of each FOMC communication and $EDSRj \in \{1, 2, 3, 4\}$ denotes the j^{th} expiring eurodollar or $(j + 1)^{th}$ expiring SOFR future.

clustered closer to zero—than those for FOMC statements or press conferences. This arises because 76 percent of speeches have a market reaction that is less than 3 basis points, or quite close to zero. While some speeches can move markets just as much as press conferences or FOMC statements, market movements are on average quite small.

The small market reaction to speeches highlights how speeches may be distinct from other events.

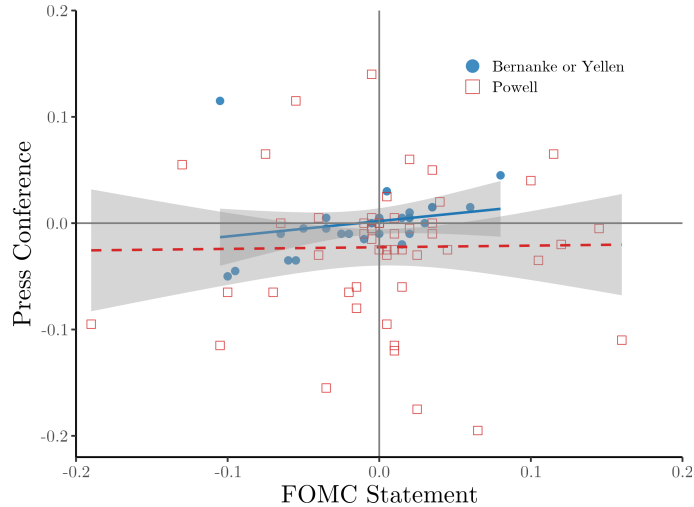


Figure 2: Market reactions to the press conference vs. FOMC statements, basis points.

The figure shows the slope coefficient $\hat{\beta}$ from the regression $\text{Market Reaction}_{t,\text{Press}} = \alpha + \beta \text{Market Reaction}_{t,\text{FOMC}} + \epsilon_t$ by Fed chairs for the 4th Eurodollar/5th SOFR future. Bernanke or Yellen is April 2011 to January 2018 and Powell is from February 2018 to April 2025. Shaded bands are 90% error bands.

While FOMC statements and press conferences occur alongside policy actions, like changes in the federal funds rate, speeches do not. Even though all these communications can contain information about the future stance of policy, speeches may not undergo the same degree of market re-pricing given that they do not occur alongside changes in fundamentals. Relatedly, the market may react more to statements and press conferences because they are the first communication to follow a 10-day blackout preceding the FOMC meeting as studied by Ehrmann and Fratzscher (2009b).

Given that market reactions to press conferences and the FOMC statements are roughly the same size, are they often in the same direction? Figure 2 shows the market reaction of the press conference regressed on that of the preceding FOMC statement for the fourth Eurodollar/fifth SOFR future, which represented the expected federal funds rate one year ahead.⁷ While the slope is positive under Chairs Bernanke and Yellen (2011-2018), the slope is insignificant from zero under Chair Powell (2018-2025). In fact, there are many observations where the press conference has the opposite sign to that of the FOMC statements under Chair Powell.

Message 1. *The market reaction to the press conference sometimes reverses FOMC statements, especially under Chair Powell.*

Figure 3 shows an example of a market reversal on June 15, 2022 where the market reaction to the FOMC statement is positive, but is negative to the press conference. This suggests that market participants revised up their expectations for the federal funds rate a year ahead in reaction to the FOMC statement, but revised them down in reaction to the subsequent press conference. Appendix figure A.2 confirms that these reversals are not one-off events. Relatedly, Appendix figure A.3 shows that the speeches

⁷Appendix figure A.1 shows a similar relationship between the market reaction to the press conference and the FOMC statements by Fed chair for other interest rate futures used in construction of monetary policy shocks.

in the week after an FOMC statement did not have the same wide-spread opposite-signed market reactions prior to the introduction of the press conference in 2011.

Given that the press conference has reversed the market reaction to the statement under Chair Powell, but not his predecessors, we next explore why. While Narain and Sangani (2026) attribute these reversals in market reactions to different content conveyed by the Q&A of the press conference relative to that of the FOMC statement, Gómez-Cram and Grotteria (2022) detect a similarity between FOMC and press conference pairs, albeit on a sample that ends in 2019. We use a large language model to clarify these somewhat contrasting findings by showing that the content of the press conference refines the coarse signal of the statement. This refined signal, in turn, contains predictive correlations for the future stance of policy to a greater extent than the statement. Understanding the source of these reversals is important for estimating monetary transmission as reversals could alter the sign of monetary policy shocks if the FOMC statement and press conference are treated as a single event.

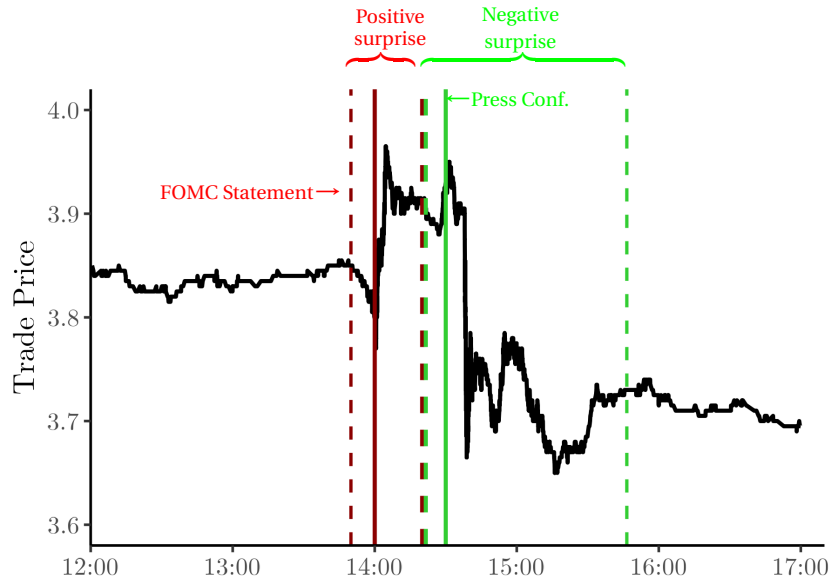


Figure 3: Trade prices of the 5th SOFR future on the afternoon of June 15, 2022, percent

The figure shows intra-day trade prices for the 5th SOFR future (5 quarter ahead interest rate exposure) when the Federal Reserve raised interest rates 75 basis points on June 15, 2022. The solid red line represents the FOMC statement release with the dashed red lines indicating the trade price pulled 10 minutes before and 20 minutes after the FOMC statement release. The solid green line represents the start of the press conference and the dashed green lines indicate the trade price pulled 10 minutes before and 20 minutes after the conference ends.

4 LARGE LANGUAGE MODELING

To quantify the content of Federal Reserve communications, we employ DeBERTa V3 (He et al., 2021, 2023), an iteration of the Bidirectional Encoder Representations from Transformers (BERT) architecture Devlin et al. (2019) optimized for natural language understanding. Unlike generative models (e.g., GPT) designed for text synthesis, BERT-based architectures excel at producing contextualized word embeddings, dynamic numerical vectors that capture the meaning of a word based on its specific usage within

a sentence. While standard self-attention (Vaswani et al., 2017) collapses content and position into a single query-key product, DeBERTa separates content and relative position.⁸ By isolating relative positioning from semantic content, the model achieves finer distinctions in meaning.

Using this advanced natural language processing technique, we analyze the text of Federal Reserve’s communications at the paragraph or sentence level. By training text classification models based on BERT to recognize pre-defined categories, we quantify the monetary policy stance and content related to macroeconomic conditions via sentiment scores. We use two distinct classification approaches based on BERT, which are subsequently passed through a classification header—a fully connected neural network layer—to compute the probability of text belonging into a predefined category.

$$P(s \in \mathbb{C}) = \sigma(\text{BERT}(s)), \quad (2)$$

where s is a text sequence (sentence or paragraph), \mathbb{C} represents the class category, and $\sigma(\cdot)$ is the classification header.

We fine-tune these models using training data specific to two classification tasks:

- **Sentiment classification (BERT-Sentiment):** Paragraph-level classification into monetary policy stances: *Dovish*, *Hawkish*, or *Neutral*. These labels pertain to the stance of policy: dovish indicates loosening, hawkish indicates tightening, and neutral indicates no change. Each paragraph s_i is assigned to the category with the highest predicted probability:

$$s_i \in \mathbb{C}^L, \quad \text{where } L = \arg \max_{\ell \in \{\text{Dove}, \text{Hawk}, \text{Neut}\}} P(s_i \in \mathbb{C}^\ell). \quad (3)$$

The sentiment scores are aggregated as

$$\text{FedStance}_{c,t}^{\text{Dove/Hawk}} = \frac{1}{N_{c,t}} \sum_{i=1}^{N_{c,t}} \mathbf{1}(s_i \in \mathbb{C}^{\text{Dove/Hawk}}), \quad (4)$$

where $N_{c,t}$ is the number of paragraphs in communication c at time t . Paragraphs without explicit policy stance or with ambiguous statements are classified as *Neutral*.

- **Topic-based classification (BERT-Topic):** Sentence-level binary classification identifying macroeconomic aspects influencing policy decisions: employment, inflation, financial conditions, economic growth, global economic conditions, and “others” (including fiscal policy, oil prices, etc.). Each sentence can be classified into multiple overlapping categories, subject to a 70% probability threshold

$$\text{TopicWeight}_{c,t}^{\mathcal{T}} = \frac{1}{N_{c,t}} \sum_{i=1}^{N_{c,t}} \mathbf{1}(s_i \in \mathcal{T}), \quad (5)$$

⁸Mathematically, the attention weight $A_{i,j}$ between word i and word j is decomposed into a sum of components representing content-to-content, content-to-position, and position-to-content interactions

$$A_{i,j} = Q_c K_c^T + Q_c K_r^T + P_r K_c^T + P_r K_r^T$$

where Q_c and K_c are content-based query and key matrices, and Q_r and K_r are their relative position counterparts.

where \mathcal{T} is the topic category. Sentences discussing monetary policy without explicit reference to economic contexts are classified separately.

Topic-specific sentiment scores are computed as

$$\text{TopicStance}_{c,t}^{\mathcal{T}, \text{Dove/Hawk}} = \frac{1}{N_{c,t}} \sum_{i=1}^{N_{c,t}} [1(s_i \in \mathcal{T}) \times 1(s_i \in \mathbb{C}^{\text{Dove/Hawk}})] \quad (6)$$

To determine which communication channel has the most significant impact, we analyze texts of 259 FOMC statements, 85 post-FOMC press conferences, 226 Federal Reserve Chair speeches, and 34 congressional testimonies by the Fed Chair from 1999 to 2025. These documents contained a total of 12,684 paragraphs and 60,111 sentences. Footnotes, appendices, supplementary information, and administrative addenda were excluded from the analysis.

Appendix B shows that raw sentiment scores across topics and types of communications. The values of our sentiment scores are in line with those of Dunn et al. (2024) and Fischer et al. (2023). Following Silva et al. (2025), we compute net policy sentiment scores that quantifies the directional stance of monetary policy—essentially where it is and where it going. For each communication type $j \in \{\text{Press conference, Speech, FOMC Statement}\}$, we aggregate paragraph-level classifications from equation (4) to obtain $\text{Hawkish}_{j,t} = \text{FedStance}_{j,t}^{\text{Hawk}}$ and $\text{Dovish}_{j,t} = \text{FedStance}_{j,t}^{\text{Dove}}$.

$$\text{Net Sentiment}_{j,t} = \frac{\text{Hawkish}_{j,t} - \text{Dovish}_{j,t}}{\text{Hawkish}_{j,t} + \text{Dovish}_{j,t}} \quad (7)$$

When $\text{Hawkish}_{j,t} + \text{Dovish}_{j,t} = 0$ (all neutral), we set $\text{Net Sentiment}_{j,t} = 0$. $\text{Net Sentiment}_{j,t} \in [-1, 1]$ such that a value of -1 indicates entirely dovish sentiment, 0 is neutral, and 1 entirely hawkish. A value of 0.75, for example, indicates predominantly hawkish sentiment, but with some dovish sentiment.

As shown in figure 4, net sentiment at the paragraph-level is generally consistent with the stance of monetary policy: Hawkish (dovish) net sentiment, is consistent with tightening (loosening) cycles of monetary policy. The correlation between the net sentiment of the press conference and the target federal funds rate is the most striking.⁹ The contemporaneous correlation of the net sentiment of the press conference and the federal funds rate is only 0.37—much lower than that of the net sentiment of the FOMC statement and the federal funds rate of 0.53. However, the correlation between contemporaneous net sentiment and the future federal funds rate peaks at about 0.87 nine meetings ahead for the press conference. By contrast, the peak correlation between net sentiment of FOMC statements and the federal funds rate comes in lower at 0.79 seven meetings ahead. The higher correlation between net sentiment of the press conference and the future federal funds rate likely arises because net sentiment at the paragraph level is finer and more varied for press conferences than FOMC statements. While over three-fourths of all net sentiment scores for the FOMC statement are 1, 0, or -1—entirely hawkish, neutral, or dovish—only one-fourth of net sentiment scores for the press conference are that coarse. Appendix figure B.3 is the same as figure 4, but shows sentence level instead of paragraph level net sentiment for the

⁹See Appendix F for the construction of the target federal funds rate. We use the mid-point of the target range after each FOMC meeting.

FOMC statement in the top panel. At this finer frequency, there is more variation than the coarse paragraph level analysis of the statement, but peak correlation is still only 0.8 five meetings ahead, which is still below that of the press conference.

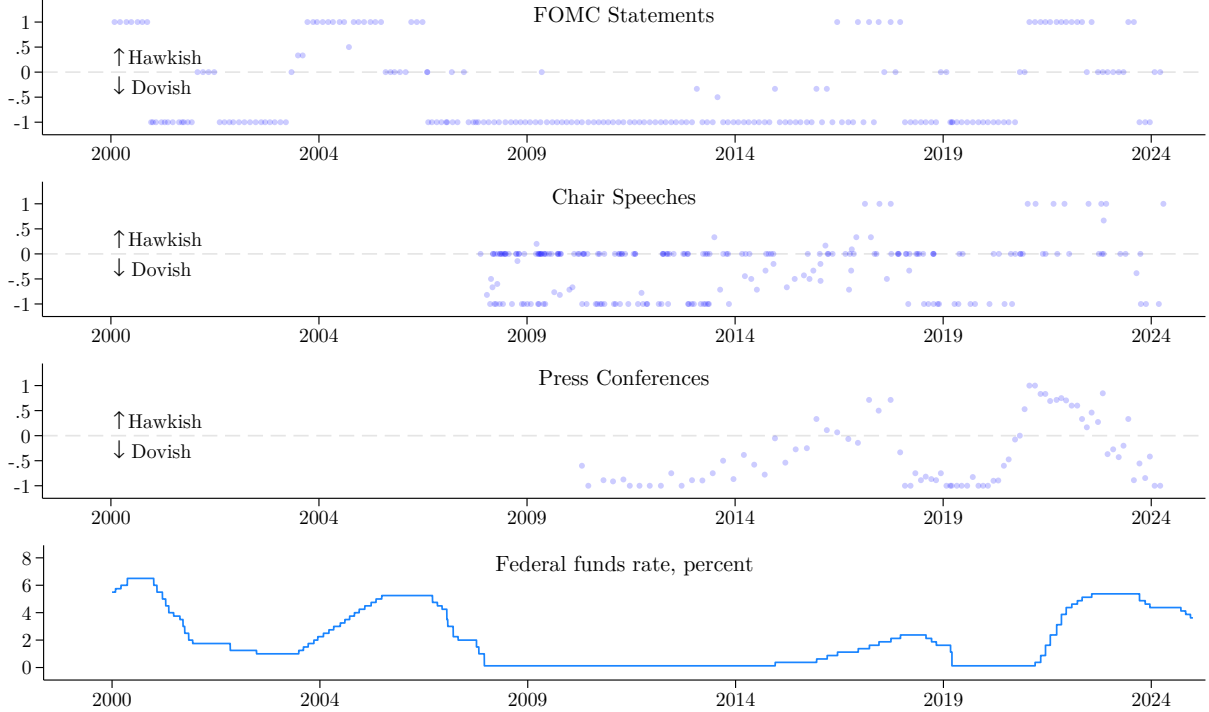


Figure 4: Net sentiment scores at the paragraph level and the target federal funds rate.

Hawkish sentiment pertains to tight policy and dovish to loose. For communication type $j \in \{\text{Press conference, Speech, FOMC Statement}\}$, Net Sentiment $_{j,t} = (\text{Hawkish}_{j,t} - \text{Dovish}_{j,t}) / (\text{Hawkish}_{j,t} + \text{Dovish}_{j,t})$. The federal funds rate is the target after each FOMC meeting, see Appendix F for details on its construction.

Message 2. *The press conference correlates with the future policy rate to a greater extent than other communications. This is because the FOMC statement coarsely signals the current stance of policy and the press conference fine-tunes the message to signal future policy.*

Figure 5 plots impulse responses from local projections that establish predictive correlations between current sentiment and the future federal funds rate. We first estimate impulse responses separately for the statement and the press conference:

$$\text{Federal Funds Rate}_{t+h} = \beta_0^h + \beta_1^h \text{Net Sentiment}_{j,t} + \epsilon_{j,t} \quad (8)$$

Where t is the FOMC meeting frequency, $h = 0, \dots, 20$, and $j \in \{\text{FOMC Announcement, Press}\}$. Appendix figure B.5 shows that the impulse response coefficients of the net sentiment of speeches is lower than that of either press conferences or FOMC statements. Appendix figures B.7-B.9 show the joint predictive correlations of speeches with FOMC statements and the press conference at daily frequency.

The figure shows that an increase in net sentiment (hawkish content) is correlated with a higher federal funds rate for both the net sentiment of the FOMC statement and the press conference. The response to the press conference (dashed red line) has a more distinct hump shape and peaks about 8 meetings (one year) ahead. While this suggests that an increase in net sentiment in the press conference is associated with a relatively higher federal funds rate than the same increase in the FOMC statement, these sentiment scores are highly correlated at 0.8 and their impulse response coefficient not statistically significant from each other.

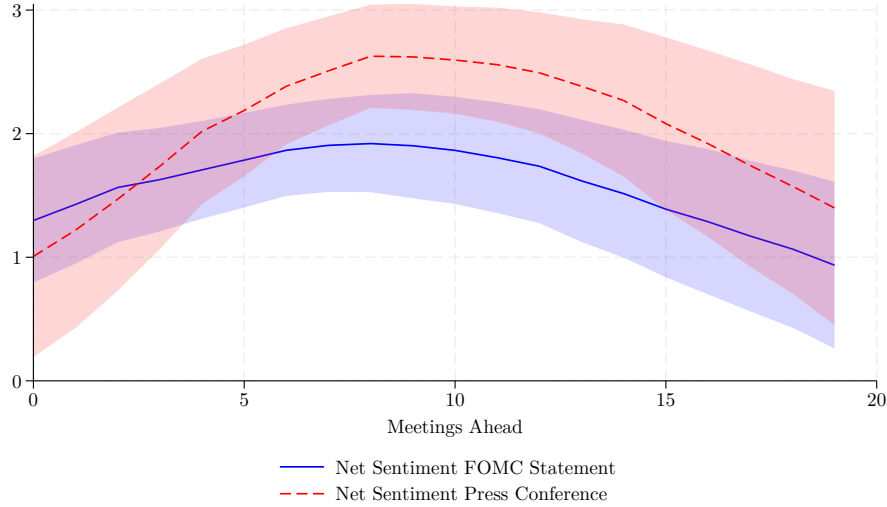


Figure 5: Impulse response of the federal funds rate to net sentiment, 90% error bands with two Newey-West lags.

The figure plots $\hat{\beta}_1^h$ from the local projection, $\text{Federal Funds Rate}_{t+h} = \beta_0^h + \beta_1^h \text{Net Sentiment}_{j,t} + \epsilon_{j,t}$ in equation (8). Where t is the FOMC meeting frequency, $h = 0, \dots, 20$, and $j \in \{\text{FOMC statement, Press}\}$. $\text{Net Sentiment}_{j,t} = (\text{Hawkish}_{j,t} - \text{Dovish}_{j,t}) / (\text{Hawkish}_{j,t} + \text{Dovish}_{j,t})$

Consequently, we expand the specification in equation (8) to include both net sentiment scores an interaction term.

$$\text{Federal Funds Rate}_{t+h} = \beta_0^h + \beta_1^h \text{Net Sentiment}_{FOMC,t} + \beta_2^h \text{Net Sentiment}_{Press,t} + \epsilon_t \quad (9)$$

$$\begin{aligned} \text{Federal Funds Rate}_{t+h} = & \beta_0^h + \beta_1^h \text{Net Sentiment}_{FOMC,t} + \beta_2^h \text{Net Sentiment}_{Press,t} + \dots \\ & \dots \beta_3^h (\text{Net Sentiment}_{FOMC,t} \times \text{Net Sentiment}_{Press,t}) + \epsilon_t \end{aligned} \quad (10)$$

Figure 6 shows the impulse response to specifications (9) and (10) in panels 6a and 6b, respectively. Panel 6a shows a mostly positive coefficient on the correlation between current net sentiment of the FOMC statement and the future federal funds rate. That is, an increase in net sentiment represents more hawkish content in the FOMC statement and correlates with a higher federal funds rate about 12 meetings ahead. Thereafter, the coefficient turns negative which likely represents the federal funds rate returning to neutral about 2.5 years ahead. By contrast, the coefficient on the net sentiment of the press

conference is initially negative for about four meetings ahead before turning positive. Because the press conference leads the federal funds rate, the negative coefficient can be interpreted as a hawkish statement today coinciding with a lower federal funds rate in the near term. As the time horizon increases, the coefficient turns positive such that a more hawkish press conference is associated with a higher federal funds rate.

Panel 6b shows a similar pattern of impulse response coefficients for the net sentiment of FOMC statements and the press conference along with an interaction term. The negative interaction coefficient is key for interpretation: an entirely hawkish FOMC statement ($\hat{\beta}_1^0 \times \text{Net sentiment} = 1$) is associated with about a 1.5 p.p. higher federal funds rate, but an entirely dovish press conference ($\hat{\beta}_2^0 \times \text{Net sentiment} = -1$) is associated with a 0.5 p.p higher (-0.5×-1) federal funds rate. The interaction of hawkish net sentiment from the FOMC statement combined with dovish net sentiment from the press conference contributes an additional -1.5 p.p. ($\hat{\beta}_3^0 \times (-1) \times 1$) such that an entirely hawkish FOMC statement combined with an entire dovish statement is associated with a federal funds rate 3.5 p.p. above average. Essentially the peak of a tightening cycle—the highest total effect on the federal funds rate—is characterized by a hawkish statement and a dovish press conference.

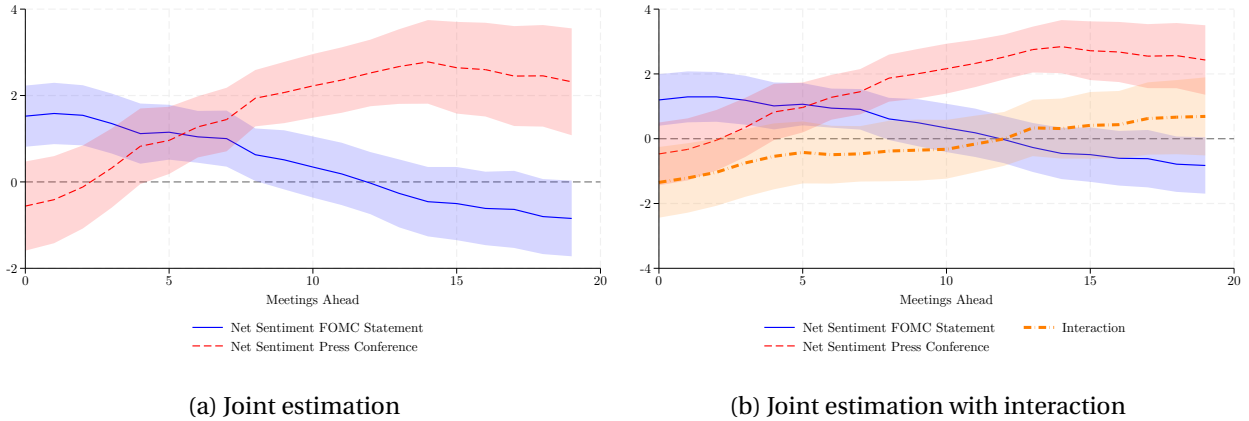


Figure 6: Impulse response of the federal funds rate to net sentiment, 90% error bands with two Newey-West lags.

Panel 6a plots $\hat{\beta}_1^h$ and $\hat{\beta}_2^h$ from the local projection, $\text{Federal Funds Rate}_{t+h} = \beta_0^h + \beta_1^h \text{Net Sentiment}_{FOMC,t} + \beta_2^h \text{Net Sentiment}_{Press,t} + \epsilon_t$ in equation (9). Panel 6b plots $\{\hat{\beta}_1^h, \hat{\beta}_2^h, \hat{\beta}_3^h\}$ from $\text{Federal Funds Rate}_{t+h} = \beta_0^h + \beta_1^h \text{Net Sentiment}_{FOMC,t} + \beta_2^h \text{Net Sentiment}_{Press,t} + \beta_3^h (\text{Net Sentiment}_{FOMC,t} \times \text{Net Sentiment}_{Press,t}) + \epsilon_t$ in equation (10). Where t is the FOMC meeting frequency and $h = 0, \dots, 20$. $\text{Net Sentiment}_{j,t} = (\text{Hawkish}_{j,t} - \text{Dovish}_{j,t}) / (\text{Hawkish}_{j,t} + \text{Dovish}_{j,t})$

Appendix figure B.4 shows that local projections with the sentiment-level FOMC statements instead of the paragraph-level ones are similar. Appendix figure B.6 controls for the lagged federal funds rate. Finally, Appendix figures B.7-B.9 use daily local projections specifications as in Jacobson et al. (2026) to allow for the timing of events and lagged stance of policy.

Figure 7 shows out of sample forecasts of the federal funds rate via net sentiment of press conferences and FOMC statements and compares these forecasts to those of a well-known Taylor (1999) rule as featured in the Federal Reserve’s June 2025 Monetary Policy Report to Congress and version of the Taylor (1999) rule augmented with a lagged value of the federal funds rate.¹⁰

$$\text{Federal Funds Rate}_{t+h} = \hat{\beta}_0^t + \hat{\beta}_1^t \text{Net Sentiment}_{FOMC,t+h} + \hat{\beta}_2^t \text{Net Sentiment}_{Press,t+h} \quad (11)$$

$$\text{Federal Funds Rate}_{t+h} = \hat{\rho}^{t-1} \text{Federal Funds Rate}_{t-1+h} \quad (12)$$

$$\text{Federal Funds Rate}_{t+h} = 2.5 + 1.5(\pi_{t+h} - \pi) + 2(u_{t+h}^* - u_{t+h}) \quad (13)$$

$$\text{Federal Funds Rate}_{t+h} = 0.85 \text{Federal Funds Rate}_{t-1+h} + 0.15 \left(2.5 + 1.5(\pi_{t+h} - \pi) + 2(u_{t+h}^* - u_{t+h}) \right) \quad (14)$$

For forecast horizon $h = 1, \dots, 8$. The net sentiment and AR(1) forecasts shown in equation 11 and 12, respectively, are initially estimated for $t = \{1994, \dots, 1997\}$ and then re-estimated for each meeting through April 2025. The coefficients for the non-inertial and inertial Taylor (1999) rule shown in equations (13) and (14), respectively, are the well-known value given by Taylor (1999).

Panel 7a shows that the forecast of the federal funds rate using just the net sentiment of press conferences and the FOMC statement as detailed in equation (11) performs remarkably well in forecasting the federal funds rate out sample. In fact, it performs much better than the Taylor (1999) rule detailed in equation (13). However, the forecast with net sentiment is also quite close to those of the inertial Taylor (1999) rule and a simple AR(1) forecast of the federal funds rate, detailed in equation (14) and (12), respectively.¹¹ For this reason, we calculated root mean squared errors for 8 FOMC meetings ahead to understand which forecast specification performs the best.

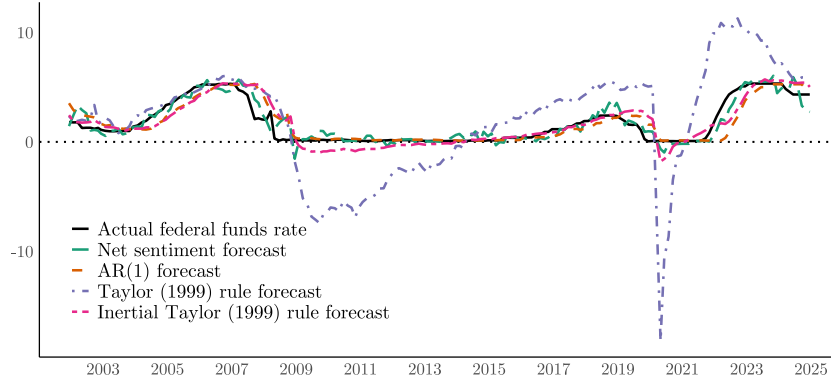
$$\text{RMSE}_h = \sqrt{\frac{1}{h} \sum_{t=1}^h (\text{Federal Funds Rate}_{t+h} - \widehat{\text{Federal Funds Rate}}_{t+h})^2} \quad (15)$$

Panel 7b shows that the root mean squared error of the net sentiment forecast is the lowest for all horizons shown and thus the best performing. While the AR(1) rule performs better than the Taylor (1999) rule at short horizons, as shown by Crawley et al. (2026), the net sentiment forecast performs better than these other specifications at all horizons. Taken together, this evidence suggests that net sentiment communicated by the Federal Reserve is a better predictor of future policy than macroeconomic aggregates and a well-studied reaction function.

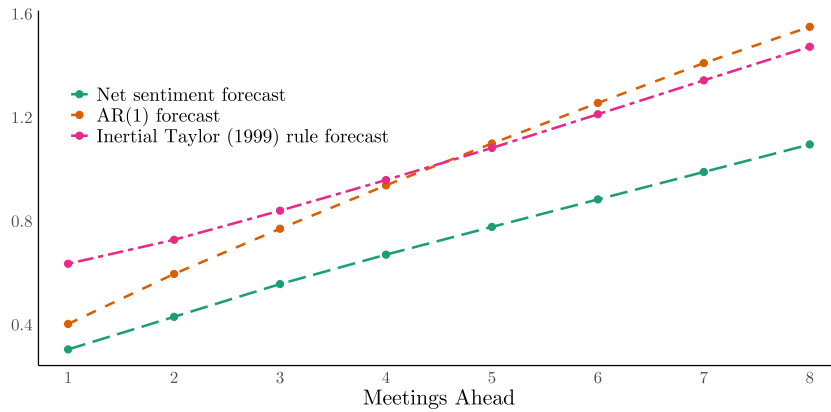
While this section shows that the net sentiment of the press conference contains predictive correlations with the future federal funds rate, these specifications are highly endogenous. To better understand the effect of sentiment on future policy, we next turn to high-frequency market reactions that allow for the construction of monetary policy shocks.

¹⁰See pages 43-45, https://www.federalreserve.gov/monetarypolicy/files/20250620_mprfullreport.pdf.

¹¹Crawley et al. (2026) show that double inertial rules are sometimes necessary to improve upon the predictive fit of an AR(1) forecast of the federal funds rate in the short-term.



(a) Recursive forecast of the federal funds rate, percent



(b) Root mean squared errors for the predicted federal funds rate

Figure 7: Out of sample forecasts of the federal funds rate

5 SENTIMENT SCORES AND MARKET REACTIONS

We regress market reactions discussed in section 3 on sentiment as constructed in section 4 for each type of communication to partially control for the endogeneity of the federal funds rate. We focus on the 4th Eurodollar/5th SOFR future, $EDSR4$, which is the interest rate future four quarters ahead, for ease of discussion. Appendix C.1 confirms that all results for $EDSR4$ hold with all other interest rate futures of lower maturities.

$$\text{Market Reaction}_{t,i,j} = \alpha + \beta \text{Sentiment}_{t,i,j} + \epsilon_{t,j,i} \quad (16)$$

For communication type $j \in \{\text{Press conference, Speech, FOMC Statement}\}$ and raw sentiment $i \in \{\text{Hawkish, Dovish, Neutral}\}$ for each monetary event t .

Message 3. *When regressing market reactions on LLM sentiment, the press conference stands out for the strongest relationship between sentiment and market reaction.*

Figure 8 shows the estimates of the slope coefficient $\hat{\beta}$ from equation (16) estimated via OLS with Huber-White robust standard errors and 95 percent error bands. The x-axis shown is hawkish sentiment and the y-axis is the 4th Eurodollar/5th SOFR futures. Appendix C.1 shows the results for dovish and neutral sentiment along with other market indicators. The market reaction can vary, with some communication events having almost no market reaction and others having one that is almost 20 basis points. As in section 4, communication events can contain dovish, hawkish, and neutral sentiment.

The press conference stands out as having the strongest relationship between hawkish sentiment and market reaction, consistent with its predictive correlations with the federal funds rate shown in the previous section. The slope coefficient $\hat{\beta}$ is statistically significant from zero meaning that the stronger the hawkish content, the stronger the market reaction. By contrast, speeches by the chair and FOMC statements have a slope coefficient that is statistically insignificant from zero suggesting no discernible relationship between content and the size of the market reaction. If speeches also had a statistically significant slope coefficient like press conferences, one could conclude that markets react more to FOMC communications than actions. However, the results in figure 8 suggest that communications following actions elicit the largest market reactions, which suggests the importance of communications related to changes in fundamentals and special role for the press conference that is distinct from speeches.

Figure 8 presents a puzzle: the most negative market reactions of the press conference are those in the 2022-2024 tightening cycle. Why was the market surprised to the downside during a rapid tightening cycle characterized by hawkish sentiment? We first note that Appendix figure C.4 confirms that the strongest market reactions are indeed those that reverse the reactions to the preceding FOMC statement, as shown in figure 3 and Appendix A.3. We argue that these reversals are the result of dovish sentiment in the press conference refining the coarse hawkish signal of the statement about the future course of policy. That is, because the press conference has a higher correlation with the future federal funds rate, the market is reacting to refined signals.

While FOMC statements used to be the primary form of communication, our findings highlight a key role for the content of the press conference in explaining market reactions that sometimes reverse those of the statement, especially in interest rate futures one year ahead. We next test if the market does indeed perceive the press conference as clarifying information that shapes expectations about the future path of policy. After all, Narain and Sangani (2026) document heightened market volatility under Chair Powell's press conferences, particularly when addressing forward guidance, which aligns with our finding that press conferences refine the statement's message.

6 SIGNAL-TO-NOISE

Although elevated trading volume around FOMC statements is well known, less is understood about how long the announcement-related impulse remains informative. To measure the incremental signal associated with the press conference, we estimate a variant of a signal-to-noise ratio using an approach similar in spirit to the local-projections difference-in-differences framework in Dube et al. (2025).¹² More

¹²Annette Vissing-Jorgensen's discussion of Swanson and Jayawickrema (2024) features signal-to-noise analysis of stock market returns around FOMC events. She finds that speeches are noisier than statements and press conferences

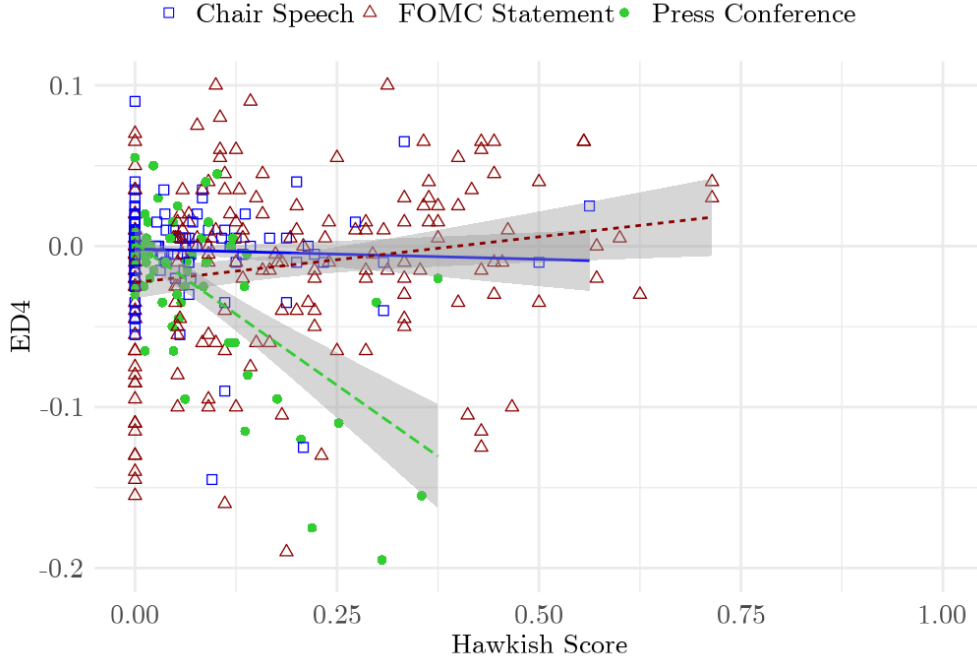


Figure 8: Regression of market surprises on hawkish sentiment.

The figures shows equation (16) $\Delta\text{Market Reaction}_{t,j} = \alpha + \beta\text{Sentiment}_j + \epsilon_{t,j}$ for hawkish sentiment for each type of communication $j \in \{\text{Press conference, Speech, FOMC statement}\}$. Shaded bands are 95 percent confidence intervals.

specifically, we estimate the marginal variation in trading activity around the time of an FOMC statement relative to the same day and time one week before and one week after the statement release.

For each futures contract i and each horizon h , we estimate

$$Y_{\tau,d}^i = \beta_0^{i,h} + \beta_1^{i,h} \mathbb{1}(d = \text{FOMC}) + \beta_2^{i,h} \mathbb{1}(-10 \leq \tau \leq h) + \beta_3^{i,h} \left[\mathbb{1}(d = \text{FOMC}) \times \mathbb{1}(-10 \leq \tau \leq h) \right] + \lambda_{m \times y} + \epsilon_{\tau,d}^{i,h}, \quad (17)$$

where $Y_{\tau,d}^i$ is minute- τ trading volume for contract i , scaled by that day's (d) total trading volume, and $\tau = 0$ denotes the scheduled FOMC statement release time. The indicator $\mathbb{1}(d = \text{FOMC})$ equals one on FOMC statement days and zero on control days, defined as the same weekday one week before and one week after the FOMC meeting. Scaling by daily trading volume accounts for differences in overall trading intensity across days, while month \times year fixed effects absorb additional variation.

The estimation sample is fixed over $\tau \in [-70, 170]$. For a given horizon h , the treated window is defined as the interval from ten minutes before the scheduled statement release through minute h , that is, $\tau \in [-10, h]$. We begin with $h = -9$, so the initial treated window contains only the two minutes immediately preceding the scheduled release, and then expand the window one minute at a time up to $h = 170$. This design preserves comparability with standard high-frequency monetary-policy identification, which measures price changes relative to the trade price ten minutes before the statement release.

We focus on the incremental explanatory power of the interaction term as the treated window ex-

<https://drive.google.com/file/d/1GD8FK7QwA1VqSu1g1LdCiLeOqYQ1cujT/view>.

pands. At each horizon h , we compute

$$\text{SNR}_h = \frac{SS(\mathbb{1}(d = \text{FOMC}) \times \mathbb{1}(-10 \leq \tau \leq h))}{RSS_h}, \quad (18)$$

where $SS(\cdot)$ denotes the ANOVA sum of squares attributable to the interaction term and RSS_h is the residual sum of squares from the full model estimated at horizon h . A higher value of the statistic indicates that including minute h in the event window adds more FOMC-related signal than residual noise.

This minute-by-minute analysis provides a direct way to assess how quickly statement-related trading activity becomes informative and how long that informativeness persists. In particular, a value of zero when $h < 0$ indicates little differential trading activity before the scheduled release, as shown in figure 9. An increase in the statistic at $\tau = 0$ and continuing afterward suggests that statement-related information arrives at the scheduled release and continues to unfold during the subsequent press conference period which begins at $\tau = 30$.

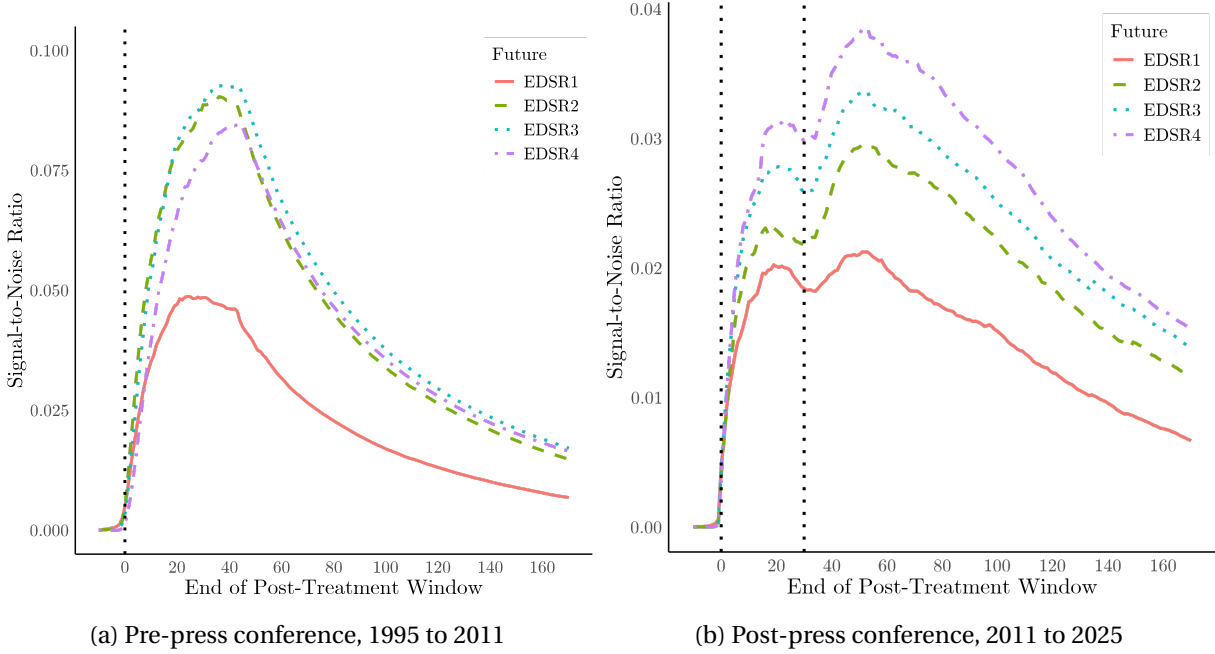


Figure 9: Signal-to-Noise Ratios

The figure plots a signal-to-noise ratio, which is the sum of squares of the coefficient $Y_{\tau,d}^i = \beta_0^{i,h} + \beta_1^{i,h} \mathbb{1}(d = \text{FOMC}) + \beta_2^{i,h} \mathbb{1}(-10 \leq \tau \leq h) + \beta_3^{i,h} [\mathbb{1}(d = \text{FOMC}) \times \mathbb{1}(-10 \leq \tau \leq h)] + \lambda_{m \times y} + \varepsilon_{\tau,d}^{i,h}$. Zero indicates the minute of the FOMC statement (typically 2:00 PM EST), and the x-axis is minutes since the statement release. The press conference typically starts 30 minutes after the statement release, as indicated by the second vertical dashed line in panel.

Message 4. *The statement alone is less influential compared to a few years ago. Market participants increasingly wait for the press conference to fine-tune their expectations, as indicated by relatively higher signal-to-noise detected from the press conference relative to the statement.*

Figure 9 compares the signal-to-noise ratio around releases of FOMC statements in the period prior to the press conference in panel 9a (1995 to 2011) to that after the introduction of the press conference

in panel 9b (2011-2025) and shows that the market perceives additional signal from the press conference. While panel 9a shows that signal detected from trading volumes peaked about 40 minutes after FOMC statements in all four interest rate futures shown, panel 9b shows a different pattern after the introduction of the press conference. In panel 9b, signal peaks about 20 minutes after the FOMC statement release, flattens and then begins to climb again after the start of the press conference, which is 30 minutes after the statement release (denoted by the second dashed vertical line). The signal continues to climb during and peaks about 30 minutes after the start of the press conference, which is about an hour after the release of the FOMC statement.

Instead of averaging over the pre- and post-press conference periods, figure 10 shows estimates of equation 17 by year for *EDSR4*—interest rate futures one year ahead. It shows that by 2019, when Chair Powell institutes a press conference after every meeting instead of every other, more signal is detected via the press conference than via the statement. Appendix D shows versions of the figure for all maturities of Eurodollar/SOFR futures of a year or less.

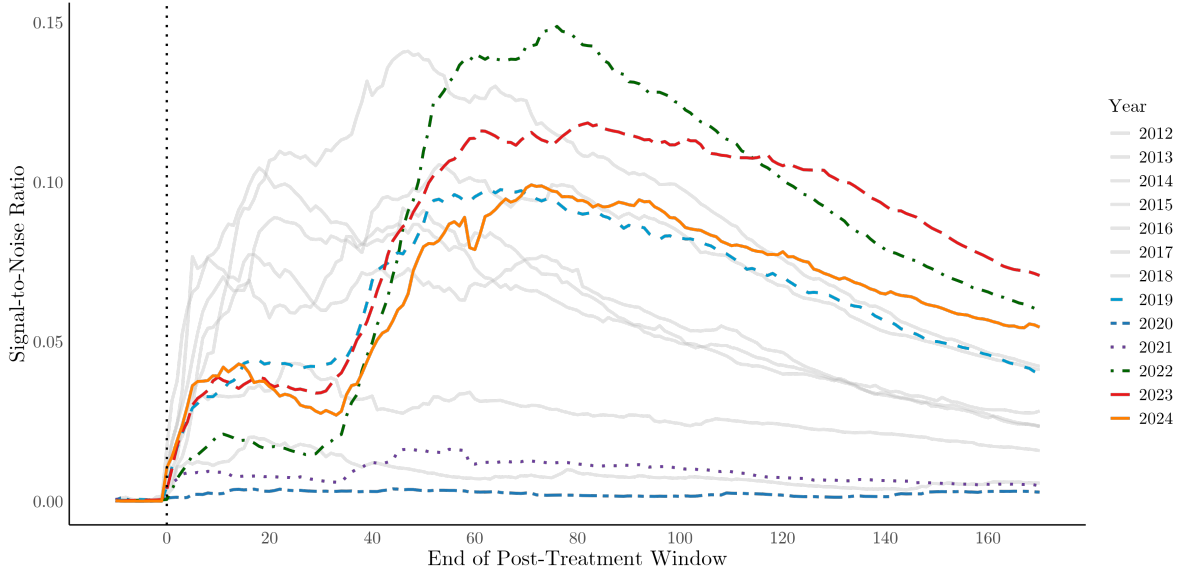


Figure 10: Signal-to-Noise ratio by year, 2011-2025.

The figure plots a signal-to-noise ratio, which is the sum of squares of the coefficient $Y_{\tau,d}^i = \beta_0^{i,h} + \beta_1^{i,h} \mathbb{1}(d = \text{FOMC}) + \beta_2^{i,h} \mathbb{1}(-10 \leq \tau \leq h) + \beta_3^{i,h} \left[\mathbb{1}(d = \text{FOMC}) \times \mathbb{1}(-10 \leq \tau \leq h) \right] + \lambda_{m \times y} + \varepsilon_{\tau,d}^{i,h}$. Zero indicates the minute of the FOMC statement (typically 2:00 PM EST), and the x-axis is minutes since the statement release. The press conference typically starts 30 minutes after the statement release.

Given that the press conference contains additional signal than the statement, how should researchers incorporate the press conference into the construction of high-frequency monetary policy shocks? After all, focusing solely on statements may miss the full scope of monetary news contained in the press conference.

7 MONETARY TRANSMISSION

We construct commonly used monetary policy shocks from the previously discussed market reactions to intraday changes in federal funds futures and Eurodollar/SOFR futures. The Nakamura and Steinsson (2018) shock series is the scaled first principal component of the instrument set $\{MP1, MP2, EDSR2, EDSR3, EDSR4\}$ using 30-minute windows around FOMC statements.¹³ We construct a second version of this series using the same instrument set, but 90-minute windows around FOMC statements when there is a post-meeting press conference. Using this same instrument set, Gürkaynak et al. (2005) extract and rotate two factors—the target and path—which correspond to the level and slope of the yield curve for one-year-ahead interest rates. Given that the net sentiment of the press conference contains predictive correlations with the future federal funds rate, we augment the instrument set to include high-frequency changes in 2-, 5-, 10-, and 30-year Treasury yields as in Brennan et al. (2025). Appendix E contains details on shock construction, which also follows Brennan et al. (2025).

The effect of monetary policy on the macroeconomy is frequently estimated via a structural vector autoregression framework at a monthly frequency by using high-frequency monetary policy shock series as external instruments.¹⁴ We use the VAR specification of Bauer and Swanson (2022) which is a variant of Gertler and Karadi (2015) and extend it to April 2025 instead of stopping in 2019 as in previous studies. The external instrument imposes a second moment restriction to identify shocks, more specifically it replaces one column of the rotation matrix with predicted values from a regression of a reduced form VAR innovation on the external instrument.

Identification via an external instrument hinges on a high-frequency monetary policy shock series ε_t^i satisfying relevance and exogeneity conditions to be an adequate external instrument for ε_t^{mp} the unobservable true monetary shocks.

$$E[\varepsilon_t^{mp} \varepsilon_t^i] \neq 0 \quad \text{and} \quad E[\varepsilon_t^i \varepsilon_t^{mp}] = 0$$

Where ε_t is any serially uncorrelated structural shocks driving the economy and ε_t^{mp} is a subset of these shocks unrelated to monetary policy.

Since the true value of ε_t^{mp} is unobserved, instrument validity must ultimately be justified logically. Any high-frequency monetary shock series should satisfy the relevance condition as they capture monetary news conveyed by Fed communication by construction. The exclusion condition should also be satisfied because the tight windows around FOMC statement releases should prevent non-monetary news from moving markets. While Bauer and Swanson (2023) show that the exclusion condition is violated for the Nakamura and Steinsson (2018) monetary policy shock series, Brennan et al. (2025) find that that other shock series like those of Bu et al. (2021) and Kuttner (2001) are unpredictable, which suggests that predictability is a feature of certain shocks, not high-frequency monetary shocks per se. Relatedly, these shock series exhibit conventionally-signed responses which can alleviate concerns about contamination

¹³ *MP1* and *MP2* are calculations performed on *FF1* through *FF4* to correct for time averaging in settlement prices. See Brennan et al. (2025) and Appendix E for detailed descriptions.

¹⁴ See Stock and Watson (2018) for additional documentation of VARs with external instruments and Miranda-Agrippino and Ricco (2023) for a discussion of why it is the dominant specification in empirical macroeconomics.

from the so-called Fed information effect.

The specification for a VAR with external instruments is given as:

$$Y_T = \alpha + B(L)Y_{T-1} + s_1 Y_T^{2Y} + \tilde{u}_T \quad (19)$$

Where Y_T is a vector containing four monthly economic variables from January 1973 to April 2025: the log of the consumer price index (CPI), the log of industrial production (IP), the Gilchrist and Zakrajšek (2012) excess bond premium (as advocated by Caldara and Herbst (2019), and the two-year zero-coupon Treasury yield at a monthly frequency. Appendix F details the sources of these series. We also note that the two-year Treasury yield is the daily change observed at the end of the month as in the excel spreadsheet used by Bauer and Swanson (2022).¹⁵ The excess bond premium controls for financial factors and the two-year Treasury is a measure of the stance of monetary policy. Although the original Gertler and Karadi (2015) specification uses the one-year Treasury, the two-year has the advantage of being less constrained at the ELB and is used by Bauer and Swanson (2022).

Next, $B(L)$ is the matrix polynomial in the lag operator. Although Bauer and Swanson (2022) follow Gertler and Karadi (2015) and Ramey (2016) in using 12 lags, we follow Brennan et al. (2025) and use 8 lags.¹⁶ While Bauer and Swanson (2022) construct a version of the NS shock series from 1988 to 2019, our monetary policy shock series begins in 1995 which is as close to the 1994 introduction of explicit policy statements as our intraday data allows without resorting to sources we cannot replicate from intraday data on actual trades. We extend these shock series to present and estimate the VAR to present as well with Appendix figures E.4-E.6 showing that results are similar if we instead stop in 2019.

Finally, e_t^i is the instrument for $s_1 Y_T^{2Y}$ estimated via two-stage least squares and \tilde{u}_T is the residual. The sample of the external instrument e_t^i does not have to be the same as that of the economic data. In fact, the sample used for our shock series is from January 1995 to April 2025 and the sample for the economic data is from January 1973 to April 2025. Furthermore, following the literature, e_t^i is aggregated to a monthly frequency by summation, $e_T^i = \sum_t e_t^i$. We do not make any further adjustments for the timing of shocks within the month as Ramey (2016) and Miranda-Agrippino and Ricco (2021) find that the adjustments proposed by Gertler and Karadi (2015) can induce serial correlation.

Figure 11 plots impulse responses from equation (19) obtained via the Canova and Ferroni (2022) toolbox with 68 and 90 percent error bands and 20,000 draws. The impulse responses to a 25 basis point monetary shock are qualitatively in line with macroeconomic theory and similar in sign and shape, even though the shock series used in panel 11a is constructed without the press conference, its counterpart in panel 11b includes the press conference, and panel 11c contains the press conference and longer-term Treasuries in the instrument set. The response of the two-year Treasury, shown in the bottom row of each panel, rises on impact to a normalized initial response of 25 basis points and then returns to zero about 10 months after the initial impulse.

The impulse responses of both industrial production and CPI to a contractionary monetary policy shown in the first and second rows of figure 11, respectively, are significantly negative—as standard New

¹⁵See <https://www.frbsf.org/wp-content/uploads/monetary-policy-surprises-data.xlsx?2026-03-24>.

¹⁶Appendix figures E.1-E.3 show that the results are quite similar with 12 lags, albeit with wider error bands in some instances.

Keynesian theory predicts. Differences in point estimates among the shock series are only in magnitude rather than in sign. A 25 basis point contractionary monetary policy shocks results in about a 1 and 0.25 percentage point reduction in industrial production (IP) and the consumer price index (CPI), respectively.

The excess bond premium shown in row three is the only variable that displays qualitative differences in point estimates. While the coefficients are ambiguously zero for the original 30-minute time window shown in panel 11a, they are positive and statistically significant from zero on impact, as shown in panel 11b, and statistically negative in panel 11c. In Gertler and Karadi (2015) and Brennan et al. (2025), the excess bond premium is positive and significant, which is only the case in panel 11b where the Nakamura and Steinsson (2018) monetary policy shock is constructed to include the press conference, but not long-term Treasuries.

Figure 12 plots the impulse responses from equation (19) using the target shock of Gürkaynak et al. (2005) constructed from the rotated first principal component of the instrument set $\{MP1, MP2, EDSR2, EDSR3, EDSR4\}$ and the version augmented with intraday changes in 2-, 5-, 10-, and 30-year Treasuries. The target shock represent an unexpected change in actual interest rate decisions by the FOMC. The figure shows point estimates that are aligned with theoretical predictions and have little difference across monetary policy shock constructions. In fact, unlike the impulse responses to the Nakamura and Steinsson (2018) shock shown in figure 11, those for the target shock of Gürkaynak et al. (2005) are all positive and significant for the excess bond premium shown in row three of figure 12. Taken together, these results suggest that expanding time windows to include the forward guidance contained in the press conference and its effects on long-term rates has little effect on unexpected changes in the federal funds rate, as one would expect.

Figure 13 plots the impulse responses from equation (19) using the path shock of Gürkaynak et al. (2005) constructed from the rotated second principal component of the instrument set $\{MP1, MP2, EDSR2, EDSR3, EDSR4\}$ and the version augmented with intraday change in 2-, 5-, 10-, and 30-year Treasuries. The figure shows point estimates that are either opposite-signed or insignificant from zero for the original shock construction and the version that includes information from the press conference (panels 13a and 13b, respectively). While authors like Bundick and Smith (2020) account for these point estimates as information shocks about the state of the economy, Swanson and Jayawickrema (2024) show that including market reactions to speeches in monetary policy shock construction can lead to signs of point estimates that are conventionally-signed and look like those in panel 13c. Additionally, Adams and Barrett (2026) find point estimates similar to ours with long-term rates in panel 13c from synthetic monetary policy shocks constructed from long-horizon forward guidance.

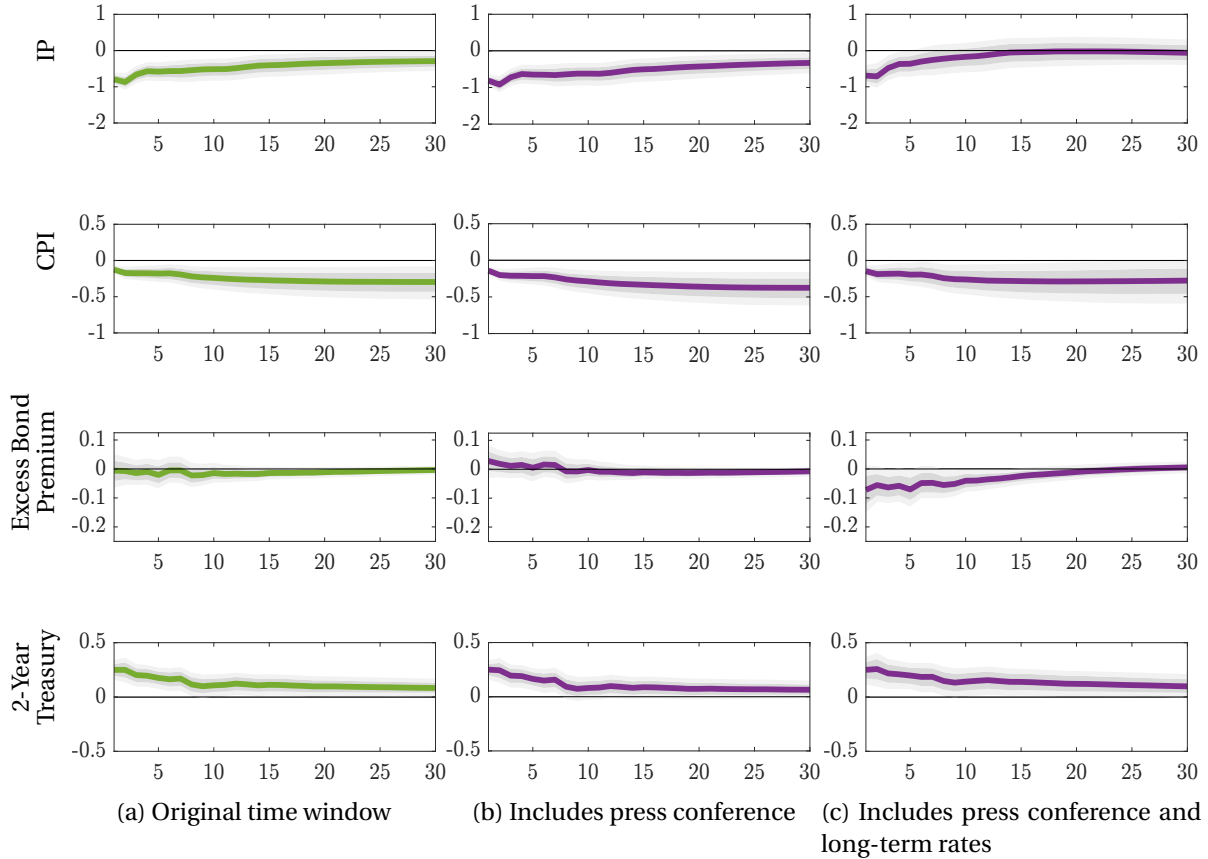


Figure 11: Impulse response to a 25 basis point Nakamura and Steinsson (2018) monetary policy shock, x-axis is months and y-axis is percentage points.

Impulse responses are estimates from equation (19) $Y_T = \alpha + B(L)Y_{T-1} + s_1 Y_T^{2Y} + \tilde{u}_T$ obtained via the Canova and Ferroni (2022) Bayesian VAR toolbox with 68 and 90 percent error bands (darker and lighter bands, respectively), 20,000 draws, and 8 lags. The sample of monetary shock series is from January 1995 to April 2025 while the sample of economic data starts in January 1973. The shock series are the first principal component of the instrument set $\{MP1, MP2, EDSR2, EDSR3, EDSR4\}$. The shock series in panel a is constructed from the 30-minute change in these futures around FOMC statements. The shock series in panel b is constructed from the 90-minute change in these futures around FOMC statements when there is a post-meeting press conference so that the time window includes the press conference. Panel c augments the instrument set in panel b with intraday changes in 2-, 5-, 10-, and 30-year Treasury yields. IP is the industrial production index, CPI is the consumer price index, excess bond premium is from Gilchrist and Zakrajšek (2012), and the two-year Treasury is the end of the month daily change in the zero-coupon yield. All sources of series are detailed in Appendix F. Appendix Table 1 displays the first-stage F-statistics.

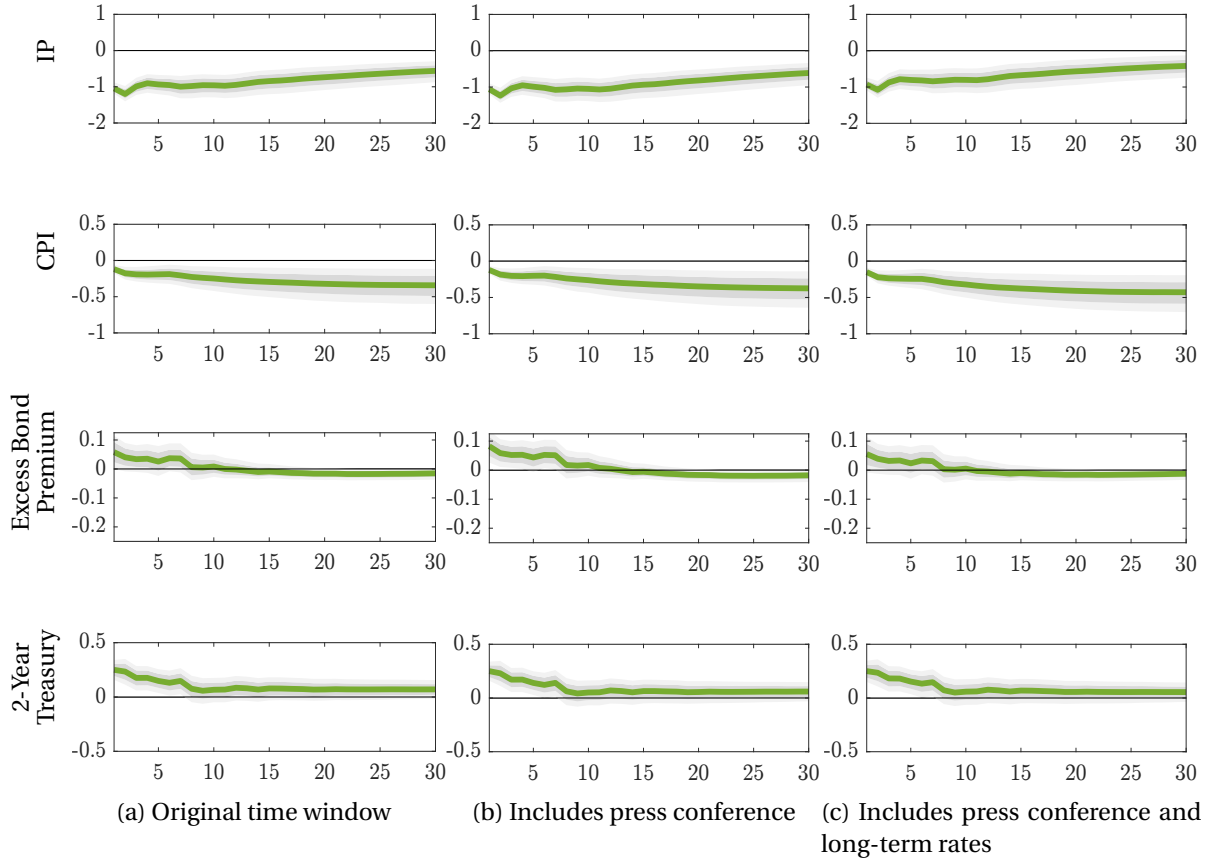


Figure 12: Impulse response to a 25 basis point *Gürkaynak et al. (2005)* target monetary policy shock, x-axis is months and y-axis is percentage points.

Impulse responses are estimates from equation (19) $Y_T = \alpha + B(L)Y_{T-1} + s_1 Y_T^{2Y} + \tilde{u}_T$ obtained via the Canova and Ferroni (2022) Bayesian VAR toolbox with 68 and 90 percent error bands (darker and lighter bands, respectively), 20,000 draws, and 8 lags. The sample of monetary shock series is from January 1995 to April 2025 while the sample of economic data starts in January 1973. The shock series is the rotated first principal component of the instrument set $\{MP1, MP2, EDSR2, EDSR3, EDSR4\}$. The shock series in panel a is constructed from the 30-minute change in these futures around FOMC statements. The shock series in panel b is constructed from the 90-minute change in these futures around FOMC statements when there is a post-meeting press conference so that the time window includes the press conference. Panel c augments the instrument set in panel b with intraday changes in 2-, 5-, 10-, and 30-year Treasury yields. IP is the industrial production index, CPI is the consumer price index, excess bond premium is from *Gilchrist and Zakrajšek (2012)*, and the two-year Treasury is the end of the month daily change in the zero-coupon yield. All sources of series are detailed in Appendix F. Appendix Table 1 displays the first-stage F-statistics.

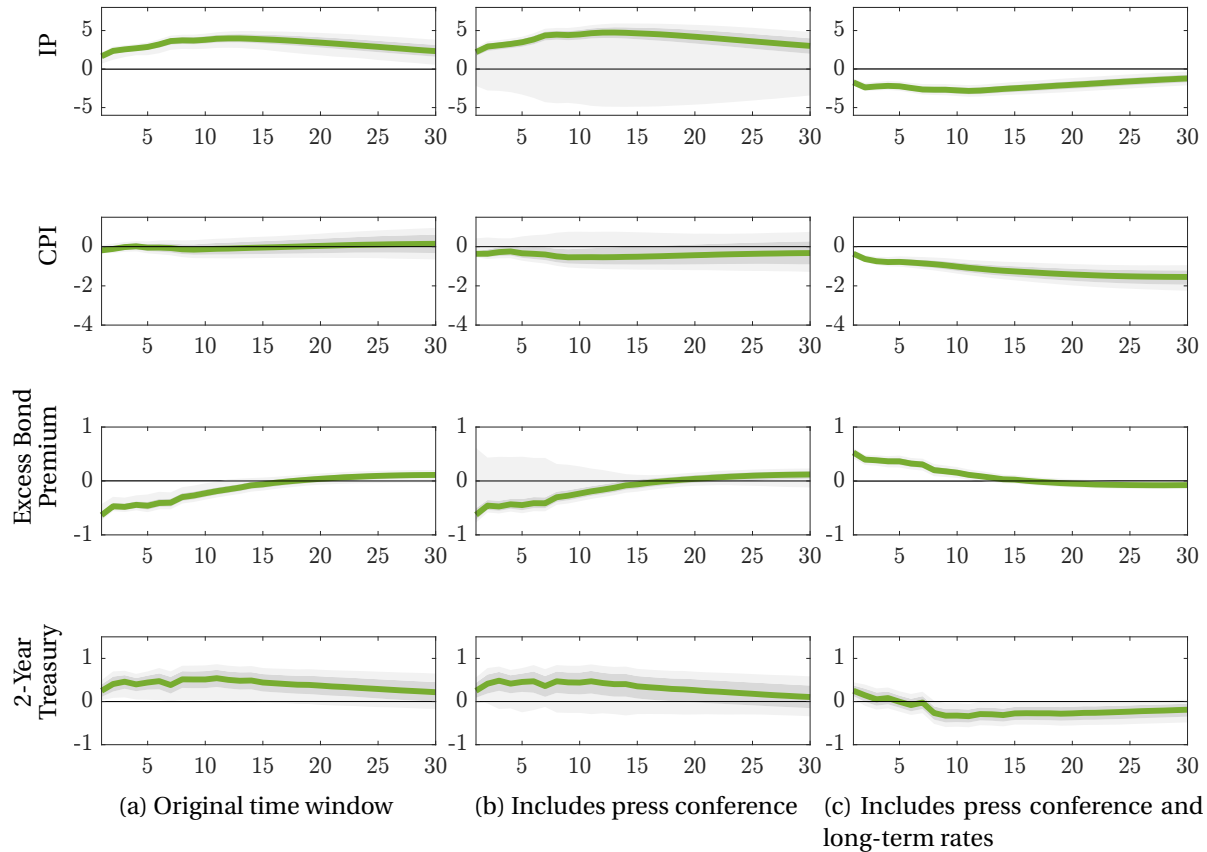


Figure 13: Impulse response to a 25 basis point Gürkaynak et al. (2005) path monetary policy shock, x-axis is months and y-axis is percentage points.

Impulse responses are estimates from equation (19) $Y_T = \alpha + B(L)Y_{T-1} + s_1 Y_T^{2Y} + \bar{u}_T$ obtained via the Canova and Ferroni (2022) Bayesian VAR toolbox with 68 and 90 percent error bands (darker and lighter bands, respectively), 20,000 draws, and 8 lags. The sample of monetary shock series is from January 1995 to April 2025 while the sample of economic data starts in January 1973. The shock series are the rotated second principal component of the instrument set $\{MP1, MP2, EDSR2, EDSR3, EDSR4\}$. The shock series in panel a is constructed from the 30-minute change in these futures around FOMC statements. The shock series in panel b is constructed from the 90-minute change in these futures around FOMC statements when there is a post-meeting press conference so that the time window includes the press conference. Panel c augments the instrument set in panel b with intraday changes in 2-, 5-, 10-, and 30-year Treasury yields. IP is the industrial production index, CPI is the consumer price index, excess bond premium is from Gilchrist and Zakrajšek (2012), and the two-year Treasury is the end of the month daily change in the zero-coupon yield. All sources of series are detailed in Appendix F. Appendix Table 1 displays the first-stage F-statistics.

8 CONCLUSION

This study explains patterns in market reactions to Federal Reserve communications with insights from large language modeling. We document empirical relationships showing that Federal Reserve press conferences refine coarse signals of the FOMC statement and contain content that accounts for the future federal funds rate and puzzling market reactions that reverse those of FOMC statements. By integrating large language models with high-frequency asset price data, we find that press conferences stand out for their intensity of sentiment and market reactions. We confirm the distinct role of press conferences in refining the statement's message by showing that market participants indeed perceive additional signal. Finally, we show that including press conferences in the construction of high-frequency monetary policy shocks can affect estimates of monetary policy transmission. Some shock constructions benefit from including longer-term interest rates in the instrument set to capture expectations beyond the first year of the term structure of interest rates, which is consistent with press conferences containing important forward guidance about the future stance of monetary policy.

REFERENCES

- Acosta, Miguel and Ellen Meade**, “Hanging on every word: Semantic analysis of the FOMC’s postmeeting statement,” 2015. FEDS Notes. Washington: Board of Governors of the Federal Reserve System, September 30, 2015. <https://doi.org/10.17016/2380-7172.1580>.
- , **Andrea Ajello, Francesca Loria, and Silvia Miranda-Agrippino**, “Financial Market Effects of FOMC Communication: Evidence from a New Event-Study Database,” 2025. Working Paper.
- , **Connor M. Brennan, and Margaret M. Jacobson**, “Constructing high-frequency monetary policy surprises from SOFR futures,” *Economics Letters*, 2024, 242, 111873.
- Adams, Jonathan J. and Philip Barrett**, “What are Empirical Monetary Policy Shocks? Estimating the Term Structure of Policy News,” 2026. Working paper.
- Ahrens, Maximilian, Deniz Erdemlioglu, Michael McMahon, Christopher J. Neely, and Xiye Yang**, “Mind your language: Market responses to central bank speeches,” *Journal of Econometrics*, 2025, 249, 105921.
- Alexopoulos, Michelle, Xinfen Han, Oleksiy Kryvtsov, and Xu Zhang**, “More than words: Fed Chairs’ communication during congressional testimonies,” *Journal of Monetary Economics*, 2024, 142, 103515.
- Altavilla, Carlo, Refet Gurkaynak, Thilo Kind, and Luc Laeven**, “Monetary Transmission with Frequent Policy Events,” 2025. Working Paper.
- An, Phillip, Karlye Dilts Stedman, and Amaze Lusompa**, “How High Does High Frequency Need to Be? A Comparison of Daily and Intraday Monetary Policy Surprises,” 2025. Working Paper.
- Apel, Mikael, Marianna Blix Grimaldi, and Isaiah Hull**, “How Much Information Do Monetary Policy Committees Disclose? Evidence from the FOMC’s Minutes and Transcripts,” *Journal of Money, Credit and Banking*, 2022, 54 (5), 1459–1490.
- Aruoba, S. Boragan and Thomas Drechsel**, “Identifying Monetary Policy Shocks: A Natural Language Approach,” 2026. Forthcoming, *American Economic Journal: Macroeconomics*.
- Banerjee, Shantanu, Paul Cordova, Michiel De Pooter, and Olesya V. Grishchenko**, “Gauging the Sentiment of Federal Open Market Committee Communications through the Eyes of the Financial Press,” 2025. Working Paper.
- Bauer, Michael D. and Eric T. Swanson**, “A Reassessment of Monetary Policy Surprises and High-Frequency Identification,” in “NBER Macroeconomics Annual 2022, volume 37,” University of Chicago Press, 2022.
- **and** – , “An Alternative Explanation for the “Fed Information Effect”,” *American Economic Review*, March 2023, 113 (3), 664–700.

- Brennan, Connor M., Margaret M. Jacobson, Christian Matthes, and Todd B. Walker**, “Monetary Policy Shocks: Data or Methods?,” *The B.E. Journal of Macroeconomics*, 2025, 25 (2), 595–659.
- Bu, Chunya, John Rogers, and Wenbin Wu**, “A unified measure of Fed monetary policy shocks,” *Journal of Monetary Economics*, 2021, 118, 331–349.
- Bundick, Brent and A. Lee Smith**, “The Dynamic Effects of Forward Guidance Shocks,” *The Review of Economics and Statistics*, 12 2020, 102 (5), 946–965.
- Caldara, Dario and Edward Herbst**, “Monetary Policy, Real Activity, and Credit Spreads: Evidence from Bayesian Proxy SVARs,” *American Economic Journal: Macroeconomics*, 2019, 11 (1), 157–192.
- Calomiris, Charles W., Joanna Harris, Harry Mamaysky, and Cristina Tessari**, “Fed Implied Market Prices and Risk Premia,” 2022. Working Paper.
- Canova, Fabio and Filippo Ferroni**, “A hitchhiker’s guide to empirical macro models,” 2022. Working Paper.
- Cherry, Rennae and Eric Tong**, “Words of the RBNZ: Textual Analysis of Monetary Policy Statements,” 2023. Working Paper.
- Cieslak, Anna, Michael McMahon, and Hao Pang**, “Did I make myself clear? The Fed and the market under the 2020 monetary policy framework,” 2025. Working Paper.
- , **Stephen Hansen, and Michael McMahon**, “Tough Talk: The Fed and the Risk Premium,” 2024. Working Paper.
- , – , – , **and Hao Pang**, “Risk Management in Monetary Policy: Review with Asset Pricing Implications,” 2025. Working Paper.
- , – , – , **and Song Xiao**, “Policymakers’ Uncertainty,” 2024. Working Paper.
- Crawley, Edmund, Liam Goodwin, Margaret M. Jacobson, and Fabian Winkler**, “Double Inertia, Taylor Rules, and Monetary Policy Gradualism,” 2026. Working Paper.
- Curti, Filippo and Sophia Kazinnik**, “Let’s face it: Quantifying the impact of nonverbal communication in FOMC press conferences,” *Journal of Monetary Economics*, 2023, 139, 110–126.
- Czudaj, Robert L. and Bich Ngoc Nguyen**, “ECB’s central bank communication and monetary policy transmission: predictability from text-based sentiment indicators?,” *Macroeconomic Dynamics*, 2025, 29, e102.
- De Pooter, Michiel**, “Questions and Answers: The Information Content of the Post-FOMC Meeting Press Conference,” 2021. FEDS Notes. Washington: Board of Governors of the Federal Reserve System, October 12, 2021, <https://doi.org/10.17016/2380-7172.2997>.

- Deng, Yayue, Mohan Xu, and Yao Tang**, “FMPAF: How Do Fed Chairs Affect the Financial Market? A Fine-grained Monetary Policy Analysis Framework on Their Language,” 2024.
- Devlin, Jacob, Ming-Wei Chang, Kenton Lee, and Kristina Toutanova**, “BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding,” *Proceedings of NAACL-HLT*, 2019, pp. 4171–4186.
- Doh, Taeyoung, Songho Song, and Shu-Kuei Yang**, “Deciphering Federal Reserve Communication via Text Analysis of Alternative FOMC Statements,” 2025. Working Paper.
- , **Sungil Kim, and Shu-Kuei Yang**, “How You Say It Matters: Text Analysis of FOMC Statements Using Natural Language Processing,” 2021. Working Paper.
- Dube, Arindrajit, Daniele Girardi, Òscar Jordà, and Alan M. Taylor**, “A Local Projections Approach to Difference-in-Differences,” *Journal of Applied Econometrics*, 2025, 40 (7), 741–758.
- Dunn, Wendy, Ellen E. Meade, Nitish Ranjan Sinha, and Raakin Kabir**, “Using Generative AI Models to Understand FOMC Monetary Policy Discussions,” 2024. FEDS Notes. Washington: Board of Governors of the Federal Reserve System, December 06, 2024, <https://doi.org/10.17016/2380-7172.3678>.
- Ehrmann, Michael and Jonathan Talmi**, “Starting from a blank page? Semantic similarity in central bank communication and market volatility,” *Journal of Monetary Economics*, 2020, 111, 48–62.
- **and Marcel Fratzscher**, “Explaining Monetary Policy in Press Conferences,” *Journal of International Central Banking*, 2009, 5.
- **and –**, “Purdah—On the Rationale for Central Bank Silence around Policy Meetings,” *Journal of Money, Credit and Banking*, 2009, 41 (2-3), 517–528.
- Fischer, Eric, Rebecca McCaughrin, Saketh Prazad, and Mark Vandergon**, “Fed Transparency and Policy Expectation Errors: A Text Analysis Approach,” 2023. Working Paper.
- Fracaroli, Nicolo, Alessandro Giovannini, and Jean-Francois Jamet**, “Central Banks in Parliaments: A Text Analysis of the Parliamentary Hearings of the Bank of England, The European Central Bank, and the Federal Reserve,” 2020. Working Paper.
- Gambacorta, Leonardo, Byeungchun Kwon, Taejin Park, Pietro Patelli, and Sonya Zhu**, “CB-LMs: language models for central banking,” 2024.
- Gardner, Ben, Chiara Scotti, and Clara Vega**, “Words speak as loudly as actions: Central bank communication and the response of equity prices to macroeconomic announcements,” *Journal of Econometrics*, 2022, 231 (2), 387–409. Special Issue: The Econometrics of Macroeconomic and Financial Data.
- Gati, Laura and Amy Handlan**, “Monetary Communication Rules,” 2023. Working Paper.
- Gertler, Mark and Peter Karadi**, “Monetary Policy Surprises, Credit Costs, and Economic Activity,” *AEJ: Macroeconomics*, 2015, 7, 44–76.

- Gilchrist, Simon and Egon Zakrajšek**, “Credit Spreads and Business Cycle Fluctuations,” *American Economic Review*, June 2012, 102 (4), 1692–1720.
- Gnan, Phillipp, Maximilian Schleritzko, Maik Schmeling, and Christian Wagner**, “Deciphering Monetary Policy Shocks,” 2025. Working Paper.
- Gordon, Matthew V. and Kurt G. Lunsford**, “The effects of the Federal Reserve Chair’s testimony on interest rates and stock prices,” *Economics Letters*, 2024, 235, 111537.
- Gorodnichenko, Yuriy, Tho Pham, and Oleksandr Talavera**, “The Voice of Monetary Policy,” *American Economic Review*, February 2023, 113 (2), 548–84.
- Granziera, Eleanora, Vegard H. Larsen, Greta Meggiorini, and Leonardo Melosi**, “Speaking of Inflation: The Influence of Fed Speeches on Expectations,” 2025. Working Paper.
- Grotteria, Marco and Jules van Binsbergen**, “Monetary Policy Wedges and the Long-term Liabilities of Households and Firms,” 2025. Working Paper.
- Gürkaynak, Refet S., Brian P. Sack, and Eric T. Swanson**, “Do Actions Speak Louder than Words? The Response of Asset Prices to Monetary Policy Actions and Statements,” *International Journal of Central Banking*, 2005, 1, 55–93.
- Gómez-Cram, Roberto and Marco Grotteria**, “Real-time price discovery via verbal communication: Method and application to FedSpeak,” *Journal of Financial Economics*, 2022, 143 (3), 993–1025.
- Handlan, Amy**, “FedSpeak Matters: Statement Similarity and Monetary Policy Expectations,” 2022. Working Paper.
- , “Text Shocks and Monetary Surprises: Text Analysis of FOMC Statements with Machine Learning,” 2022. Working Paper.
- Hansen, Anne Lundgaard and Sophia Kazinnik**, “Can ChatGPT Decipher FedSpeak?,” 2024. Working Paper.
- Hansen, Stephen and Michael McMahon**, “Shocking language: Understanding the macroeconomic effects of central bank communication,” *Journal of International Economics*, 2016, 99, S114–S133. 38th Annual NBER International Seminar on Macroeconomics.
- , —, and **Andrea Prat**, “Transparency and Deliberation Within the FOMC: A Computational Linguistics Approach,” *The Quarterly Journal of Economics*, 10 2017, 133 (2), 801–870.
- He, Pengcheng, Jianfeng Gao, and Weizhu Chen**, “DeBERTaV3: Improving DeBERTa using ELECTRA-Style Pre-Training with Gradient-Disentangled Embedding Sharing,” *CoRR*, 2023, *abs/2111.09543*.
- , **Xiaodong Liu, Jianfeng Gao, and Weizhu Chen**, “DeBERTa: Decoding-enhanced BERT with Disentangled Attention,” *CoRR*, 2020, *abs/2006.03654*.

- , —, —, and —, “DeBERTa: Decoding-enhanced BERT with Disentangled Attention,” *International Conference on Learning Representations (ICLR)*, 2021.
- Jacobson, Margaret M., Christian Matthes, and Todd B. Walker**, “Temporal Aggregation Bias and Monetary Policy Transmission,” 2026. Forthcoming, *Journal of Political Economy Macroeconomics*.
- Jarocinski, Marek and Peter Karadi**, “Disentangling Monetary Policy, Central Bank Information, and Fed Response to News,” 2025. Working Paper.
- Jorda, Oscar**, “Estimation and Inference of Impulse Responses by Local Projections,” *American Economic Review*, March 2005, 95 (1), 161–182.
- Kuttner, Kenneth N.**, “Monetary Policy Surprises and Interest Rates: Evidence from the Fed Funds Futures Market,” *Journal of Monetary Economics*, 2001, 47, 523–544.
- Kypraios, Emmanuel, Juan Arismendi-Zambrano, and Alessia Paccagnini**, “Moderating Uncertainty with Sentiment: The Case of the Federal Reserve Chair Communication,” *Academy of Management Proceedings*, 2024, 2024 (1), 14009.
- Lamla, Michael J. and Dmitri V. Vinogradov**, “Central bank announcements: Big news for little people?,” *Journal of Monetary Economics*, 2019, 108, 21–38.
- Lucca, David O. and Francesco Trebbi**, “Measuring Central Bank Communication: An Automated Approach with Application to FOMC Statements,” 2011. Working Paper.
- Miranda-Agrippino, Silvia and Giovanni Ricco**, “The Transmission of Monetary Policy Shocks,” *American Economic Journal: Macroeconomics*, July 2021, 13 (3), 74–107.
- and —, “Identification with External Instruments in Structural VARs,” *Journal of Monetary Economics*, 2023, 135 (C), 1–19.
- Mumtaz, Haroon, Jumana Saleheen, and Roxane Spitznagel**, “Keep It Simple: Central Bank Communication and Asset Prices,” 2024. Working Paper.
- Munday, Tim and James Brookes**, “Mark my Words: the Transmission of Central Bank Communication to the General Public via the Print Media,” 2021. Working Paper.
- Nakamura, Emi and Jón Steinsson**, “High-Frequency Identification of Monetary Non-Neutrality: The Information Effect,” *Quarterly Journal of Economics*, 2018, 133, 1283–1330.
- Narain, Namrata and Kunal Sangani**, “The Market Impact of Fed Communications: The Role of the Press Conference,” 2026. Forthcoming, *International Journal of Central Banking*.
- Osovska, Ewelina and Piotr Wojcik**, “Predicting the reaction of financial markets to Federal Open Market Committee post-meeting statements,” *Digital Finance*, 2024, 6, 145–175.

- Parle, Conor**, “The financial market impact of ECB monetary policy press conferences — A text based approach,” *European Journal of Political Economy*, 2022, 74, 102230.
- Pfeifer, Moritz and Vincent P. Marohl**, “CentralBankRoBERTa: A fine-tuned large language model for central bank communications,” *The Journal of Finance and Data Science*, 2023, 9, 100114.
- Picault, Matthieu and Thomas Renault**, “Words are not all created equal: A new measure of ECB communication,” *Journal of International Money and Finance*, 2017, 79, 136–156.
- Ramey, V.A.**, “Chapter 2 - Macroeconomic Shocks and Their Propagation,” in John B. Taylor and Harald Uhlig, eds., *Handbook of Macroeconomics*, Vol. 2, Elsevier, 2016, pp. 71–162.
- Rosa, Carlo**, “Fedspeak: Who Moves U.S. Asset Prices,” 2016.
- Schmanski, Bennett, Chiara Scotti, Clara Vega, and Hedi Benamar**, “Fed Communication, News, Twitter, and Echo Chambers,” 2023. Working Paper.
- Sekkel, Rodrigo and Xu Zhan**, “Speeches, Press Conferences and Minutes: The International Transmission of Federal Reserve Communication,” 2024. Working Paper.
- Shah, Agam, Suvan Paturi, and Sudheer Chava**, “Trillion Dollar Words: A New Financial Dataset, Task & Market Analysis,” 2023.
- Silva, Thiago Christiano, Kei Moriya, and Romain M Veyrune**, “From Text to Quantified Insights - A Large-Scale LLM Analysis of Central Bank Communication,” 2025. Working Paper.
- Stock, James and Mark Watson**, “Identification and Estimation of Dynamic Causal Effects in Macroeconomics Using External Instruments,” *Economic Journal*, 2018, 128 (610), 917–948.
- Swanson, Eric T. and Vishuddi Jayawickrema**, “Speeches by the Fed Chair are more Important than FOMC Announcements: an Improved High-Frequency Measure of U.S. Monetary Policy Shocks,” 2024. Working Paper.
- Taylor, John B.**, “The robustness and efficiency of monetary policy rules as guidelines for interest rate setting by the European central bank,” *Journal of Monetary Economics*, 1999, 43 (3), 655–679.
- Tobback, Ellen, Stefano Nardelli, and David Martens**, “Between Hawks and Doves: Measuring Central Bank Communication,” 2017. Working Paper.
- Vaswani, Ashish, Noam Shazeer, Niki Parmar, Jakob Uszkoreit, Llion Jones, Aidan N Gomez, Łukasz Kaiser, and Illia Polosukhin**, “Attention is All You Need,” *Advances in Neural Information Processing Systems*, 2017, 30, 5998–6008.
- Wessel, David and Sam Boocker**, “Grading Fed communications: A 2024 survey of Fed watchers,” 2024. Brookings Economic Research, <https://www.brookings.edu/articles/grading-fed-communications-a-2024-survey-of-fed-watchers/>.

A APPENDIX: HIGH-FREQUENCY MARKET REACTIONS

A.1 DATES AND TIMES We determine the dates and times of the monetary policy announcements following Swanson and Jayawickrema (2023). In particular, we collected the dates, times, and high-frequency, intraday asset price changes from June 1999 to April 2025 for: i) unscheduled and scheduled FOMC statements, ii) speeches by the Federal Reserve chair, iii) Congressional testimony by the Federal Reserve Chair, and iv) post-FOMC-meeting press conferences from January 2011 to April 2025. The start and end times of Congressional testimony start times were confirmed and end times obtained from Gordon and Lunsford (2023).

FOMC Statements and Minutes Releases

We collected the schedules of FOMC announcements and meeting minutes releases from June 1995 to April 2025 through the Federal Reserve Board's public website. The Federal Reserve announces decisions on monetary policy or regulations to the press, and all such statements can be found in the press release section of the official website. The dates and times when FOMC statements were released and when the minutes of each meeting were made public are also available from 2006 onward.

Schedules for FOMC statements and minutes releases prior to 2006 can be found in the archives of the Federal Reserve Board, but these only show the release dates without exact times. For events from 1995 to 2005, we obtained the dates through the website and supplemented the timing information from Gürkaynak et al. (2005) and Swanson and Jayawickrema (2024). Any remaining missing information was verified through Factiva searches of news archives.

FOMC statements are issued on the last day of the meeting. From 1999 to 2010, with a few exceptions, these statements were announced at 2:15 PM Eastern Time. In 2011, the introduction of post-FOMC press conferences led to changes in this timing. For the two years from 2011 to 2012, if a post-meeting press conference occurred, the FOMC issued a press release at 12:30 PM Eastern Time; for meetings without press conferences, the Fed maintained the 2:15 PM release time. From 2013 onwards, the schedule was adjusted, and the FOMC generally announced its monetary policy decisions at 2:00 PM Eastern Time. We drop all notational meetings including August 27, 2000, October 4, 2019, March 11, 2008, and August 10, 2007. Following much of the literature, we drop the meetings after 9/11. We drop the March 15, 2020 unscheduled meeting as it occurred on a Sunday and it is difficult to source trades.

Post-FOMC press conferences

All materials related to post-FOMC-meeting press conferences are available on the Federal Reserve's official website. These press conferences began in April 2011, so unlike other events, the data exists only from 2011 onwards. Currently, press conferences are held after almost every FOMC meeting, resulting in eight scheduled press conferences per year. However, in the early years (2011 to 2012), press conferences were held every other meeting, occurring four times annually. During our sample period from April 2011 to May 2024, a total of 75 press conferences were held.

From 2011 to 2012, the press conferences started at 2:15 PM, and from 2013, they began at 2:30 PM. The Federal Reserve's website posts videos of press conferences along with transcripts. The duration of each conference can be verified through these videos. The press conferences last between 14 minutes at

the shortest and 76 minutes at the longest, with an average duration of 53 minutes.

Speeches by the Federal Reserve Chair

The schedules for speeches and Congressional testimonies of the Fed Chair are publicly available on the Federal Reserve Board's official website from 2006 onward. The website posts transcripts of the speeches, which include the time each document was released to the public. We extract the timing information from these transcripts. However, transcripts were not posted for speeches and Congressional testimony from 2006 to 2009, making it impossible to confirm precise timing. Therefore, for speeches and testimonies prior to 2009, we verified the timing data using the FRASER library of the Federal Reserve Bank of St. Louis. Additionally, speech materials from before 2006 that are not available on the Federal Reserve's website can also be found in FRASER. We collected data from 1999 to 2009 through FRASER.

FRASER contains transcripts of all speeches and testimonies by the Federal Reserve Chair and include the start time of the speech, from which we were able to extract the timing information. Occasionally, for Congressional testimonies rather than regular speeches, the time may not be included. In these cases, we verified the testimony time through news sources using Factiva searches.

A.2 MARKET REACTIONS: PRESS CONFERENCE VS. FOMC STATEMENT Figure A.1 plots the market reactions for the first year of interest rate futures, *EDSR1* to *EDSR4*.

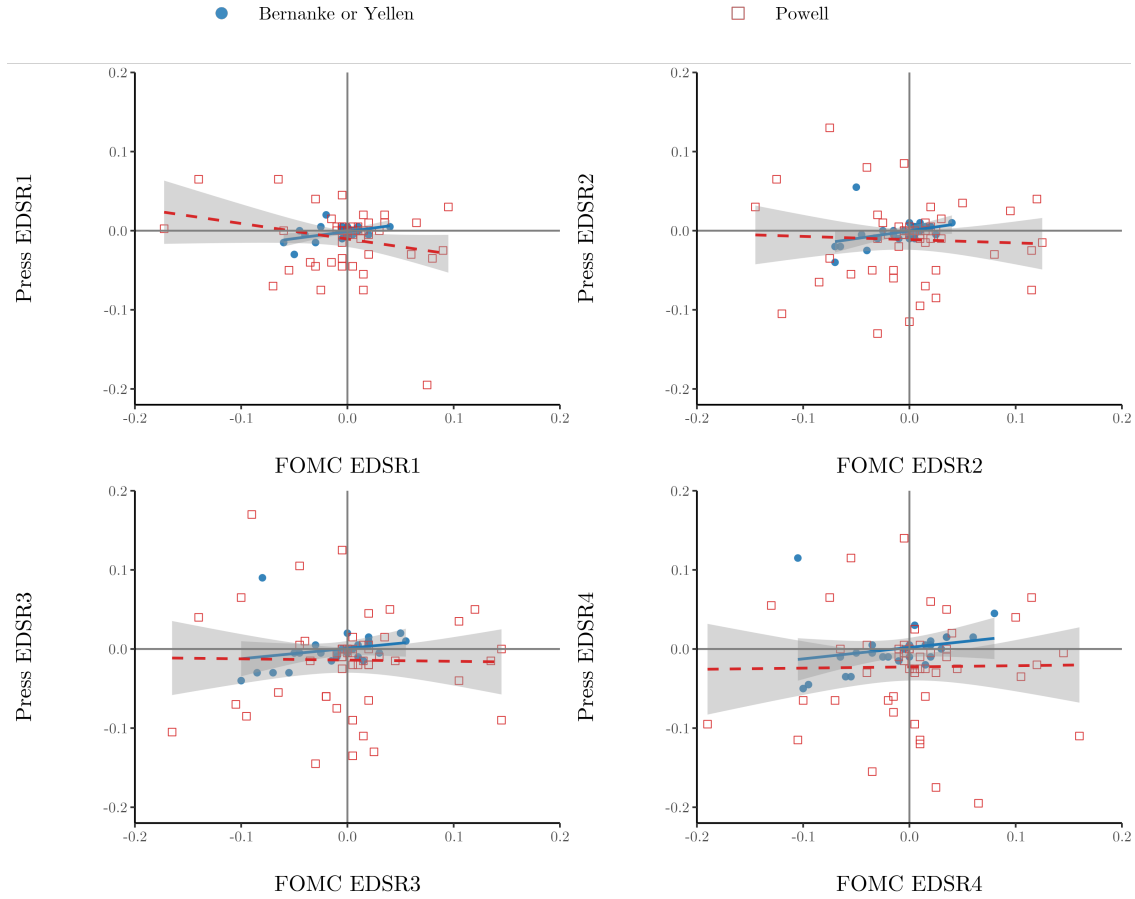
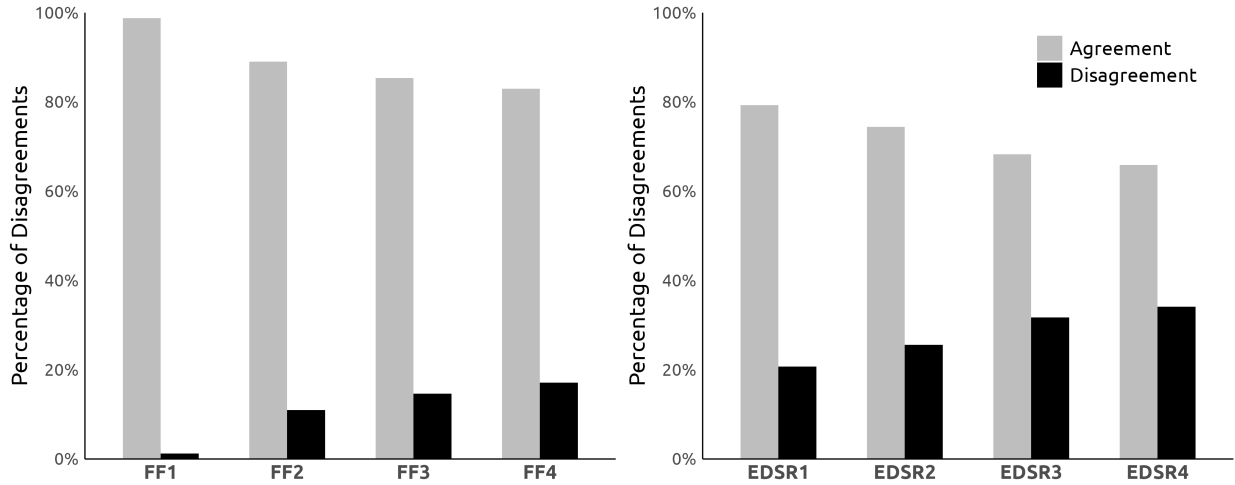


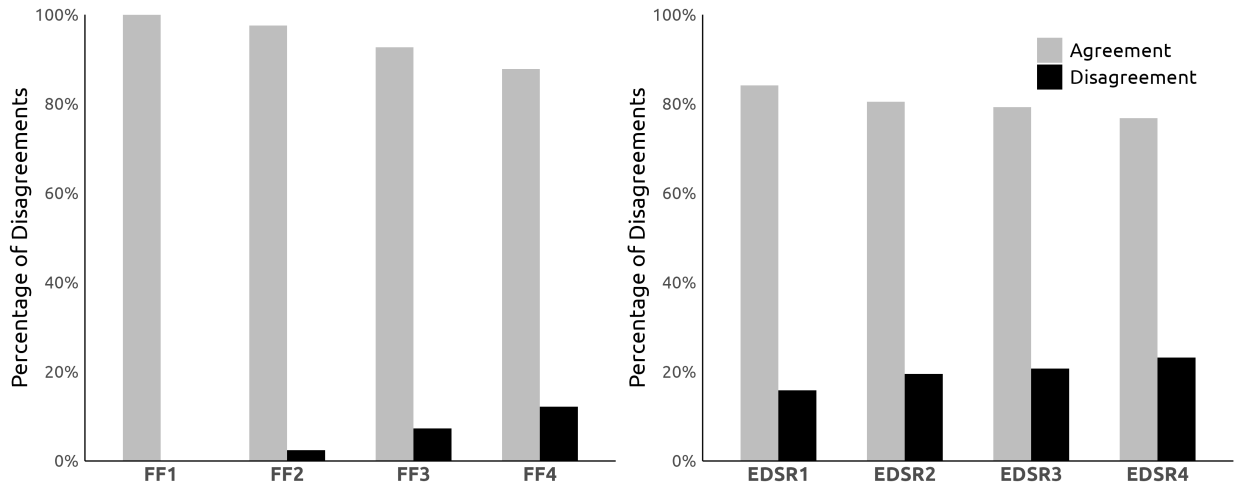
Figure A.1: Market reactions to the press conference vs. FOMC statement, basis points.

The figure shows the regression $\text{Market Reaction}_{t,\text{Press}} = \alpha + \text{Market Reaction}_{t,\text{FOMC}} + \epsilon_t$ by Fed chairs for the 1st Eurodollar/2nd SOFR future through the 4th Eurodollar/5th SOFR future. Bernanke or Yellen is April 2011 to January 2018 and Powell is from February 2018 to April 2025. Shaded bands are 90% error bands.

A.3 MARKET DISAGREEMENTS Figure A.2 shows that the rate of disagreement is increasing in the maturity of interest rate futures. The first expiring federal funds future *FF1* has no disagreements, as changes in this future are directly linked to the federal funds rate and it is therefore not affected by the press conference. By contrast, *EDSR4* has about one-fifth to one-third of all FOMC statement/press conference pairs in disagreeing in the sign of the market surprise.



(a) Three basis point threshold



(b) Five basis point threshold

Figure A.2: Disagreement in market reactions to FOMC statements and press conferences

A disagreement is an intraday change that is more than three or five basis points with different signs for an FOMC statement and a press conference. An agreement is all other observations.

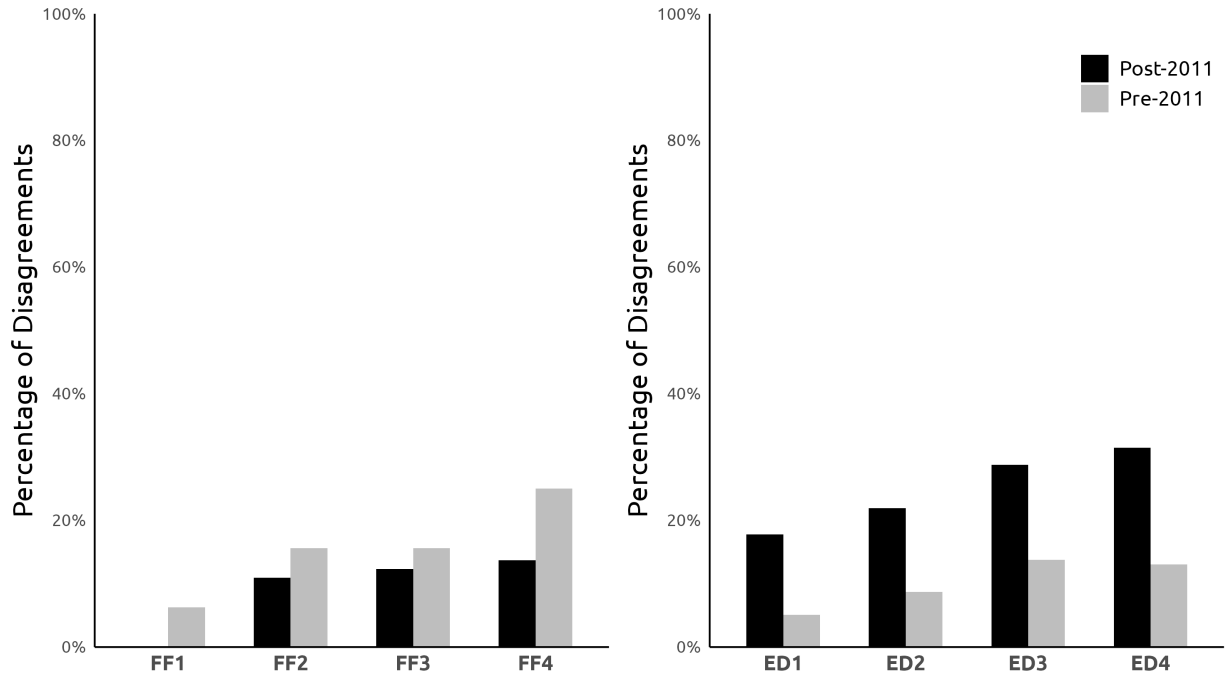


Figure A.3: Comparing disagreements in market reactions for speeches and the press conferences

Pre-2011 is the period before the introduction of the press conference in April 2011. A pre-2011 disagreement is a more than three basis point intraday change surrounding a speech by the Chair in the week following an FOMC statement that is different in sign from the intraday change around the preceding FOMC statements. A post-2011 disagreement is an intraday change that is more than three or five basis points with different signs for an FOMC statement and a press conference. An agreement is all other observations. The pre-2011 sample has 32 observations and the post-2011 sample has 76 observations.

B APPENDIX: SENTIMENT SCORES

B.1 RAW SENTIMENT SCORES This appendix shows the sentiment scores of FOMC statements, press conferences, Congressional testimonies, and Fed Chair speeches. Figures B.1 and B.2 show the Fed's statutory goals—inflation and unemployment—along with its main instrument in the form of monetary policy. The figure shows that the share of text devoted to these topics and the hawkish or dovish sentiment varies across time. The prevalence of both hawkish and dovish sentiment varies across type of communication and is discussed in the main text.

To assure that the LLM is capturing the Fed's monetary policy stance we note a few episodes. First, the Fed's 2022-2024 tightening cycle aimed to bring inflation back to its 2 percent policy objective and figures B.1 and B.2 show that hawkish sentiment about inflation consisted of about 40 percent of the FOMC statement communication, the highest hawkish inflation sentiment recorded in our sample. Second, from 2008 to about 2015 about 30 percent of the FOMC statement focused on dovish unemployment sentiment, which is consistent with the Fed's objective of returning the economy to full employment. Finally, monetary policy is detected as hawkish during the 2015-2018 and 2022-2024 tightening cycles.

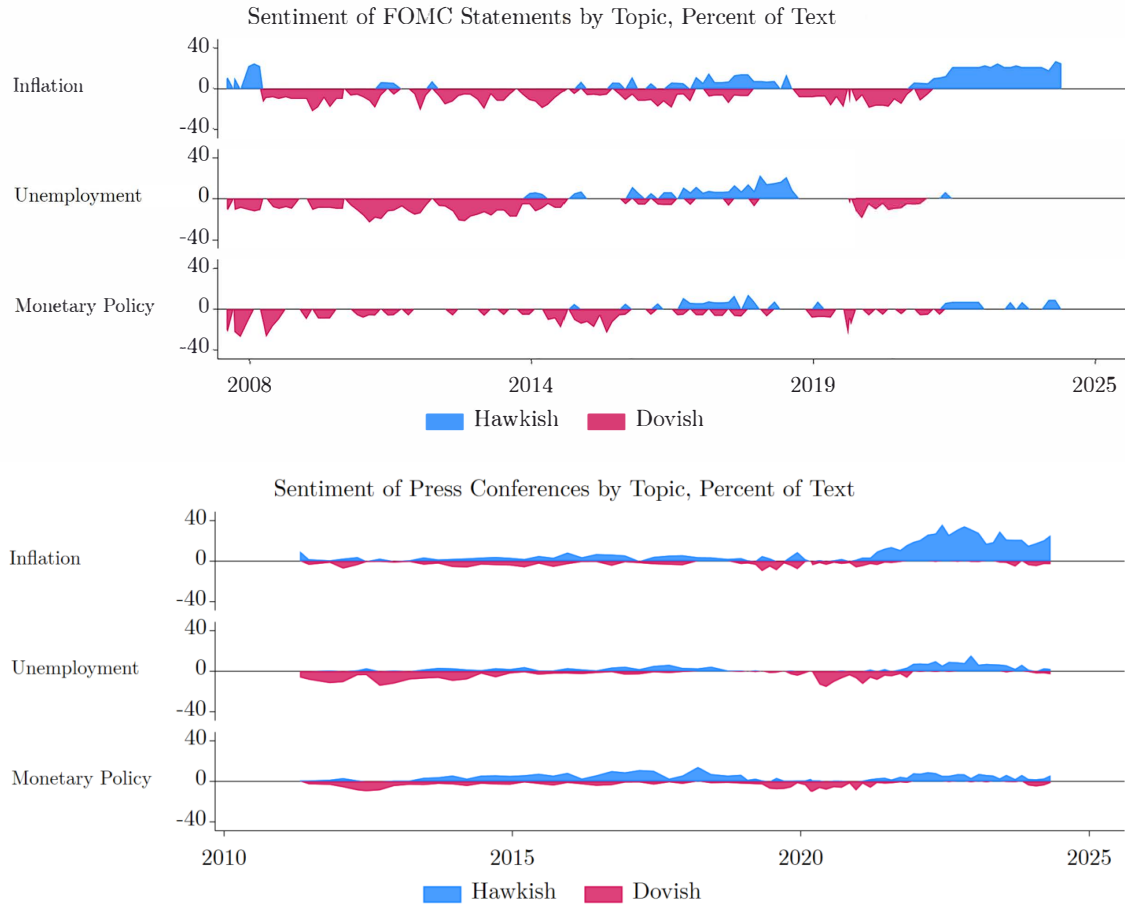


Figure B.1: Sentiment by topic, percent of text.

Hawkish denotes restrictive sentiment and dovish denotes accommodative, neutral is neither. The Y-axis values indicate the percentage of the text that is devoted to that topic.

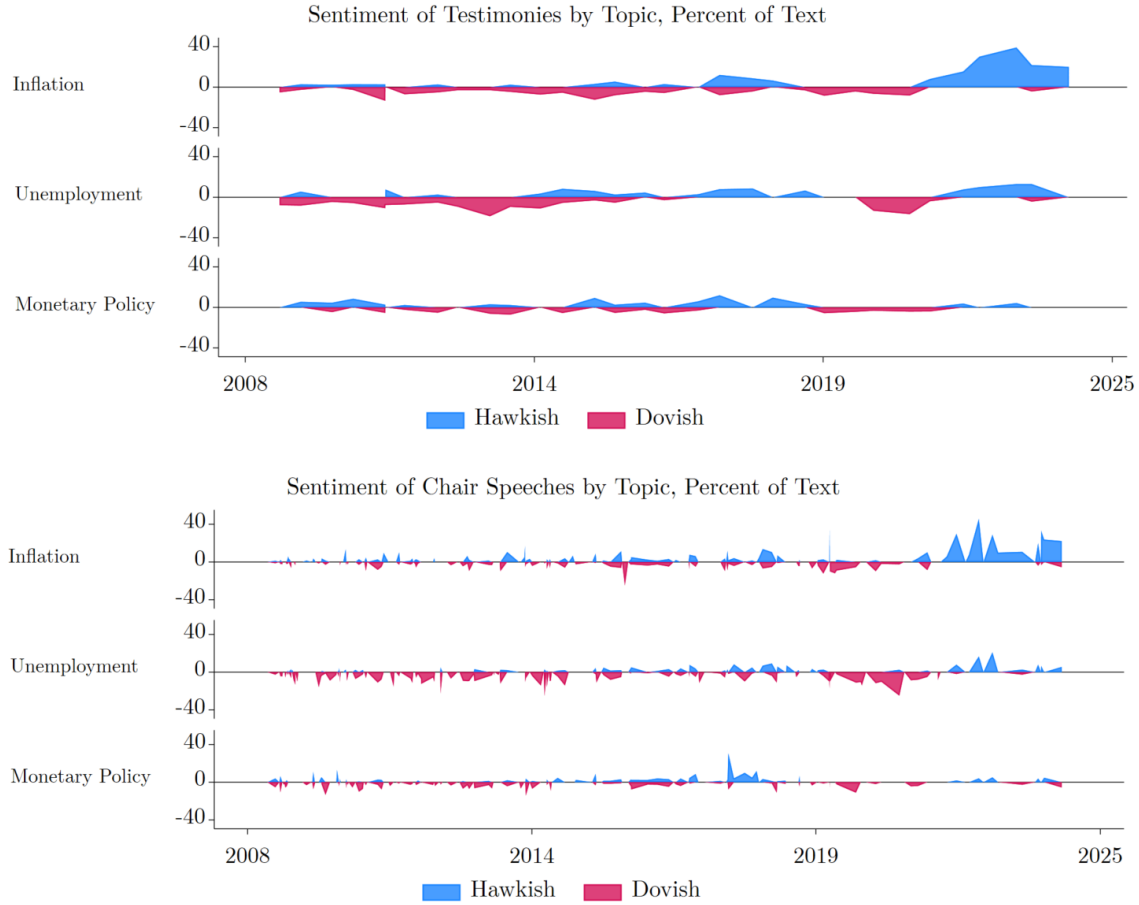


Figure B.2: Sentiment by topic, percent of text.

Hawkish denotes restrictive sentiment and dovish denotes accommodative, neutral is neither. The Y-axis values indicate the percentage of the text that is devoted to that topic.

B.2 NET SENTIMENT AND MONETARY POLICY STANCE The figure below is the same as figure 4 in the main text except for the top panel that plots sentence level net sentiment for the FOMC statement instead of paragraph level net sentiment.

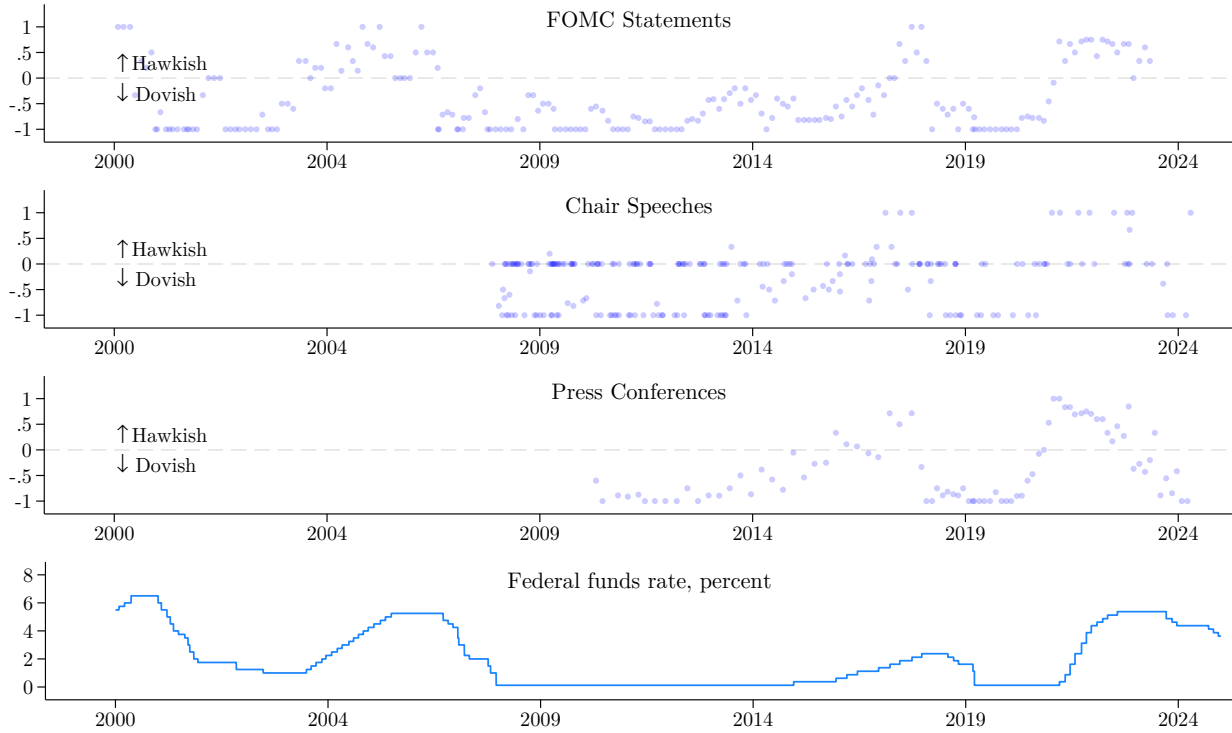


Figure B.3: Net sentiment scores at the sentence level for the FOMC statement and the paragraph level for the press conference and speeches along with the target federal funds rate.

Hawkish sentiment pertains to tight policy and dovish to loose. For communication type $j \in \{\text{Press conference, Speech, FOMC statements}\}$, Net Sentiment $_{j,t} = (\text{Hawkish}_{j,t} - \text{Dovish}_{j,t}) / (\text{Hawkish}_{j,t} + \text{Dovish}_{j,t})$. The federal funds rate is the target after each FOMC meeting, see Appendix F for details on its construction.

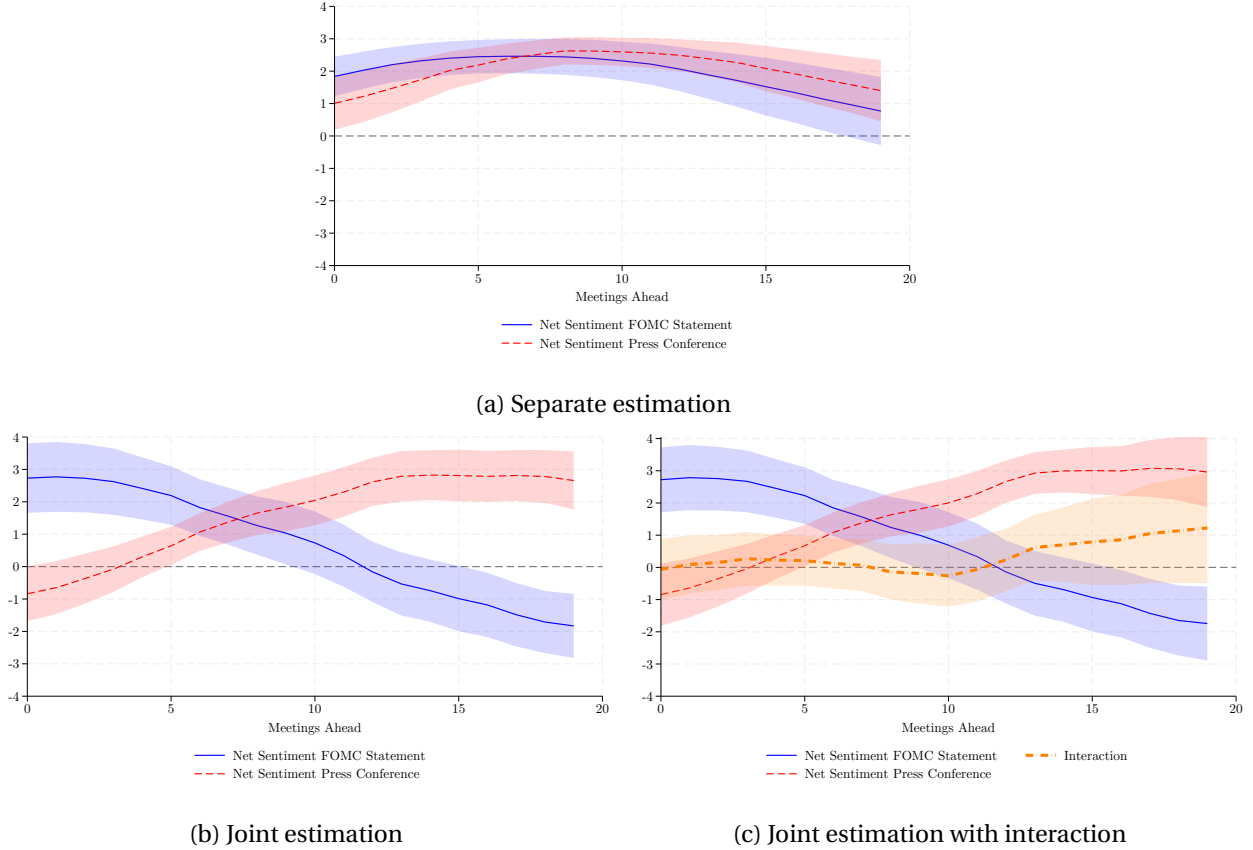


Figure B.4: Impulse response of the federal funds rate to net sentiment with sentence-level sentiment for the statement, 90% error bands with two Newey-West lags.

Panel B.4a plots $\hat{\beta}_1^h$ from the local projection, $\text{Federal Funds Rate}_{t+h} = \beta_0^h + \beta_1^h \text{Net Sentiment}_{j,t} + \epsilon_{j,t}$ for $j \in \{\text{FOMC statement sentence-level, Press}\}$. Panel B.4b plots $\hat{\beta}_1^h$ and $\hat{\beta}_2^h$ from the local projection, $\text{Federal Funds Rate}_{t+h} = \beta_0^h + \beta_1^h \text{Net Sentiment Sentence-level}_{FOMC,t} + \beta_2^h \text{Net Sentiment}_{Press,t} + \epsilon_t$. Panel B.4c plots $\{\hat{\beta}_1^h, \hat{\beta}_2^h, \hat{\beta}_3^h\}$ from $\text{Federal Funds Rate}_{t+h} = \beta_0^h + \beta_1^h \text{Net Sentiment Sentence-level}_{FOMC,t} + \beta_2^h \text{Net Sentiment}_{Press,t} + (\text{Net Sentiment}_{FOMC,t} \times \text{Net Sentiment}_{Press,t}) + \epsilon_t$. Where t is the FOMC meeting frequency and $h = 0, \dots, 20$. $\text{Net Sentiment}_{j,t} = (\text{Hawkish}_{j,t} - \text{Dovish}_{j,t}) / (\text{Hawkish}_{j,t} + \text{Dovish}_{j,t})$

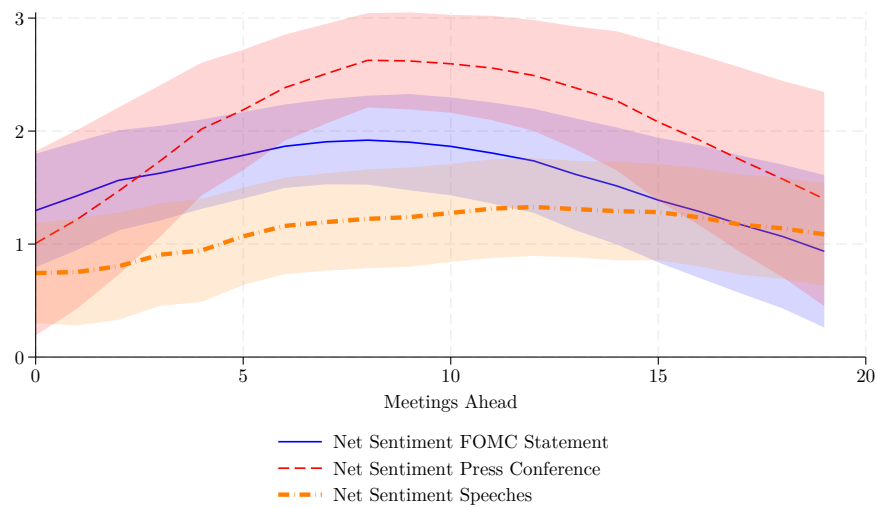


Figure B.5: Impulse response of the federal funds rate to net sentiment with speeches, 90% error bands with two Newey-West lags.

The figure plots $\hat{\beta}_1^h$ from the local projection, Federal Funds Rate $_{t+h} = \beta_0^h + \beta_1^h \text{Net Sentiment}_{j,t} + \epsilon_{j,t}$ in equation (8). Where t is the FOMC meeting frequency, $h = 0, \dots, 20$, and $j \in \{\text{FOMC statement, Press, Chair Speeches}\}$. Net Sentiment $_{j,t} = (\text{Hawkish}_{j,t} - \text{Dovish}_{j,t}) / (\text{Hawkish}_{j,t} + \text{Dovish}_{j,t})$

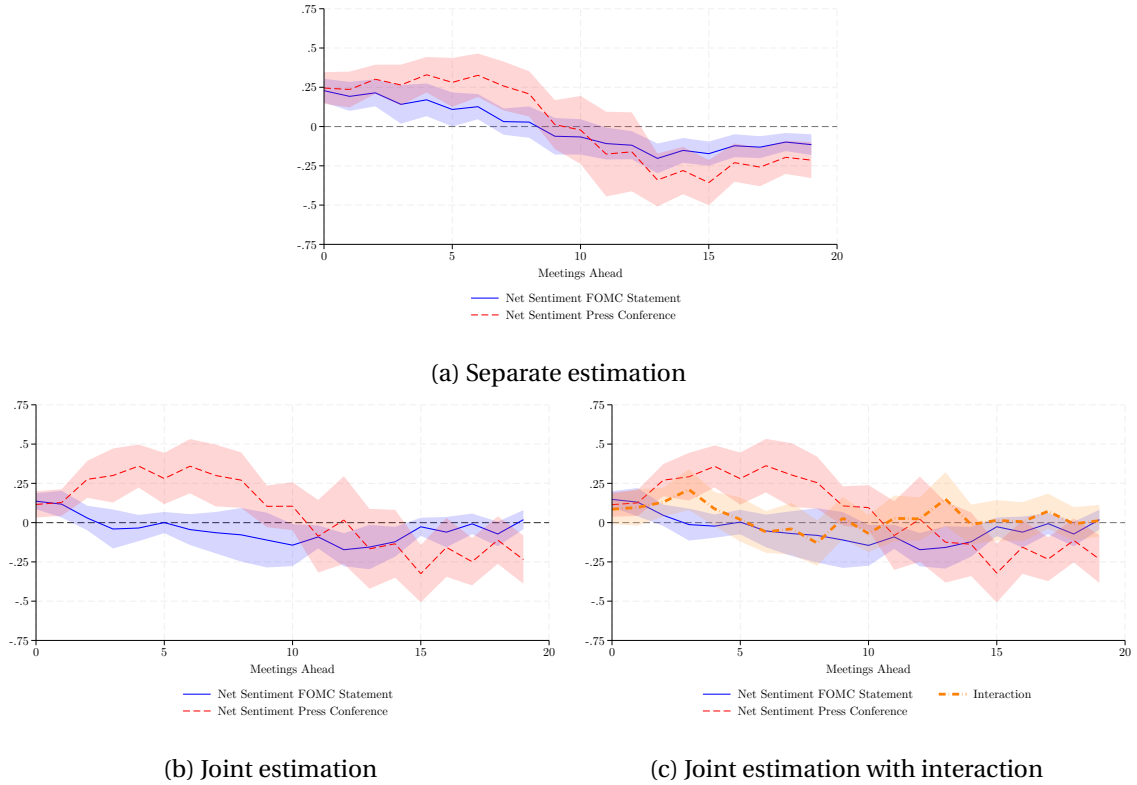


Figure B.6: Impulse response of the federal funds rate to net sentiment with inertia, 90% error bands with two Newey-West lags.

Panel B.6a plots $\hat{\beta}_1^h$ from the local projection, $\text{Federal Funds Rate}_{t+h} = \beta_0^h + \alpha^h \text{Federal Funds Rate}_{t-1+h} + \beta_1^h \text{Net Sentiment}_{j,t} + \epsilon_{j,t}$ for $j \in \{\text{FOMC statement, Press}\}$. Panel B.6b plots $\hat{\beta}_1^h$ and $\hat{\beta}_2^h$ from the local projection, $\text{Federal Funds Rate}_{t+h} = \beta_0^h + \alpha^h \text{Federal Funds Rate}_{t-1+h} + \beta_1^h \text{Net Sentiment}_{FOMC,t} + \beta_2^h \text{Net Sentiment}_{Press,t} + \epsilon_t$. Panel B.6c plots $\{\hat{\beta}_1^h, \hat{\beta}_2^h, \hat{\beta}_3^h\}$ from $\text{Federal Funds Rate}_{t+h} = \beta_0^h + \alpha^h \text{Federal Funds Rate}_{t-1+h} + \beta_1^h \text{Net Sentiment}_{FOMC,t} + \beta_2^h \text{Net Sentiment}_{Press,t} + (\text{Net Sentiment}_{FOMC,t} \times \text{Net Sentiment}_{Press,t}) + \epsilon_t$. Where t is the FOMC meeting frequency and $h = 0, \dots, 20$. $\text{Net Sentiment}_{j,t} = (\text{Hawkish}_{j,t} - \text{Dovish}_{j,t}) / (\text{Hawkish}_{j,t} + \text{Dovish}_{j,t})$

B.3 DAILY LOCAL PROJECTIONS We use local projections (Jorda, 2005) as featured in Jacobson et al. (2026) to estimate the impulse responses of the federal funds rate to net sentiment at a daily frequency. For the daily specification, let Federal Funds Rate $_{t+h}$ be the daily value of the target federal funds rate as described in Appendix F, Net Sentiment $_{j,t}$ be net sentiment—set to zero on days without a monetary event and left unstandardized—for $j \in \{\text{FOMC statement, Press conference, Chair speech}\}$, and x_{t-1} be the vector of controls, which are 60 lags of the federal funds rate to capture inertia. The sample is from 2011 to April 2025 as the first press conference was April 2011. We estimate

$$\text{Federal Funds Rate}_{t+h} = \beta_0^h + \Gamma^h x_{t-1} + \beta_1^h \text{Net Sentiment}_{j,t} + e_{t,j}^h, \quad e_{t,j}^h \sim N(0, \sigma_j^h)$$

with robust heteroskedasticity and autocorrelation consistent (HAC) standard errors. Estimates are obtained via the Canova and Ferroni (2022) toolbox with 20,000 draws.

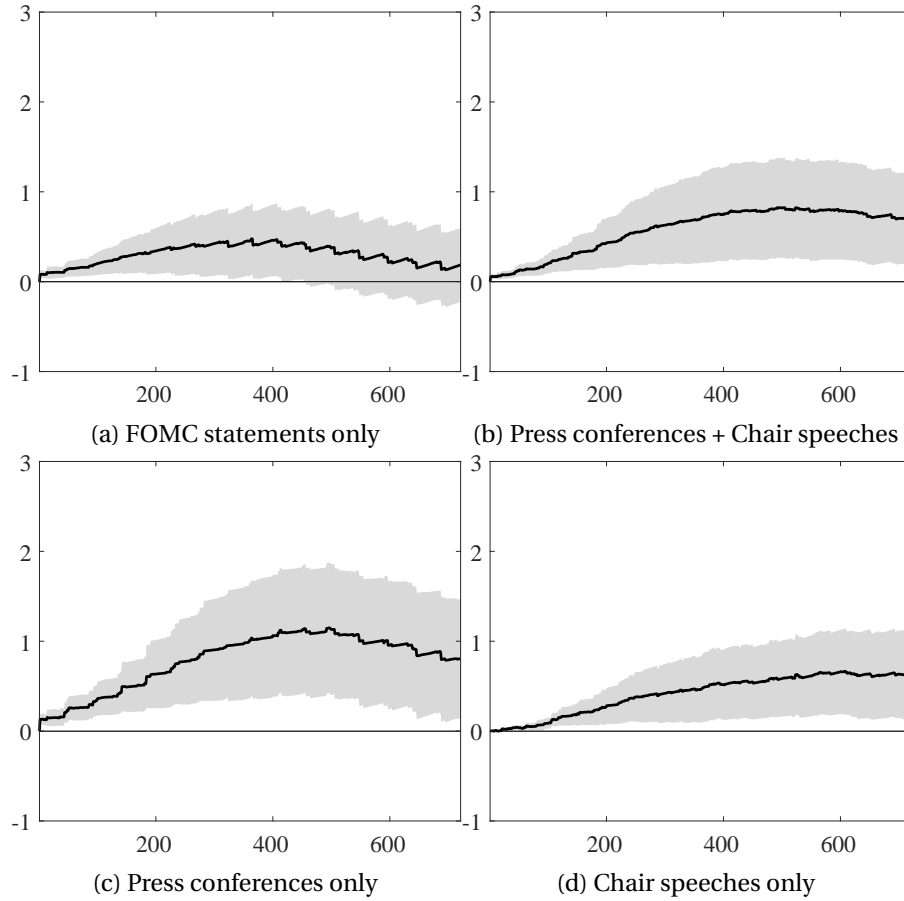


Figure B.7: Impulse response of the daily target federal funds rate to net sentiment estimated separately for each type of communication, 90% HAC error bands. X-axis is days.

The figure plots $\hat{\beta}_1^h$ from the local projection, $\text{Federal Funds Rate}_{t+h} = \beta_0^h + \Gamma^h x_{t-1} + \beta_1^h \text{Net Sentiment}_{j,t} + e_{t,j}^h$ for $j \in \{\text{FOMC statements, Press conferences + Chair speeches, Press only, Chair speeches only}\}$. x_{t-1} contains 60 lags of the federal funds rate. Press conferences+ Chair speeches is constructed by summing up the net sentiment of press conferences and chair speeches. Because they necessarily occur on different days due to the communications blackout period surround FOMC meetings, these series can be summed at daily frequency without additional adjustments. Where t is days and $h = 0, \dots, 720$ days (≈ 2 years). $\text{Net Sentiment}_{j,t} = (\text{Hawkish}_{j,t} - \text{Dovish}_{j,t}) / (\text{Hawkish}_{j,t} + \text{Dovish}_{j,t})$.

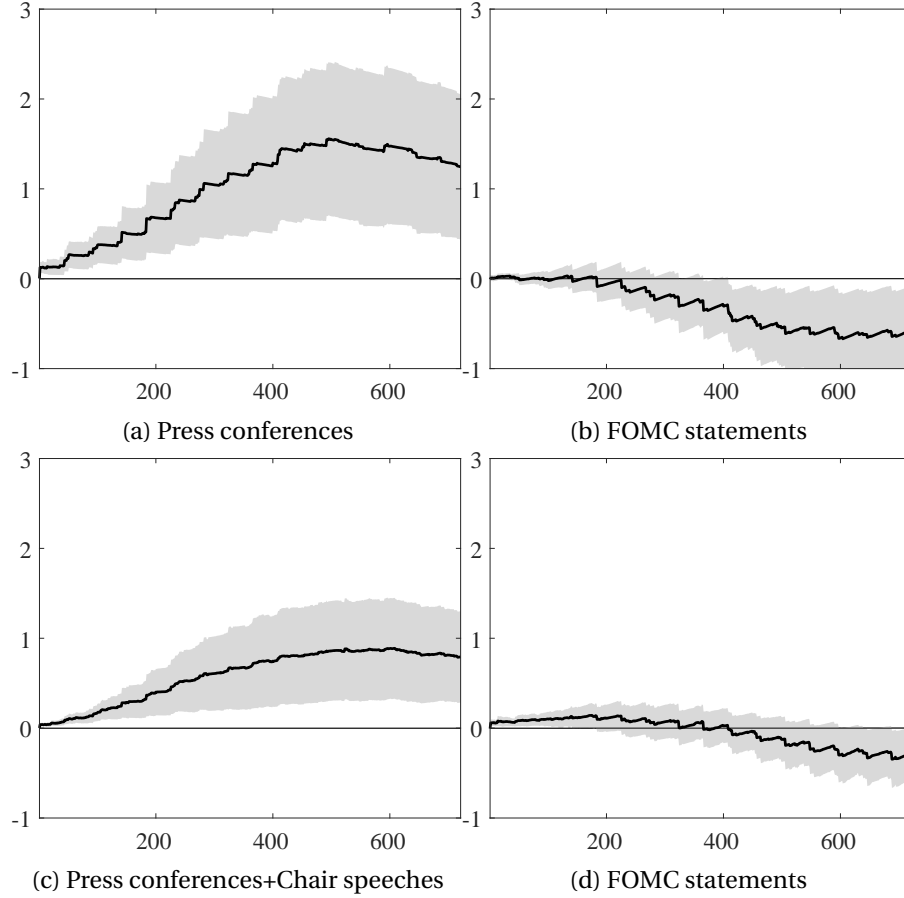


Figure B.8: Impulse response of the daily target federal funds rate to net sentiment jointly estimated, 90% HAC error bands. X-axis is days.

x_{t-1} contains 60 lags of the federal funds rate. The top row of the figure plots $\hat{\beta}_1^h$ and $\hat{\beta}_2^h$ in panels B.8a and B.8b, respectively, from the local projection $\text{Federal Funds Rate}_{t+h} = \beta_0^h + \Gamma^h x_{t-1} + \beta_1^h \text{Net Sentiment}_{\text{Press},t} + \beta_2^h \text{Net Sentiment}_{\text{FOMC},t} + e_{t,j}^h$. The bottom row plots $\hat{\beta}_1^h$ and $\hat{\beta}_2^h$ in panels B.8c and B.8d, respectively, from the local projection $\text{Federal Funds Rate}_{t+h} = \beta_0^h + \Gamma^h x_{t-1} + \beta_1^h \text{Net Sentiment}_{\text{Press+Chair speeches},t} + \beta_2^h \text{Net Sentiment}_{\text{FOMC},t} + e_{t,j}^h$. Press conferences+ Chair speeches is constructed by summing up the net sentiment of press conferences and chair speeches. Because they necessarily occur on different days due to the communications blackout period surround FOMC meetings, these series can be summed at daily frequency without additional adjustments. Where t is days and $h = 0, \dots, 720$ days (≈ 2 years). $\text{Net Sentiment}_{j,t} = (\text{Hawkish}_{j,t} - \text{Dovish}_{j,t}) / (\text{Hawkish}_{j,t} + \text{Dovish}_{j,t})$.

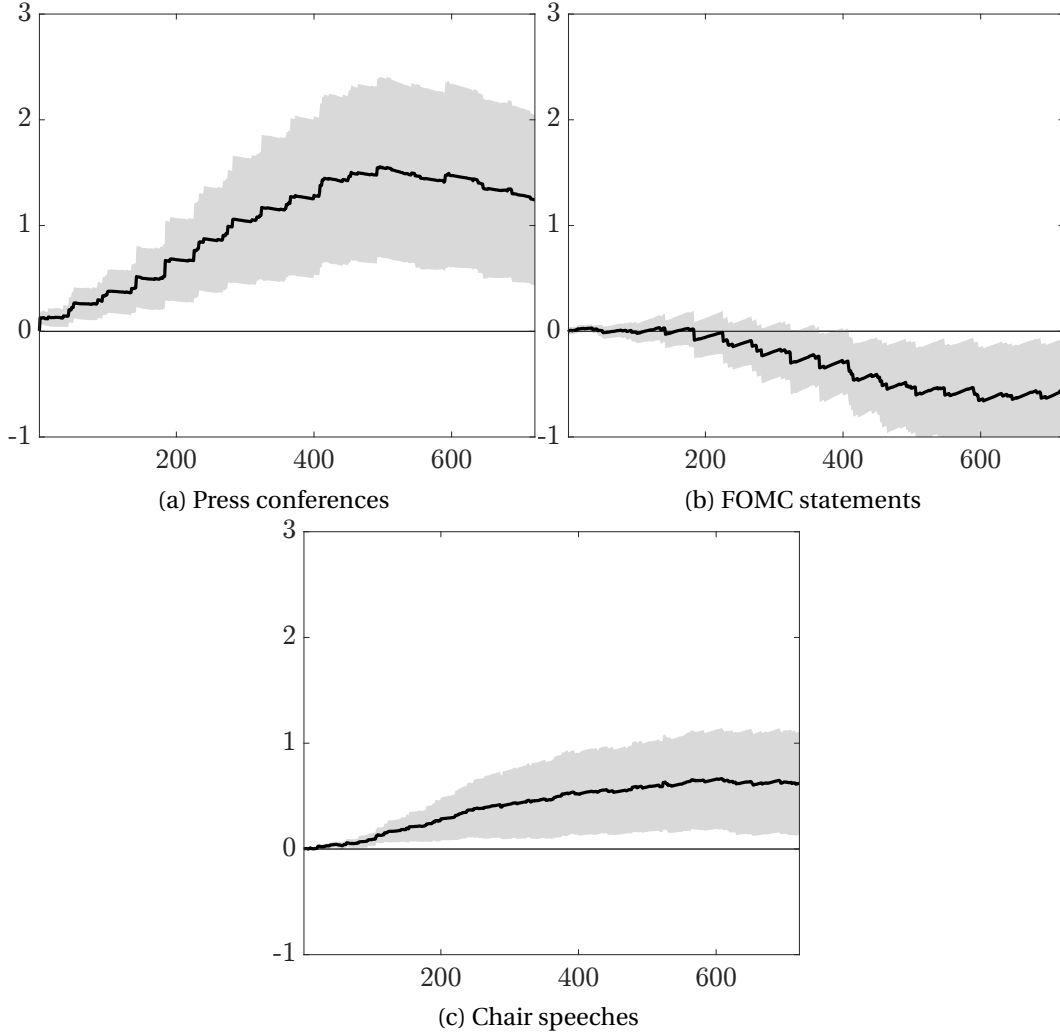


Figure B.9: Impulse response of the daily target federal funds rate to net sentiment jointly estimated, 90% HAC error bands. X-axis is days.

x_{t-1} contains 60 lags of the federal funds rate. The figure plots $\{\hat{\beta}_1^h, \hat{\beta}_2^h, \hat{\beta}_3^h\}$ in panels B.9a, B.9b, and B.9c, respectively, from the local projection Federal Funds Rate $_{t+h} = \beta_0^h + \Gamma^h x_{t-1} + \beta_1^h \text{Net Sentiment}_{Press,t} + \beta_2^h \text{Net Sentiment}_{FOMC,t} + \beta_3^h \text{Net Sentiment}_{Chair\ speeches,t} + e_{t,j}^h$. Where t is days and $h = 0, \dots, 720$ days (≈ 2 years). Net Sentiment $_{j,t} = (\text{Hawkish}_{j,t} - \text{Dovish}_{j,t}) / (\text{Hawkish}_{j,t} + \text{Dovish}_{j,t})$.

C APPENDIX: MARKET REACTIONS AND SENTIMENT SCORES

C.1 MARKET REACTION VS. SENTIMENT SCORES Figure C.1 shows estimates of equation (16) for dovish and hawkish scores as well as EDSR1-EDSR3. All of these results show that the press conference stands out for the strength of the relationship between hawkish sentiment and market reactions.

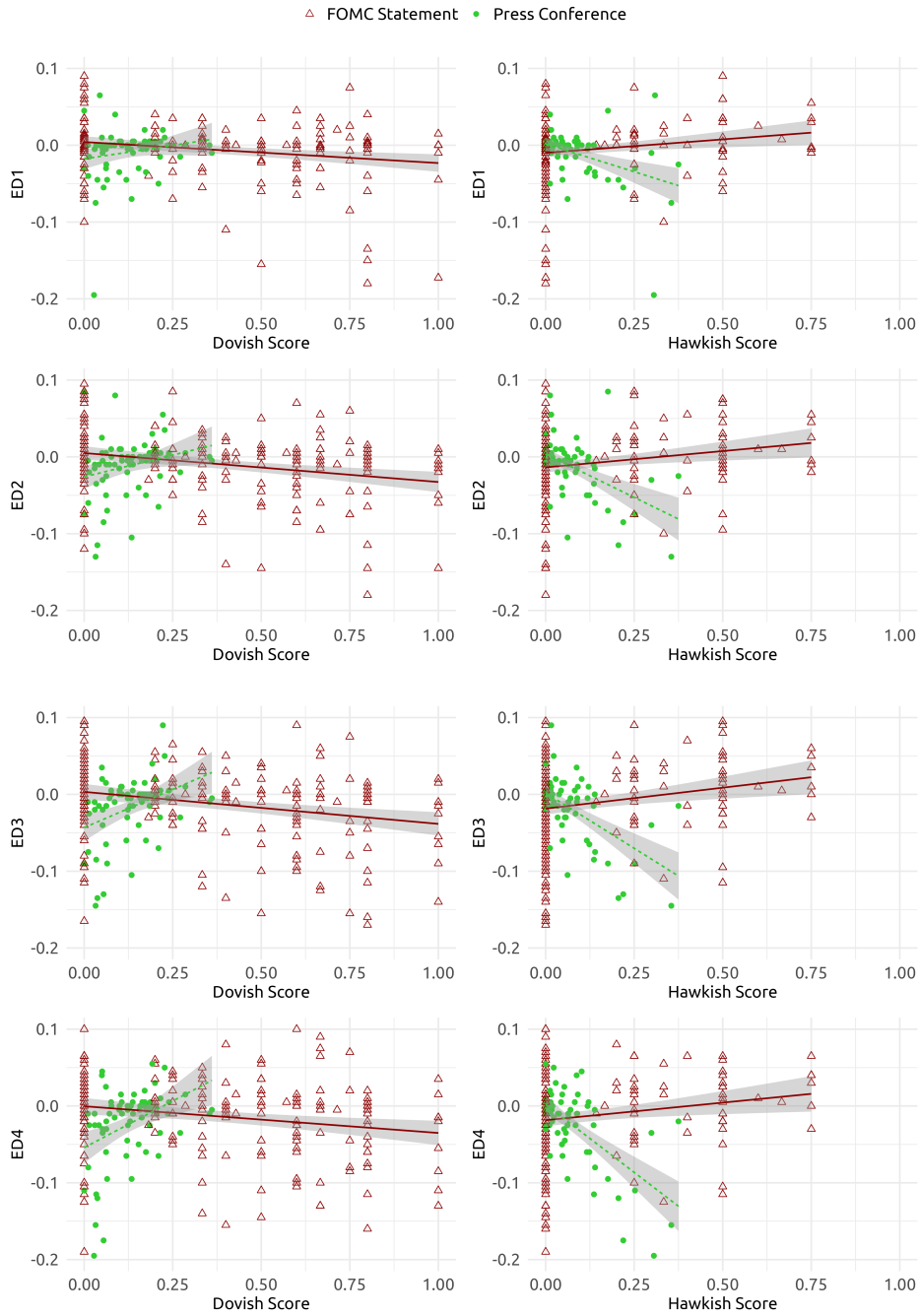


Figure C.1: Market reactions vs. Sentiment

Figure C.2 shows that many of the observations driving the strong relationship between hawkish sentiment and market surprises are those where the market reaction to the press conference is different from that of its corresponding FOMC statement.

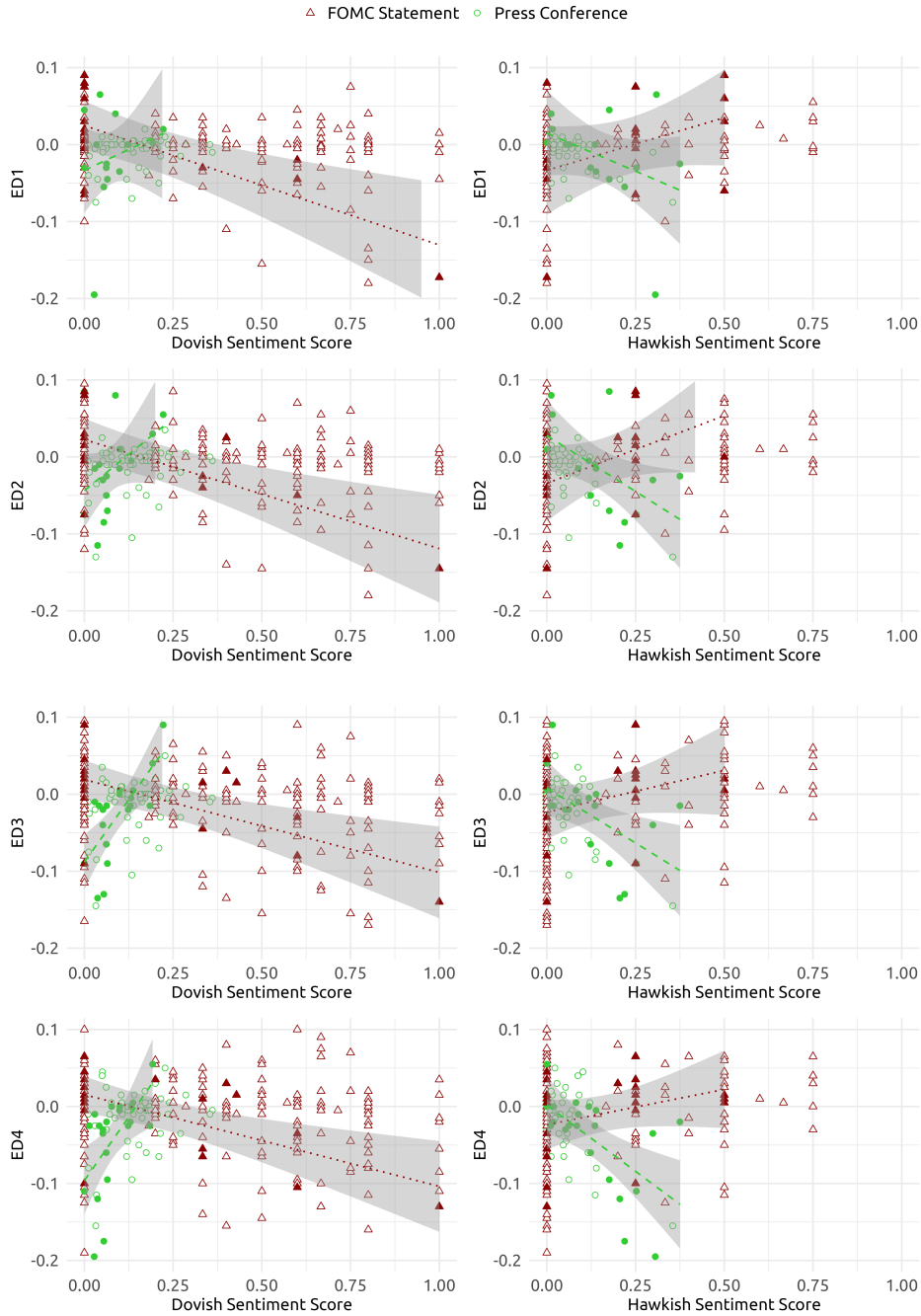


Figure C.2: Market Reaction vs. Sentiment

The figure shows the same data as figure C.1 but for press conferences and FOMC statements only. Filled observation indicate a respective opposite sign shock of at least 3 basis points.

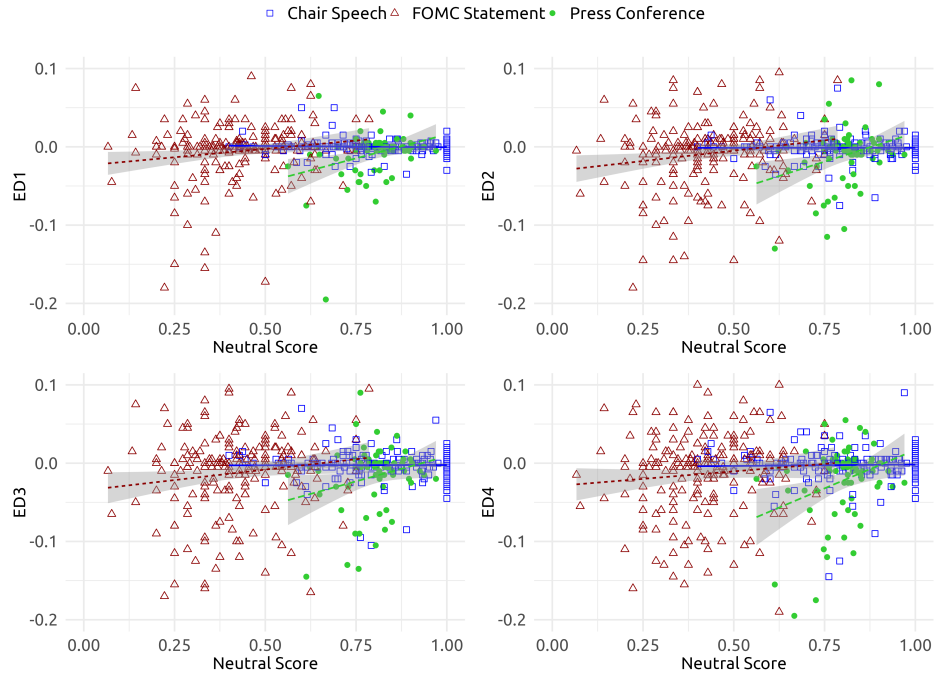


Figure C.3: Market Reaction vs. Neutral Sentiment

Note: The figure shows the same regression as figure C.1 but for the neutral sentiment score only.

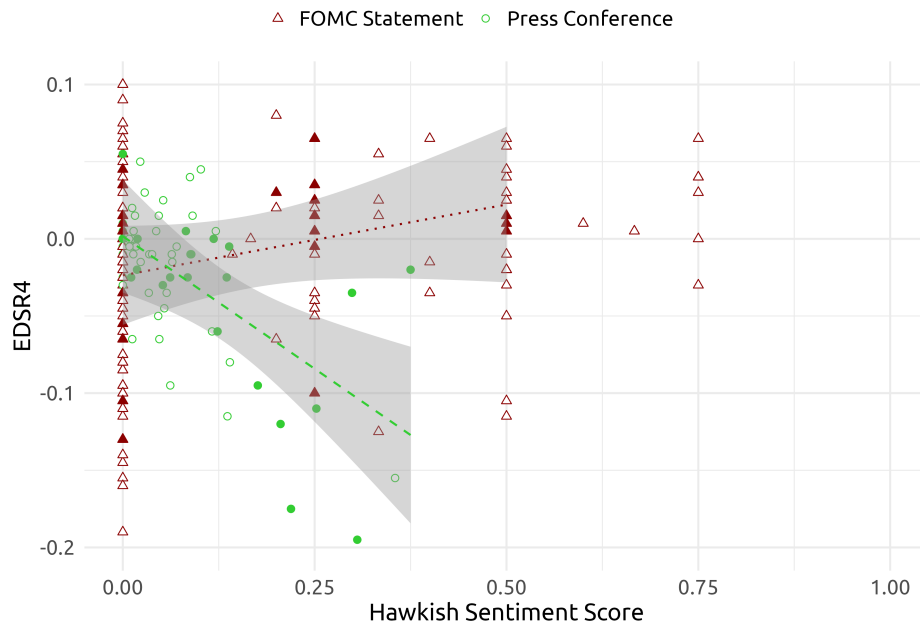


Figure C.4: Regression of market surprises on Hawkish Sentiment

Note: The figure shows the same regression as figure 8 but for press conferences and FOMC statements only. Filled observation indicate a respective opposite sign shock of at least 3 basis points. See text for details. Removing the outliers from December 14, 2022, and September 21, 2022, strengthens the negative relationship between hawkish sentiment and ED4, increasing the coefficient magnitude (-0.204 to -0.257), improving statistical significance ($p = 0.0085$ to 0.0046), and slightly raising R^2 from 0.091 to 0.108.

D SIGNAL-TO-NOISE

This appendix presents the average minute-level share of daily trades around FOMC statements with and without a press conference.

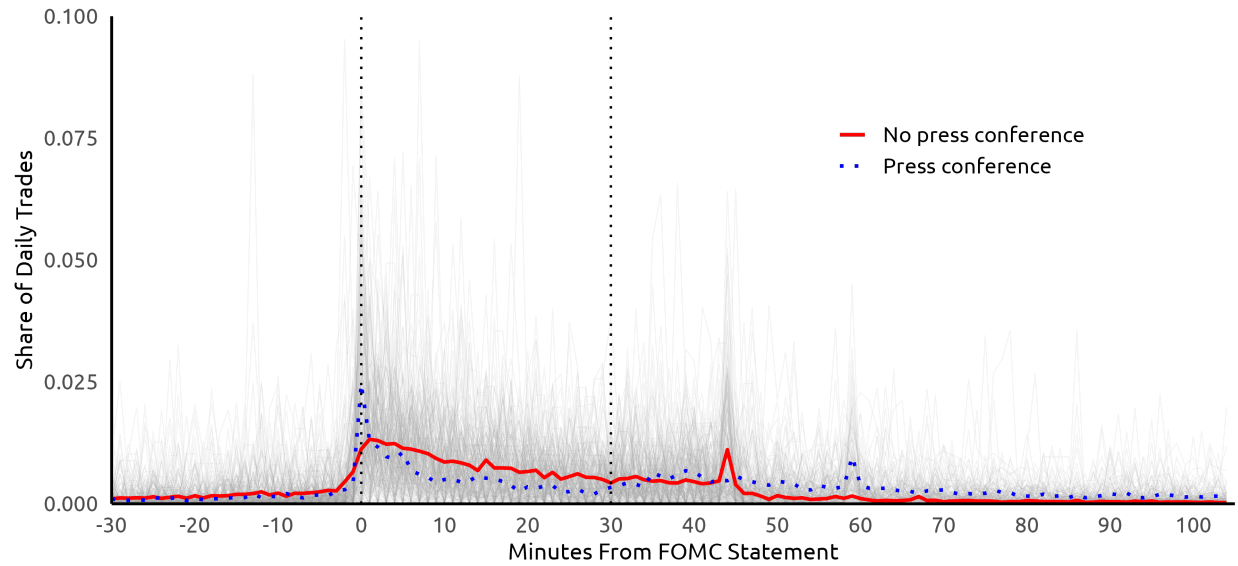


Figure D.1: Intraday Trade Share Around FOMC Statements, EDSR4

The figure plots, for each minute relative to the FOMC statement, the share of that day's total trades that occur in that minute. Gray lines show individual FOMC meeting days; colored lines show the average across meeting-day groups.

E VAR APPENDIX

E.1 MONETARY POLICY SHOCK CONSTRUCTION The details are drawn from Brennan et al. (2025).

NAKAMURA AND STEINSSON (2018) **MONETARY POLICY SHOCK** uses futures tick data accessed via CME Group Inc. DataMine (<https://datamine.cmegroup.com/>) at the Federal Reserve Board. The construction of the shock series follows that of Gürkaynak et al. (2005) as described in Nakamura and Steinson (2018) and Brennan et al. (2025). The shocks are the first principal component of changes in high-frequency federal funds rate futures and Eurodollar/SOFR futures:

$$MP1_s = \begin{cases} \frac{D^s}{D^s - d^s} (ff_{s,t+\Delta t}^1 - ff_{s,t-\Delta t}^1) & \text{if } D^s - d^s > 7 \\ ff_{s,t+\Delta t}^2 - ff_{s,t-\Delta t}^2 & \text{otherwise} \end{cases} \quad (20)$$

$$MP2_{s'} = \begin{cases} \frac{D^{s'}}{D^{s'} - d^{s'}} \left[(ff_{s',t+\Delta t}^j - ff_{s',t-\Delta t}^j) - \frac{d^{s'}}{D^{s'}} MP1_s \right] & \text{if } D^{s'} - d^{s'} > 7 \\ ff_{s',t+\Delta t}^{j+1} - ff_{s',t-\Delta t}^{j+1} & \text{otherwise} \end{cases} \quad (21)$$

$$\Delta EDSR2_q = \begin{cases} ED_{q,t+\Delta t}^2 - ED_{q,t-\Delta t}^2 & \text{if } q < 2022:Q1 \\ SF_{q,t+\Delta t}^3 - SF_{q,t-\Delta t}^3 & \text{otherwise} \end{cases} \quad (22)$$

$$\Delta EDSR3_q = \begin{cases} ED_{q,t+\Delta t}^3 - ED_{q,t-\Delta t}^3 & \text{if } q < 2022:Q1 \\ SF_{q,t+\Delta t}^4 - SF_{q,t-\Delta t}^4 & \text{otherwise} \end{cases} \quad (23)$$

$$\Delta EDSR4_q = \begin{cases} ED_{q,t+\Delta t}^4 - ED_{q,t-\Delta t}^4 & \text{if } q < 2022:Q1 \\ SF_{q,t+\Delta t}^5 - SF_{q,t-\Delta t}^5 & \text{otherwise} \end{cases} \quad (24)$$

Let s index the month of the current FOMC meeting and s' index the month of the next meeting. For example, $s = \text{March } 2014$ and $s' = \text{April } 2014$ for the March 19, 2014 FOMC meeting where s and s' need not be consecutive months. We define t as the time of the FOMC statement release, typically 14:00 EST and $t + \Delta t$ more precisely as 20 or 80 minutes *after* the FOMC statement release while $t - \Delta t$ is defined as 10 minutes *before* the FOMC statement release. For the March 19, 2014 FOMC statement, which occurred at $t = \text{March } 19, 14:00$, $t + \Delta = \text{March } 19, 2014 14:20$ or $t = \text{March } 19, 2014 15:20$ and $t - \Delta t = \text{March } 19, 2014 13:50$.

Let ff^j denote the duration j of the federal funds futures contract ff . For example, $j = 1$ denotes the contract expiring in the current month, $j = 2$ the contract expiring next month, etc. For month s , D^s and d^s are the number of total days in the month and the day of the FOMC meeting, respectively. If a monetary policy announcement occurs in the first 23 days of the month, then that month's federal funds future $j = 1$ is used to calculate $MP1_s$. Because the settlement prices are based on the average of the effective overnight federal funds rate in month s rather than the federal funds rate on a specific day, one must correct for time averaging and scale by the inverse of the share of days remaining in the month, $\frac{D^s}{D^s - d^s}$. Otherwise, if the FOMC announcement occurs in the last seven days of the month, next month's

future $j = 2$ is used to calculate $MP1_s$.

$MP2_s$ captures the unexpected change in the federal funds futures contracts that expire at the end of month s' which is the month of the next scheduled FOMC meeting. Brennan et al. (2025) show that in practice the next or following month's federal funds future $j = 2, 3$ is used to calculate $MP2_s$.

Because federal funds futures are highly liquid for contracts expiring in the next three months but less liquid for contracts thereafter, researchers use Eurodollar and SOFR futures to cover the remaining first year of the term structure. Eurodollar futures were listed quarterly and mature in March, June, September, and December. They were an agreement to exchange, on the second London business day before the third Wednesday of the last month of the quarter, the price of the contract minus the three-month US dollar BBA LIBOR interest rate. Because the BBA LIBOR interest rate is discontinued, Eurodollar futures ceased trading in April 2023. SOFR futures have successfully replaced Eurodollar futures on the Chicago Mercantile Exchange. The SOFR rate is based on the cost to borrow USD overnight using Treasury securities as collateral. Because SOFR futures are designed to replace Eurodollar futures, they can be spliced into shock construction when they are available. We follow Acosta et al. (2024) and use January 2022 as a start date for SOFR futures.

Let q index the quarter of the current FOMC meeting and $q + 1$ index the of the next FOMC meeting. For example, $q = 2014:Q1$, $q + 1 = 2014:Q2$, and $q + 2 = 2014:Q3$ for the March 19, 2014 FOMC meeting.

The monetary policy shock is then the first principal component of expressions (20)-(24) scaled so that its effect on one-year nominal Treasury yields is equal to one.

GÜRKAYNAK ET AL. (2005) **MONETARY POLICY SHOCKS** The target and path shocks of Gürkaynak et al. (2005) are constructed using principal component analysis over the same instrument set of Nakamura and Steinsson (2018)—expressions (20)-(24). Rather than extracting just the first principal component, Gürkaynak et al. (2005) extract the first two principal components and then rotate these principal components so that the second has no effect on the federal funds rate. The first rotated principal component is called the target shock and is normalized so that it is one-for-one with the federal funds rate. The second is the called path shock which is normalized to be one-for-one with the four-quarter ahead change in the Eurodollar futures ($EDSR4_q$ in expression (24)) and captures all forward guidance surprises.

E.2 VAR ESTIMATES The figure below show alternative lags and samples to those shown in the main text.

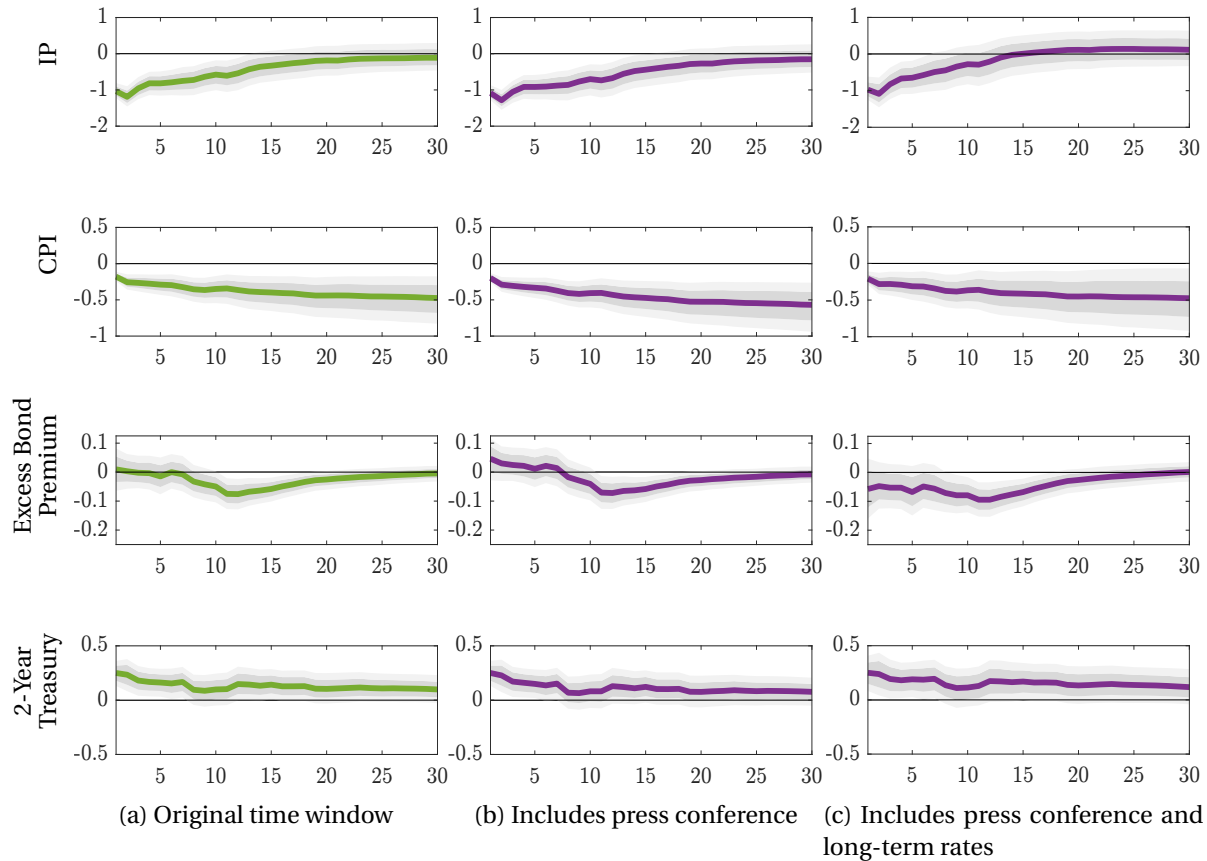


Figure E.1: Impulse response to a 25 basis point Nakamura and Steinsson (2018) monetary policy shock, x-axis is months and y-axis is percentage points.

Impulse responses are estimates from equation (19) $Y_T = \alpha + B(L)Y_{T-1} + s_1 Y_T^{2Y} + \bar{u}_T$ obtained via the Canova and Ferroni (2022) Bayesian VAR toolbox with 68 and 90 percent error bands (darker and lighter bands, respectively), 20,000 draws, and 12 lags. The sample of monetary shock series is from January 1995 to April 2025 while the sample of economic data starts in January 1973. The shock series are the first principal component of the instrument set $\{MP1, MP2, EDSR2, EDSR3, EDSR4\}$. The shock series in panel a is constructed from the 30-minute change in these futures around FOMC statements. The shock series in panel b is constructed from the 90-minute change in these futures around FOMC statements when there is a post-meeting press conference so that the time window includes the press conference. Panel c augments the instrument set in panel b with 2-, 5-, 10-, and 30-year Treasury yields. IP is the industrial production index, CPI is the consumer price index, excess bond premium is from Gilchrist and Zakrajšek (2012), and the two-year Treasury is the end of the month daily change in the zero-coupon yield. All sources of series are detailed in Appendix F. Appendix Table 1 displays the first-stage F-statistics.

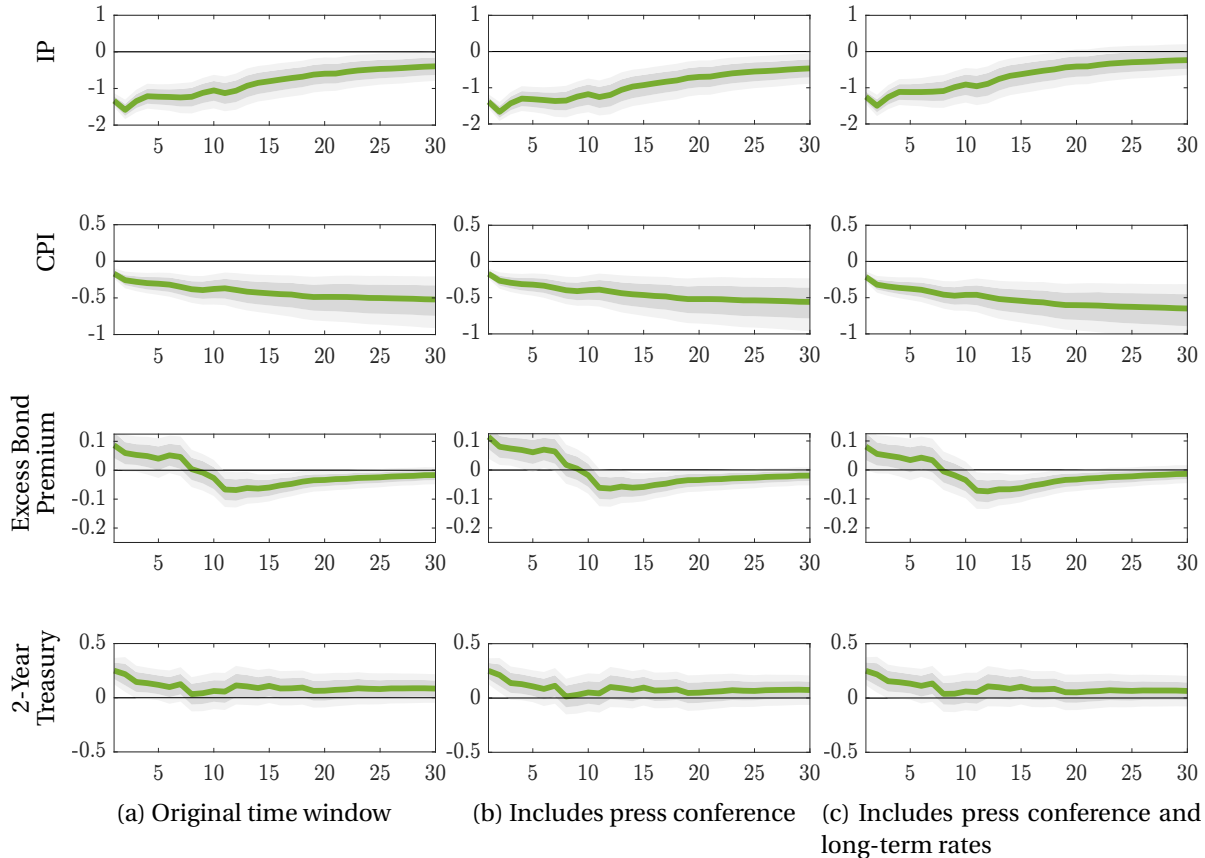


Figure E.2: Impulse response to a 25 basis point *Gürkaynak et al. (2005)* target monetary policy shock, x-axis is months and y-axis is percentage points.

Impulse responses are estimates from equation (19) $Y_T = \alpha + B(L)Y_{T-1} + s_1 Y_T^{2Y} + \bar{u}_T$ obtained via the *Canova and Ferroni (2022)* Bayesian VAR toolbox with 68 and 90 percent error bands (darker and lighter bands, respectively), 20,000 draws, and 12 lags. The sample of monetary shock series is from January 1995 to April 2025 while the sample of economic data starts in January 1973. The shock series are the rotated first principal component of the instrument set $\{MP1, MP2, EDSR2, EDSR3, EDSR4\}$. The shock series in panel a is constructed from the 30-minute change in these futures around FOMC statements. The shock series in panel b is constructed from the 90-minute change in these futures around FOMC statements when there is a post-meeting press conference so that the time window includes the press conference. Panel c augments the instrument set in panel b with 2-, 5-, 10-, and 30-year Treasury yields. IP is the industrial production index, CPI is the consumer price index, excess bond premium is from *Gilchrist and Zakrajšek (2012)*, and the two-year Treasury is the end of the month daily change in the zero-coupon yield. All sources of series are detailed in Appendix F. Appendix Table 1 displays the first-stage F-statistics.

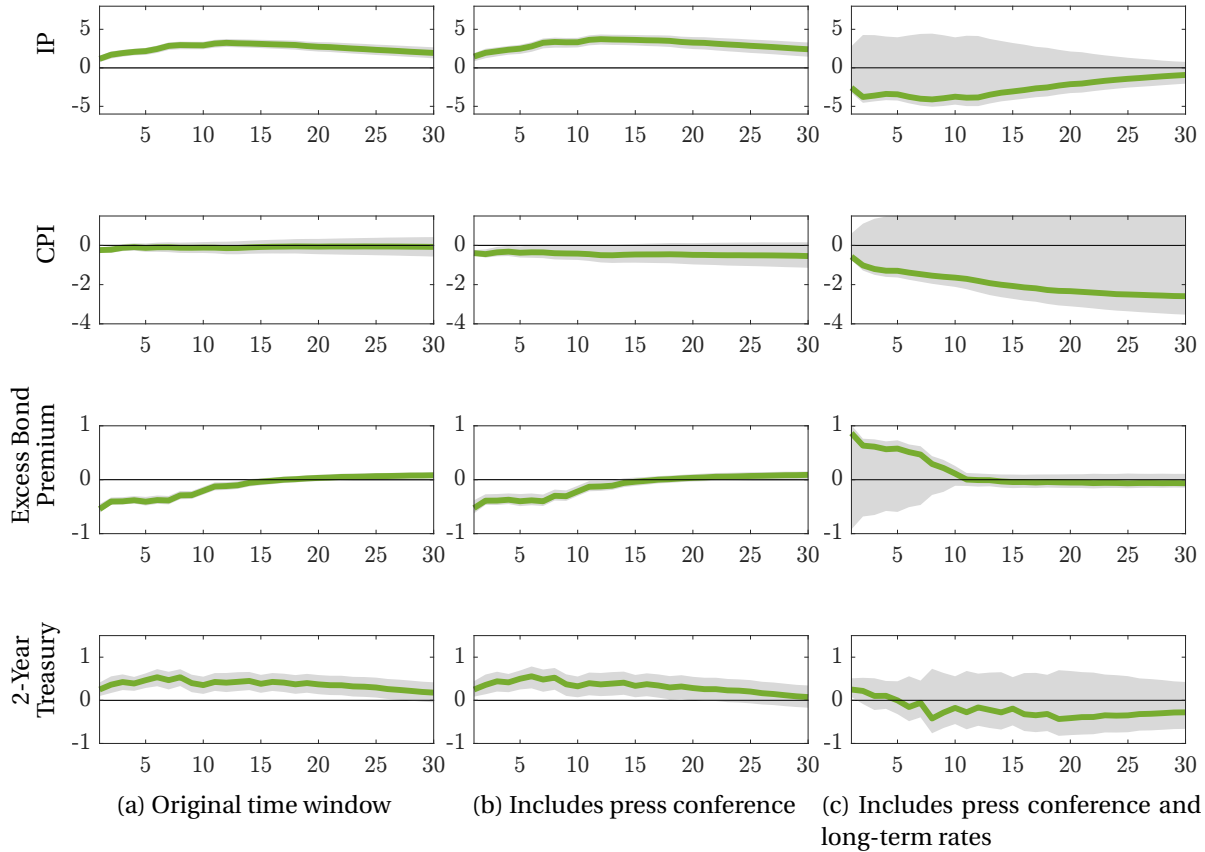


Figure E.3: Impulse response to a 25 basis point Gürkaynak et al. (2005) path monetary policy shock, x-axis is months and y-axis is percentage points.

Impulse responses are estimates from equation (19) $Y_T = \alpha + B(L)Y_{T-1} + s_1 Y_T^{2Y} + \bar{u}_T$ obtained via the Canova and Ferroni (2022) Bayesian VAR toolbox with 68 and 90 percent error bands (darker and lighter bands, respectively), 20,000 draws, and 12 lags. The sample of monetary shock series is from January 1995 to April 2025 while the sample of economic data starts in January 1973. The shock series are the rotated second principal component of the instrument set $\{MP1, MP2, EDSR2, EDSR3, EDSR4\}$. The shock series in panel a is constructed from the 30-minute change in these futures around FOMC statements. The shock series in panel b is constructed from the 90-minute change in these futures around FOMC statements when there is a post-meeting press conference so that the time window includes the press conference. Panel c augments the instrument set in panel b with 2-, 5-, 10-, and 30-year Treasury yields. IP is the industrial production index, CPI is the consumer price index, excess bond premium is from Gilchrist and Zakrajšek (2012), and the two-year Treasury is the end of the month daily change in the zero-coupon yield. All sources of series are detailed in Appendix F. Appendix Table 1 displays the first-stage F-statistics.

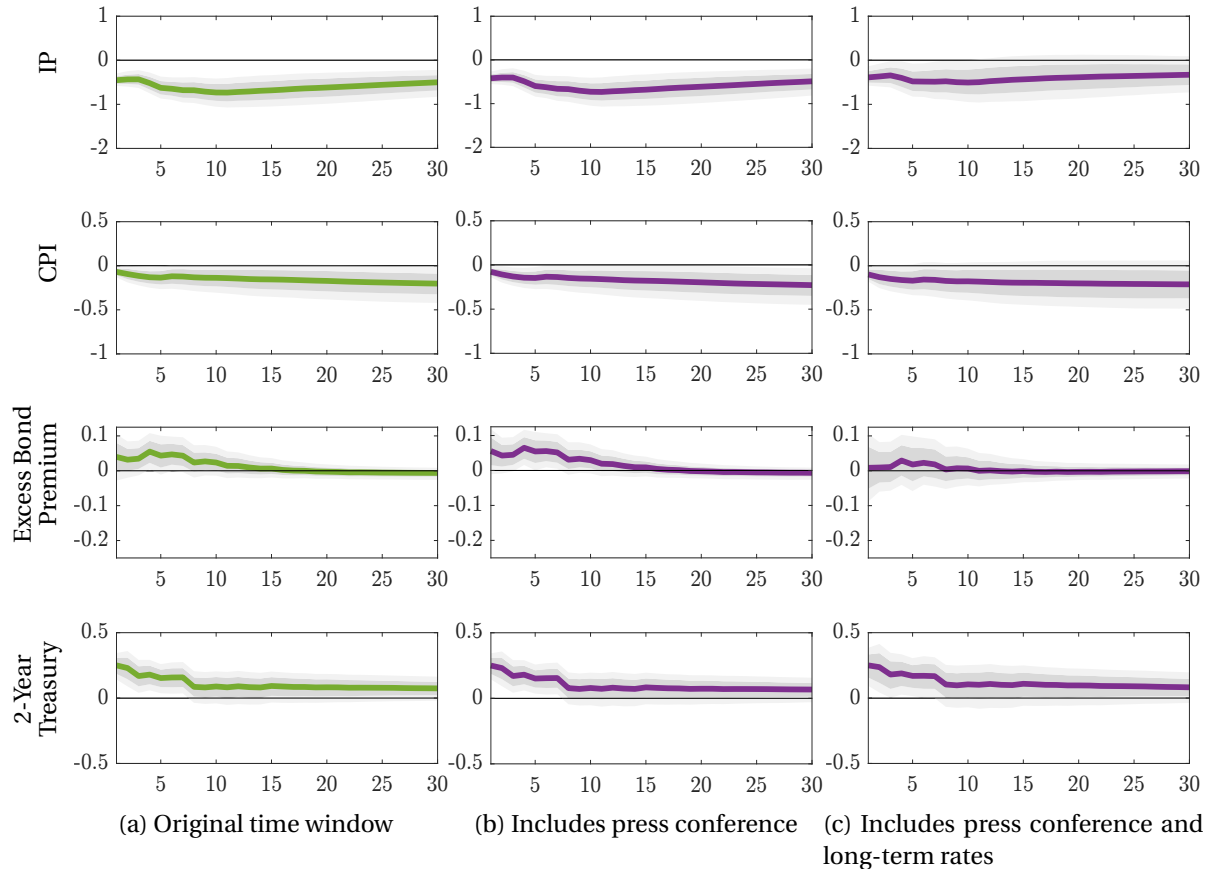


Figure E.4: Impulse response to a 25 basis point Nakamura and Steinsson (2018) monetary policy shock, x-axis is months and y-axis is percentage points stopping in 2019.

Impulse responses are estimates from equation (19) $Y_T = \alpha + B(L)Y_{T-1} + s_1 Y_T^{2Y} + \bar{u}_T$ obtained via the Canova and Ferroni (2022) Bayesian VAR toolbox with 68 and 90 percent error bands (darker and lighter bands, respectively), 20,000 draws, and 8 lags. The sample of monetary shock series is from January 1995 to April 2025 while the sample of economic data starts in January 1973. The shock series are the first principal component of the instrument set $\{MP1, MP2, EDSR2, EDSR3, EDSR4\}$. The shock series in panel a is constructed from the 30-minute change in these futures around FOMC statements. The shock series in panel b is constructed from the 90-minute change in these futures around FOMC statements when there is a post-meeting press conference so that the time window includes the press conference. Panel c augments the instrument set in panel b with 2-, 5-, 10-, and 30-year Treasury yields. IP is the industrial production index, CPI is the consumer price index, excess bond premium is from Gilchrist and Zakrajšek (2012), and the two-year Treasury is the end of the month daily change in the zero-coupon yield. All sources of series are detailed in Appendix F. Appendix Table 1 displays the first-stage F-statistics.

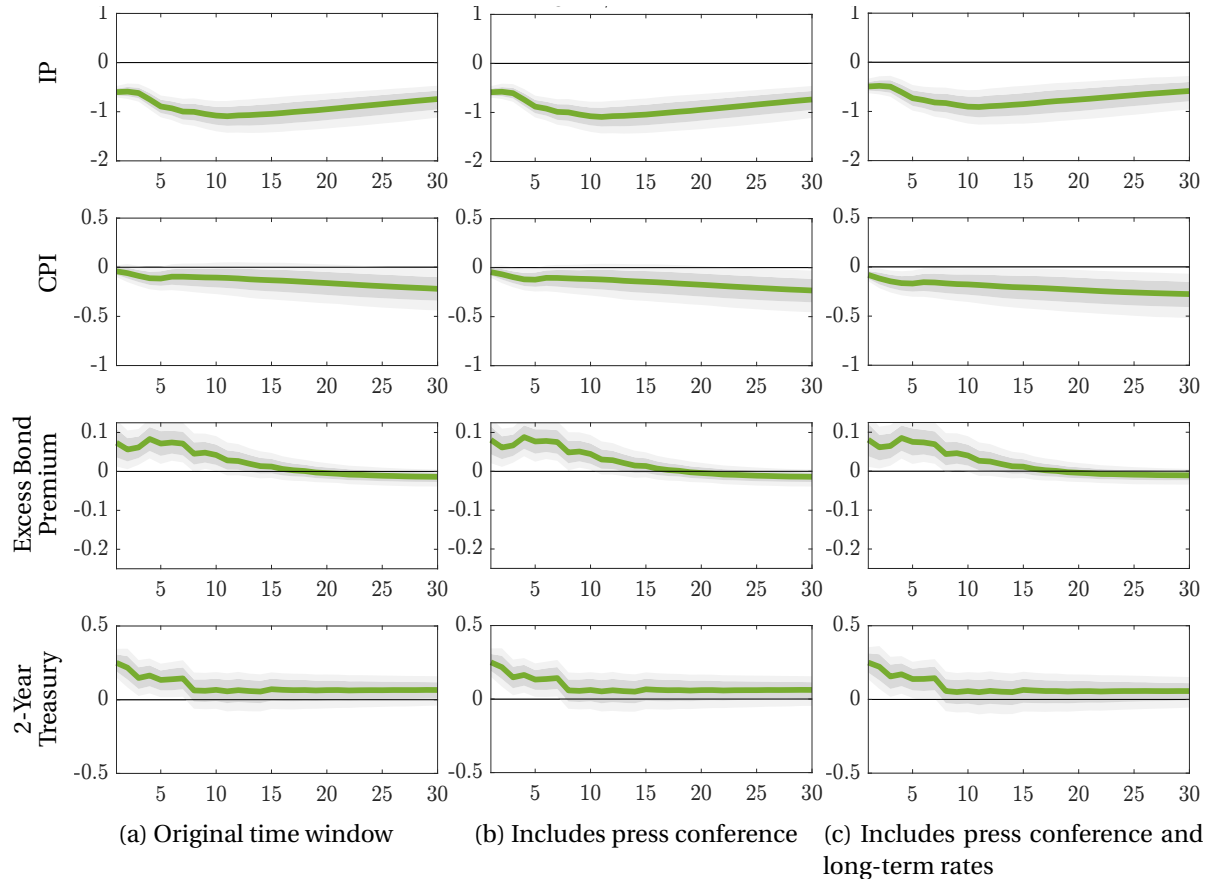


Figure E.5: Impulse response to a 25 basis point *Gürkaynak et al. (2005)* target monetary policy shock, x-axis is months and y-axis is percentage points stopping in 2019.

Impulse responses are estimates from equation (19) $Y_T = \alpha + B(L)Y_{T-1} + s_1 Y_T^{2Y} + \bar{u}_T$ obtained via the Canova and Ferroni (2022) Bayesian VAR toolbox with 68 and 90 percent error bands (darker and lighter bands, respectively), 20,000 draws, and 8 lags. The sample of monetary shock series is from January 1995 to December 2019 while the sample of economic data starts in January 1973. The shock series are the rotated first principal component of the instrument set $\{MP1, MP2, EDSR2, EDSR3, EDSR4\}$. The shock series in panel a is constructed from the 30-minute change in these futures around FOMC statements. The shock series in panel b is constructed from the 90-minute change in these futures around FOMC statements when there is a post-meeting press conference so that the time window includes the press conference. Panel c augments the instrument set in panel b with 2-, 5-, 10-, and 30-year Treasury yields. IP is the industrial production index, CPI is the consumer price index, excess bond premium is from Gilchrist and Zakrajšek (2012), and the two-year Treasury is the end of the month daily change in the zero-coupon yield. All sources of series are detailed in Appendix F. Appendix Table 1 displays the first-stage F-statistics.

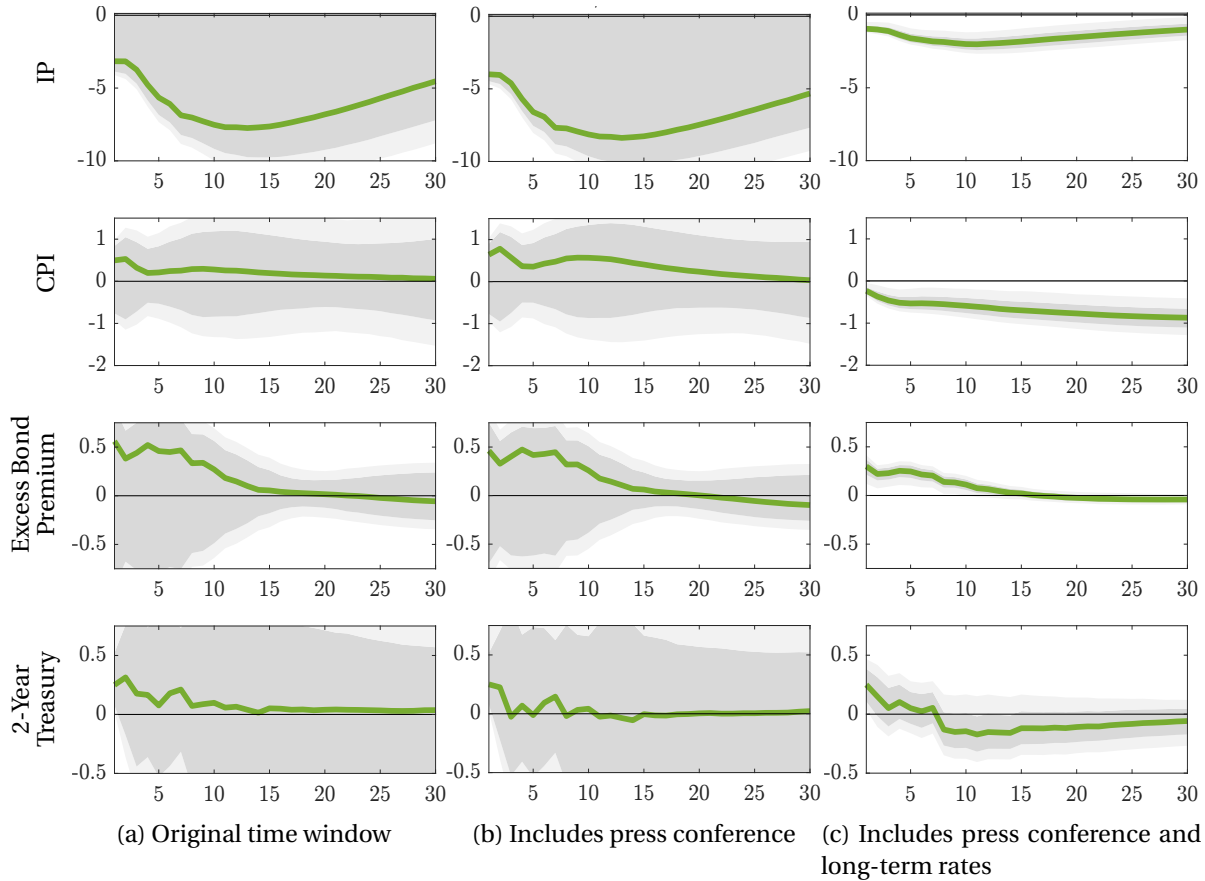


Figure E.6: Impulse response to a 25 basis point *Gürkaynak et al. (2005)* path monetary policy shock, x-axis is months and y-axis is percentage points stopping in 2019.

Impulse responses are estimates from equation (19) $Y_T = \alpha + B(L)Y_{T-1} + s_1 Y_T^{2Y} + \bar{u}_T$ obtained via the Canova and Ferroni (2022) Bayesian VAR toolbox with 68 and 90 percent error bands (darker and lighter bands, respectively), 20,000 draws, and 8 lags. The sample of monetary shock series is from January 1995 to December 2019 while the sample of economic data starts in January 1973. The shock series are the rotated second principal component of the instrument set $\{MP1, MP2, EDSR2, EDSR3, EDSR4\}$. The shock series in panel a is constructed from the 30-minute change in these futures around FOMC statements. The shock series in panel b is constructed from the 90-minute change in these futures around FOMC statements when there is a post-meeting press conference so that the time window includes the press conference. Panel c augments the instrument set in panel b with 2-, 5-, 10-, and 30-year Treasury yields. IP is the industrial production index, CPI is the consumer price index, excess bond premium is from *Gilchrist and Zakrajšek (2012)*, and the two-year Treasury is the end of the month daily change in the zero-coupon yield. All sources of series are detailed in Appendix F. Appendix Table 1 displays the first-stage F-statistics.

Series name	F-stat	Robust F-stat
<hr/>		
8 lags, April 2025 end date		
Original time window, NS	4.08	1.73
Press conference included, NS	4.16	1.83
Press conference + long-rates, NS	1.77	1.49
Original time window, target	3.71	1.30
Press conference included, target	3.96	1.41
Press conference + long-rates, target	3.42	1.50
Original time window, path	0.34	0.14
Press conference included, path	0.21	0.09
Press conference + long-rates, path	0.69	0.24
<hr/>		
12 lags, April 2025 end date		
Original time window, NS	2.94	1.35
Press conference included, NS	2.90	1.41
Press conference + long-rates, NS	1.53	1.29
Original time window, target	2.51	0.97
Press conference included, target	2.60	1.02
Press conference + long-rates, target	2.33	1.11
Original time window, path	0.41	0.17
Press conference included, path	0.27	0.13
Press conference + long-rates, path	0.15	0.05
<hr/>		
8 lags, 2019 end date		
Original time window, NS	4.14	1.60
Press conference included, NS	4.22	1.64
Press conference + long-rates, NS	1.80	1.63
Original time window, target	4.33	1.32
Press conference included, target	4.42	1.35
Press conference + long-rates, target	3.58	1.38
Original time window, path	0.00	0.00
Press conference included, path	0.02	0.01
Press conference + long-rates, path	0.75	0.23
<hr/>		

Table 1: First-stage F-statistics.

Estimates from equation (19) $Y_T = \alpha + B(L)Y_{T-1} + s_1 Y_T^2 + \tilde{u}_T$ obtained via the Canova and Ferroni (2022) Bayesian VAR toolbox with 68 percent error bands, 20,000 draws. The sample of monetary shock series is from January 1995 to April 2025, unless otherwise noted, while the sample of economic data starts in January 1973. The shock series of each panel are principal components of the instrument set $\{MP1, MP2, EDSR2, EDSR3, EDSR4\}$ with the series constructed from long rates augmented with intraday changes in 2-, 5-, 10-, and 30-year Treasuries. The “NS” shock is the first principal component and the target and path shocks are the rotated first and second principal component, respectively. The “original time window” shock series is constructed from the 30-minute change in these futures around FOMC statements. The “press conference included” shock series is constructed from the 90-minute change in these futures around FOMC statements when there is a post-meeting press conference so that the time window includes the press conference. The “Press conference + long rates” includes intraday changes in 2-, 5-, 10-, and 30-year Treasury yields in the instrument set. All sources of series are detailed in Appendix F.

F APPENDIX DATA

CONSTANT MATURITY TREASURY YIELDS are daily market yields on U.S. Treasuries obtain via the H.15 Selected Interest Rate Release from the Federal Reserve Board.

CONSUMER PRICE INDEX is the seasonally adjusted monthly Consumer Price Index from the Bureau of Labor Statistics (FRED: CPIAUCSL).

EURODOLLAR FUTURES are available at an intraday tick frequency from 1995 to March 2023 via the CME Group Inc. DataMine (<https://datamine.cmegroup.com/>) at the Federal Reserve Board.

EXCESS BOND PREMIUM is a monthly credit spread index from Gilchrist and Zakrajšek (2012) and is available from the Federal Reserve Board (https://www.federalreserve.gov/econres/notes/feds-notes/ebp_csv.csv).

FEDERAL FUNDS FUTURES are available at an intraday tick frequency from 1995 to present via the CME Group Inc. DataMine at the Federal Reserve Board (<https://datamine.cmegroup.com/>).

FEDERAL FUNDS RATE is the target federal funds rate after each FOMC meeting. Because a change in the federal funds rate is executed the day after an FOMC meeting, this series is constructed by taking the value for the day after an FOMC meeting. The FRED series DFEDTAR is used from 1994 to December 15, 2008 and then the average of DFEDTARU and DFEDTARL is used thereafter.

INDUSTRIAL PRODUCTION is the seasonally adjusted monthly Industrial Production Index from the Federal Reserve Board (FRED: INDPRO).

SOFR FUTURES are used at an intraday tick frequency from January 2022 to September 2024 via the CME Group Inc. DataMine (<https://datamine.cmegroup.com/>) at the Federal Reserve Board.

ZERO-COUPON TREASURY YIELDS are continuously compounded zero-coupon daily yields (mnemonic: SVENYXX) obtained from the Federal Reserve Board (https://www.federalreserve.gov/data/yield-curve-tables/feds200628_1.html or as a csv file).