Department of Economics

MSc Extended Essay Cover Sheet

CANDIDATE NUMBER *(This is a **5 digit number** found on LFY. It is **not** your 9 digit student number)*	1	4	2	7	5

COURSE CODE	**E**	**C**	**4**	**2**	**4**

TITLE	**Why FOMC Press Conferences Matter**

WORD COUNT	6	0	7	2

Double spaced, typed. Maximum 6,000 words (as a guideline this is 14-21 double spaced pages). Abstract, footnotes, references and appendices do not count toward the word count, provided such additions are brief and do not contain information that rightly belongs in the body of the essay. Equations are included in the word count and counted as the page equivalent (i.e., as the number of words that would occupy the same amount of space in text). Examiners are recommended to penalise excessively long essays (+ 10% of word count) by adjusting the marks by 6000/x, where x is the word count. Pages are to be numbered. Binding is not necessary, however it is crucial that all pages are secure, i.e. stapled.*

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Why FOMC Press Conferences Matter

Extended Essay EC424
Candidate Number: 14275

June 2, 2021

Abstract

Federal Open Market Committee (FOMC) releases communicate major changes in the Fed's stance on the federal funds rate, forward guidance, and large-scale asset purchases. Prior research well documented the identification of the monetary policy regime in a high-frequency interval around the release of FOMC statements. But the identification literature neglects the monetary surprises revealed by subsequent press conferences. First, I argue that the chair's press conferences significantly impact US treasuries, corporate bonds, and stock markets during the, on average, 60 minutes span of each conference. Second, I show that these market changes can be partially explained by semantic characteristics of the chair's speech and answers – even after controlling for the statement's monetary policy surprises and intraday effects. Therefore, I exclude the possibility of a purely endogenously driven response to information released during the prior statement and SEP economic announcements. Finally, I conclude by emphasizing the economic relevance of these market reactions and provide evidence that an identification of the Fed's monetary policy is incomplete without incorporating the information conveyed by the press conferences following the FOMC statement.

Contents

1 Introduction

"Accurate measurement of the effects of changes in monetary policy on the economy is essential, both for good policy-making and for choosing among alternative macroeconomic theories. Unfortunately, attempts to quantify the links between central bank actions and the economy quickly run into a major roadblock: there is no consensus on how to measure the size and direction of changes in monetary policy."

— Bernanke and Mihov (1998)

While this quote predates my work by more than twenty years, it is as relevant as ever. During their time, Bernanke and Mihov (1998) were talking about advances in the narrative approach (Friedman and Schwartz, 1963; Romer and Romer, 1989) and the introduction of the vector autoregression (VAR) methodology (Bernanke and Blinder, 1992). Nowadays, increasing transparency and reliability of the Federal Reserve (Fed)'s communication brought along another identification strategy – high-frequency financial market responses. The financial market approach dates back to Cook and Hahn (1989) and has seen continuous interest since. Notably, Gürkaynak et al. (2005) expanded the set of measured monetary policy surprises by including a forward guidance (FG) factor. Recently, Swanson (2021) completed the known set of monetary policy by identifying rate changes, FG, and large-scale asset purchases (LSAP) separately. Moreover, the recent advancements of the proxy structural vector autoregression (proxy-SVAR) literature (Gertler and Karadi, 2015; Caldara and Herbst, 2019), which relies on these surprises for identification, add even more importance to the high-frequency methodology.

But, just as identification strategies arose and changed over time, so has FOMC communication. In 2011, the Fed added regular press conferences to their repertoire. They were held every other FOMC meeting until 2018. Since 2019, press conferences were held after every meeting. However, to the best of my knowledge, there is no high-frequency identification paper that studies the information conveyed by press conferences. All of the canonical works (e.g., Kuttner, 2001; Gürkaynak et al., 2005; Swanson, 2021) either predate the occurrence of press conferences or chose to exclude them from the event window. While Gu et al. (2018)'s event window includes press conferences, they make no effort in disentangling their effect

from the statement or the Summary of Economic Projections (SEP).

The aim of my essay is to fill this gap by (i) showing that press conferences are an important transmitter of monetary policy and by (ii) providing a lower bound of their importance relative to the FOMC statements. Section 2 provides background on the data I use. In Section 3, I show that treasuries, corporate bonds, and stock markets exhibit abnormal behavior during the press conference window. While this is evidence of important news conveyed by the press conference, the high volatility is at least partially caused by the preceding release of the FOMC statement and SEP. Intraday autocorrelation and seasonality are well established in the asset pressing literature in general (e.g., Bogousslavsky, 2016; Gao et al., 2018) as well as for macroeconomic announcements in particular (Bollerslev et al., 2000).

I overcome the problem of intraday effects by *not* defining monetary policy shocks with the returns during the event window. Instead, in Section 4, I construct semantic instruments of the press conference's communication. In particular, I measure the tone, uncertainty, and topics conveyed by the chair. By doing so, I build on the established literature of the semantics of FOMC statements and minutes (e.g., Boukus and Rosenberg, 2006; Hansen and McMahon, 2016; Ehrmann and Talmi, 2020) that has proven the effectiveness of semantic instruments. To my knowledge, this essay pioneers the study of FOMC press conference semantics.

In Section 5, I show that all three semantic measures help explain the market behavior during the press conference window. The topic instrument is the most effective one. In particular, the change in coverage of inflation, labor market/consumption, and fiscal stimulus had the strongest impact on financial markets. I speculate that the inflation topic signals a more hawkish strategy and the labor market/consumption topic could be associated with the portfolio-rebalancing channel. These instruments are robust to a variety of specifications. Finally, in Section 6, I argue that the topic coverage instruments together with the Swanson (2021) measures explain 20% more 3-7 year treasury price variation than the Swanson instruments alone. I view my crude semantic instruments as a lower bound of the monetary policy conveyed during the press conference.

2 Data

2.1 FOMC communication

The Fed's communication channels are multifaceted – employing statements, press conferences, minutes, reports, and media. My analysis focuses on the two most important communication channels: FOMC statements and subsequent press conferences.[1] The Fed started to release eight scheduled FOMC statements a year in 2000. The first press conference was held in April 2011, and since then, the Fed's chair has held press conferences every other meeting until 2018. From 2019 on, press conferences are held after every FOMC meeting. My sample ends in December 2020.

All statements and transcribed press conferences are publicly available on the Fed's website.[2] I obtain FOMC statement release times from Lucca and Moench (2015) until 2011. I extend the time series for 2011-2013 using a similar approach of finding news releases. I apply the same methodology to identify the timing of the press conferences. Since March 2013, statements are released exactly at 14:00, and conferences are held at 14:30. I restrict the subset of press conferences to those that started at 14:30 and were preceded by a 14:00 statement to ensure homogeneous intraday effects.

Alongside the statements, the FOMC issues the SEP, containing FOMC participants' forecasts on the trajectory of economic variables and the federal funds rate. The first SEP was issued in October 2007. Since the occurrence of regular press conferences in 2011, the SEP is only issued on press conference days, simultaneously with the statement.

[1] Minutes are released three weeks after the FOMC statements and mostly justify decisions taken rather than informing the public on what is going on. Scientific reports fall into the same category as minutes. Media communication is irregular and difficult to track, but nevertheless a promising venture of future research.

[2] https://www.federalreserve.gov/monetarypolicy.

2.2 High-frequency financial market data

Several papers have used and emphasized the importance of high-frequency identification of monetary policy shocks.[3] For my analysis, I obtained tick-by-tick trade data of major US-listed ETFs from the TAQ database in WRDS.[4] In particular, I analyze US treasury ETFs over various maturities, a major US investment-grade corporate bond ETF, an S&P500 ETF, and a Nasdaq 100 ETF.

ETF	Ticker	Tracking
iShares 1-3 Year Treasury Bond	SHY	Short- to medium-term interest rates
iShares 3-7 Year Treasury Bond	IEI	Medium-term interest rates
iShares 7-10 Year Treasury Bond	IEF	Medium- to long-term interest rates
iShares iBoxx $ Investment Grade Corporate Bond	LQD	Corporate bond markets
SPDR S&P 500 Trust	SPY	Broadly US economy
Invesco QQQ Trust	QQQ	Nasdaq 100 non-financials

Table 1: List of analyzed ETFs to identify monetary policy surprises.

The variables of interest for the following analysis are the high-frequency ETF return, realized variance, and trading volume. I compute returns as logarithmic price changes, i.e., as continuously compounded returns, and scale them to basis points (bps) changes. Therefore, the return between time t_0 and time T is defined as

$$\text{Return}_{t_0,T} = 10{,}000\Big(Log(Price_T) - Log(Price_{t_0})\Big). \tag{1}$$

The realized variance is computed as the sum of squared five-minute returns within interval t_0 to T, i.e.,

$$\text{Realvar}_{t_0,T} = \sum_{t=t_0}^{T-1} \Big(\text{Return}_{t,t+1}\Big)^2, \tag{2}$$

where t is incremented in five-minute steps. I chose five-minute returns because they provide a good balance between noise and information content (Liu et al., 2015). Also, realized variance is a superior measure of market volatility over the standard deviation because it incorporates a feature of high-frequency financial market returns – given the efficient market hypothesis, *any* high-frequency return is unexpected, i.e., volatility.

[3] See, for example, Gürkaynak et al. (2005); Swanson (2021).

[4] https://wrds-www.wharton.upenn.edu/pages/get-data/nyse-trade-and-quote/.

For ease of interpretation, I rescale the realized variance such that the standard deviation of the realized variance is 1 for each ticker. In other words, an increase in realized variance by 1 is an increase in realized variance by one standard deviation.

Finally, the trading volume is defined as the sum of shares traded between period t_0 and T in terms of 100,000 stocks.

2.3 Robustness measures

In my following analysis, I will identify and explain exceptional market movements in the window around the FOMC press conference. While there are no contemporaneous economic releases or other announcements during the press conference, the press conference is preceded by the release of the FOMC statement and the SEP. Previous research documented a variety of intraday endogenous financial market patterns that could bias the inference when only looking at the window of the press conference.[5] Therefore, I will test the robustness of my results by controlling for various measures of the preceding FOMC statement and SEP release.

Swanson monetary policy surprises

My preferred measures of the FOMC statement surprise content are the monetary policy shocks identified by Swanson (2021). He looks at market responses in a 30-minute window around the statement release of federal funds futures, Eurodollar futures, and treasuries. Then, he determines the first three principal components and rotates the principal components to enforce three conditions. These three conditions ensure that the principal components capture federal funds rate, forward guidance, and LSAP surprises. First, forward guidance does not effect the current federal funds rate. Second, LSAP does not effect the current federal funds rate. And third, he chooses the rotation matrix to minimize LSAP surprises in the pre-zero lower bound (ZLB) period. This gives a series of monetary policy surprises induced by statements, which I denote *Swanson FFR*, *Swanson FG*, and *Swanson LSAP*. All three surprise series are scaled such that a positive surprise corresponds to contractionary monetary policy. They are available up to June 2019.

[5] See, e.g., Bollerslev et al. (2000), Bogousslavsky (2016), or Gao et al. (2018).

First federal funds future surprise

A popular method of capturing monetary policy surprises is measuring the change in the generic (i.e., rolling 30 days) first federal funds future. Because this method captures only one dimension of monetary policy, I will use this surprise in conjunction with various other measures. Note that the federal funds future measures the *average* federal funds rate in a given month. Therefore, interest rate changes at the end of the month will have a smaller impact than interest changes at the beginning of the month. Hence, I will use a transformation that weights federal funds future changes by their timing within the month (Kuttner, 2001) and scale them to percentages:

$$\Delta\text{FFF } 1_{s,t} = 100 \left(\frac{m}{m-t} \left(f^0_{s,t} - f^0_{s,t-1} \right) \right), \tag{3}$$

where $f^0_{s,t}$ is the price of the first (current month) federal funds future at day t of month s and m denotes the number of days in the month. For the first day of the month, I define $f^0_{s,t-1} = f^0_{s,0} = f^1_{s-1,M}$, i.e., I subtract the last day's second generic future of the previous month. Note that the future price $f^0_{s,t}$ is denoted as 100 minus the federal funds rate. Hence, an increase in $\Delta\text{FFF } 1_{s,t}$ corresponds to expansionary monetary policy.

Survey of economic projections

The Fed issues economic projections alongside the statements in the SEP. Ideally, I would like to control for the *surprise component* of the SEP, which requires knowing market expectations of the SEP projections ahead of the meeting. However, the two surveys that resemble that information most closely, the Survey of Primary Dealers (SPD) and the Survey of Market Participants (SMP), do not span the full horizon of conferences, lack timeliness, or do not capture the exact phrasing of the SEP projections. Fortunately, Couture (2021) shows that the changes in the economic projections from one SEP release to another are a good approximation of the surprise component. In the following analysis, I will use controls for the change in the median projection of the current year and two-year ahead GDP, unemployment rate, and personal consumption expenditures (PCE) inflation.

3 Importance of FOMC press conferences

In this section, I argue that FOMC press conferences induce abnormal market behavior that cannot be explained with endogenous intraday market reactions as a consequence of the preceding FOMC statement. Then, in Section 5, I will strengthen this argument by showing that the market reactions can be partially explained by instrument measures of monetary policy surprises, which I construct in Section 4. Finally, Section 6 emphasizes and interprets the economic relevance of these instrumented monetary policy surprises.

3.1 Average market responses to FOMC statements

Table 2 shows the average return, realized variance, and trading volume of SHY (1-3 year treasuries) and IEI (3-7 year treasuries) over various subsets of their history. Note that the realized variance is measured as the sum of squared five-minute returns within the interval scaled such that the standard deviation is 1. Trading volume is measured in 100,000 shares.

The first row provides a baseline for 30 minutes returns within the sample from 2000 to 2018.[6] The second row shows the average reaction to FOMC statements over the full horizon of 2000-2018. The response window is defined as 10 minutes before the release up to 20 minutes afterward. There were 152 scheduled FOMC statements overall.[7] On average, FOMC statements induced a 0.6 bps increase in the price of SHY. A price increase in treasury ETFs could be caused by expectations of current or future interest rate decreases, i.e., expansionary monetary policy shocks. However, a change of 0.6 bps is not economically meaningful.

[6] I chose this horizon because the FED started to release eight regularly scheduled statements in 2000 and stopped releasing statements without a subsequent press conference in 2019. Therefore, the table allows a comparison between the impact of statements before press conferences became established and during the period of alternating press conferences.

[7] To ensure comparable events, I restrict the analysis to *scheduled* FOMC statements and press conferences. See Li and Engle (1998) for an empirical justification and Kim and Verrecchia (1991) for a theoretical justification.

Statistic	N	SHY return	SHY realvar	SHY volume	IEI return	IEI realvar	IEI volume
all, 2000-2018	205,046	0.0	0.4	0.9	0.0	0.3	0.4
[30min]		(2.2)	(1.0)	(3.1)	(4.9)	(1.0)	(2.3)
statements, 2000-2018	152	0.6***	2.5***	1.3	0.9	3.9***	0.6
[30min]		(7.9)	(3.2)	(1.4)	(19.1)	(5.5)	(0.7)
statements, 2000-2010	88	0.7**	3.6***	0.9	0.3	5.7***	0.1
[30min]		(9.3)	(3.7)	(0.9)	(23.6)	(5.5)	(0.1)
statements, 2011-2018	32	−0.2	0.8**	1.5	−1.0	1.1***	0.6
[without conference, 30min]		(5.1)	(1.2)	(1.6)	(10.0)	(1.2)	(0.6)
statements, 2011-2018	32	1.3***	2.3***	1.7	3.0***	6.4***	0.7
[with conference, 30 min]		(7.3)	(3.0)	(1.6)	(23.8)	(7.0)	(0.8)
all, 2013-2018	64,906	0.0	0.8	2.8	−0.0	0.4	0.9
[70min]		(1.7)	(1.0)	(7.3)	(5.2)	(1.0)	(4.4)
proxy 14:20-15:30, 2013-2018	23	0.7*	0.9	2.5	2.7**	0.8*	1.0
[70min]		(1.7)	(0.5)	(2.1)	(7.4)	(0.8)	(1.4)
conference, 2013-2018	24	0.1	2.3***	3.0	0.7	2.3***	1.1
[70min]		(5.0)	(1.3)	(3.0)	(15.9)	(1.9)	(1.4)

Table 2: Average return, realized variance, and trading volume for various time windows of SHY (1-3 year treasuries) and IEI (3-7 year treasuries). Standard deviations are in parenthesis below. Realized variance is the sum of squared five-minute returns within the interval scaled such that the standard deviation is 1. Trading volume is measured in 100,000 shares. The first five rows show 30-minute intervals, and the last three rows show 70-minute intervals. All intervals start 10 minutes before the event. In other words, the 30-minute intervals capture 10 minutes before and 20 minutes after the FOMC statement release. The 70-minute intervals capture 10 minutes before and 60 minutes after the start of the FOMC press conference. Asterisks show the p-value of a difference-in-means t-test between a subset of returns and their benchmark. In other words, the t-test compares the first row *all, 2000-2018 [30min]* with each of the subsequent four rows *statements, [...]* and compares the sixth row *all, 2013-2018 [70min]* with the last two rows. Significance levels: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

On the other hand, statement releases did induce a noticeable increase in realized variance and trading volume. For both ETFs, the realized variance was more than two standard deviations higher than normal, and the trading volume was about 50% higher. For every measure, the table shows the standard deviations in parenthesis below. The standard deviation of the returns within the 30-minute window of the statement release was four times larger than in the average 30-minute window. Moreover, I conducted for every measure a difference-in-mean t-test to determine whether the return, realized variance, and volume are significantly different to their counterparts in the full sample. The p-value of the test is denoted by asterisks following the values with significance levels of *** $p < 0.01$, ** $p < 0.05$,

and $^{*}\ p < 0.1$. The increased realized variance around statement releases is highly significant.

The third row shows that those effects were particularly large in the period of 2000 to 2010. Notably, from 2011 on, there is a large difference between the impact of statements without (fourth row) and with (fifth row) subsequent press conference. While statements with press conferences induced reactions as strong as in the period of 2000 to 2010, statements without press conferences induced realized variances that are multiple times smaller. This insight is documented and justified in prior research (Gu et al., 2018; Boguth et al., 2019). In a nutshell, statements with subsequent press conferences were historically more likely to convey important decisions, which resolve uncertainty and are closely followed by market participants. In line with this explanation, the statements with subsequent press conferences had, on average, a positive return that is significantly different from the average return in the sample.

The important question to ask here is – why do important decisions tend to happen on press conference days? One explanation is that the accompanying SEP release provides further justification for the decision-making. Another explanation, however, is that the Fed chair can use the press conference to defend the action taken, provide further background, and explain remaining ambiguities. The latter explanation strongly suggests that the press conference brings new information that is a feature of the meeting's monetary policy surprise.

3.2 Average market responses to FOMC press conferences

The sixth row provides a baseline for 70-minute windows from 2013 to 2018. During these years, press conferences were always held at 14:30, and statements were released at 14:00.[8] The seventh row shows the window of 14:20 to 15:30 on statement days *without* a press conference, thus providing a proxy window, and the eighth row shows the same time window around each press conference. Hence, the window resembles the first 10 minutes before the start of the conference up to 60 minutes after the start. The results show an increase of more than one standard deviation in realized variance during press conferences, which is significantly different from the normal realized variance in a 70-minute window. Moreover, while the proxy window on statement days without a press conference shows a much smaller

[8] I restrict the press conference sample to these years to ensure homogeneous intraday effects.

increase in realized variance too, this effect is mostly insignificant.

Appendix Tables A.1 and A.2 show the same results for IEF, LQD, SPY, and QQQ. That is, a long-term treasury, corporate bond, S&P500, and Nasdaq 100 ETF, respectively. The described patterns in this section overwhelmingly mirror the patterns observed for the other ETFs. During press conferences, there is a multiple standard deviation increase in realized variance and, often, more than a doubling in trading volume. An effect of similar size is not observable for the proxy window of 14:20-15:30 on statement days without a press conference.

Figure 1 shows the logarithm of the realized variance on FOMC release days during the window of 13:00 to 15:30 between 2013 and 2018. The turquoise line shows days with a press conference, and the yellow line shows days without. Two gray vertical lines signify the release of the FOMC statement and the start of the press conference. Each panel shows a different ETF. The figure provides multiple insights. First, the panels confirm a higher realized variance around the statement release on days with a subsequent press conference. Second, market volatility tends to subside from 14:30 on during days without a press conference. Finally, and most importantly, market volatility tends to remain high, and often significantly increases, during the first 30 minutes of press conferences. Note that the figure is showing the *logarithm* of the realized variance to simplify the comparison. Appendix Figure A.1 shows the *ratio* of both realized variances instead and, thereby, reveals that the realized variance during press conferences is often more than five times larger than during the proxy window. Moreover, Appendix Figure A.2 shows that the trading volume tends to be around 50% larger during press conferences.

In summary, treasuries, corporate bonds, and the stock market exhibit exceptionally high realized variance during FOMC press conferences. The realized variance is often multiple magnitudes larger than during a proxy window of 14:20 to 15:30 on FOMC statement release days without a subsequent press conference. While the proxy window generally shows decreasing realized variance, FOMC press conferences often exhibit increasing realized variance during their first 30 minutes. All of this evidence suggests an important role of FOMC press conferences in communicating monetary policy.

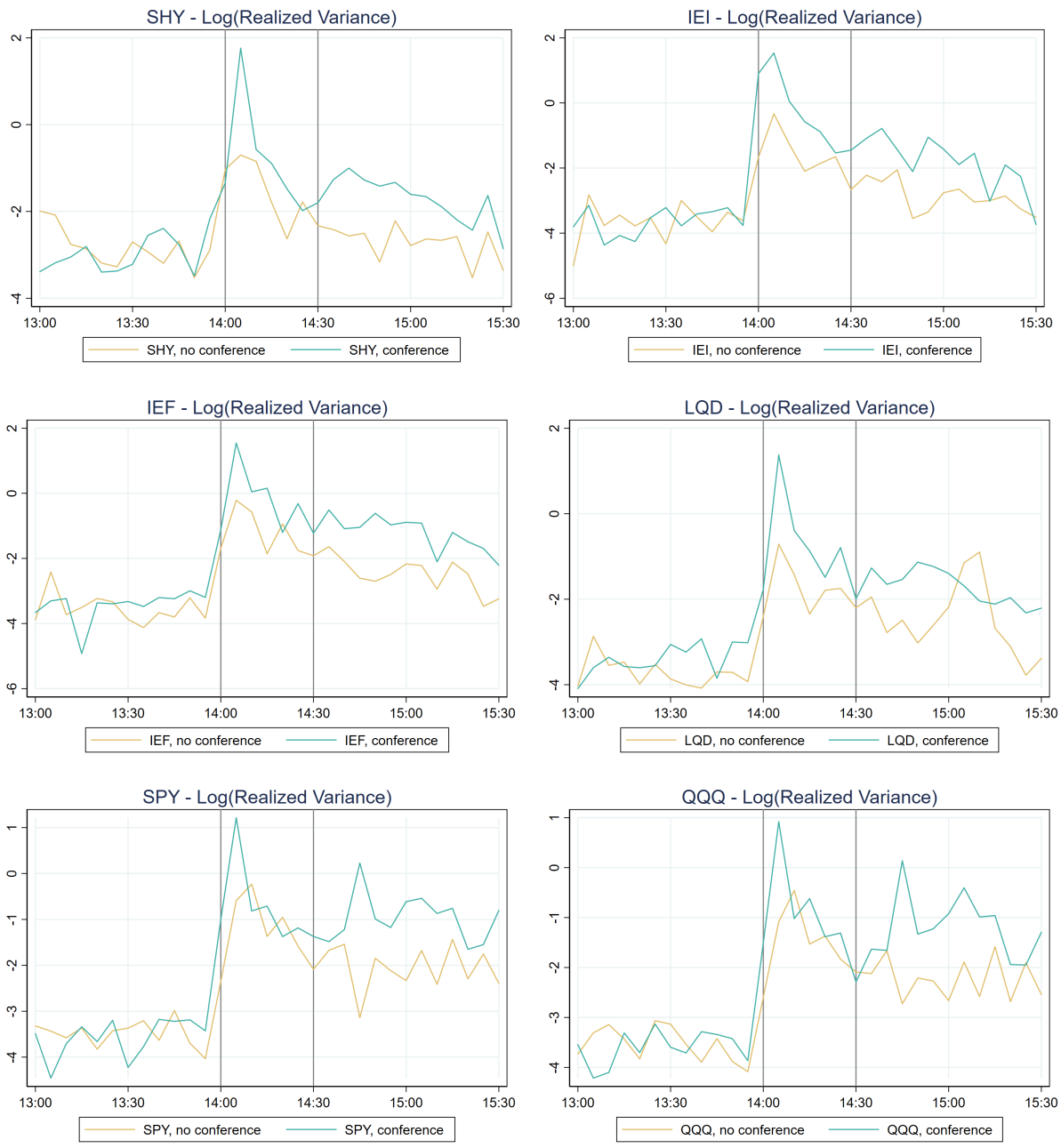

Figure 1: The graphs show the average of the logarithm of the realized variance during each five-minute window between 13:00 and 15:30 on statement release days between 2013 and 2018. FOMC days with subsequent press conferences are shown in turquoise, whereas FOMC days without press conferences are shown in yellow. During this window, all statements were released at 14:00, and all press conferences started at 14:30. The vertical gray lines mark the statement and press conference start times. Press conferences took, on average, 60 minutes.

4 Semantic Instruments

In this section, I construct semantic instruments that serve as proxies for monetary policy surprises conveyed by press conferences. Because there is no literature giving guidance on the semantics of FOMC press conferences yet, I proceed with three different measures – the press conference's tone, uncertainty, and topic distribution. All semantic measures require preprocessing of the transcript, which I explain before elaborating on the semantic instruments.

4.1 Preprocessing of the press conference transcripts

I restrict the press conferences to introductions, speeches, and answers made by the Fed's chair.[9] I transform all text to lower case and concatenate the most frequent phrases that have a unique meaning to a single word. Some examples of these phrases are *federal funds rate*, *labor market*, and *balance sheet*. The full list is in Appendix Section A.3. Then, I remove punctuation, numbers, and stop words. I use the stop word list of the Natural Language Toolkit in Python. Stop words do not add to the meaning of the sentence, e.g., *a*, *the*, and *my*.

4.2 Tone

Generally, a text's tone is determined by the share of *positively* and *negatively* connoted words. Which words are positive or negative, however, depends on the specialist context to which the tone measure is applied. Two recent applications to central bank statements are Hansen and McMahon (2016) and Ehrmann and Talmi (2020). I follow their approach by using a vocabulary of hawkish and dovish terms. Examples of hawkish terms are *expanding* and *accelerating*, whereas examples of dovish terms are *contracting* and *cooling*. The full list is in Appendix Section A.4. Then, the tone measure τ_c is computed as the difference

[9] An argument can be made that the questions asked by the press conference journalists should be included in the analysis. The journalist's questions tend to be directed at current topics and changes communicated via the prior statement. Moreover, journalists could direct the discourse to controversial topics that the statement and chair otherwise avoid. However, the Fed's chair answers every question in one way or another. Therefore, these topics will be, at least partially, covered in the chair's answers too.

between hawkish terms ω_c^+ and dovish terms ω_c^-, divided by the number of words spoken by the chair ω_c during press conference c as a percentage:

$$\tau_c = 100 \left(\frac{\omega_c^+ - \omega_c^-}{\omega_c} \right). \tag{4}$$

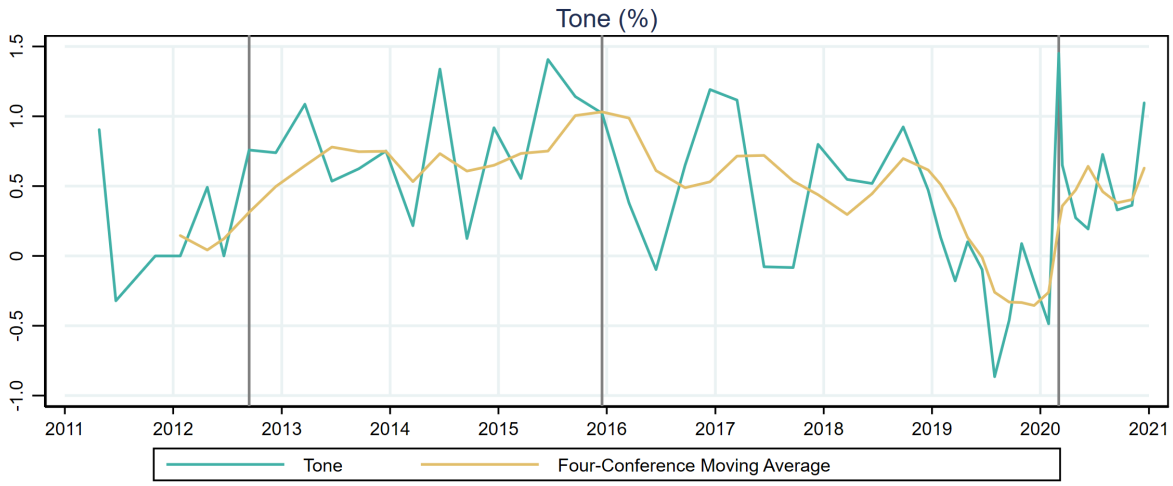

Figure 2: FOMC press conference tone over time. The gray lines mark important events in the history of monetary policy. September 13, 2012: The FOMC announces the third LSAP program. December 16, 2015: The FOMC announces the first interest rate hike after the financial crisis. March 3, 2020: The FOMC holds their first unscheduled press conference to respond to the COVID-19 pandemic.

4.3 Uncertainty

The uncertainty measure is similar to the tone measure. The idea here is to measure the share of words related to ambiguity. This technique was first introduced by Loughran and McDonald (2011) to measure the semantic content of 10-Ks. It found recent application in monetary economics (Hansen and McMahon, 2016; Hubert and Fabien, 2017). Examples of words associated with ambiguity are *uncertain* and *questionable*. The full list is in Appendix Section A.5. The uncertainty measure is then defined as the number of ambiguity words ω_c^A divided by the total number of words ω_c spoken during press conference c as a percentage:

$$\tau_c = 100 \left(\frac{\omega_c^A}{\omega_c} \right). \tag{5}$$

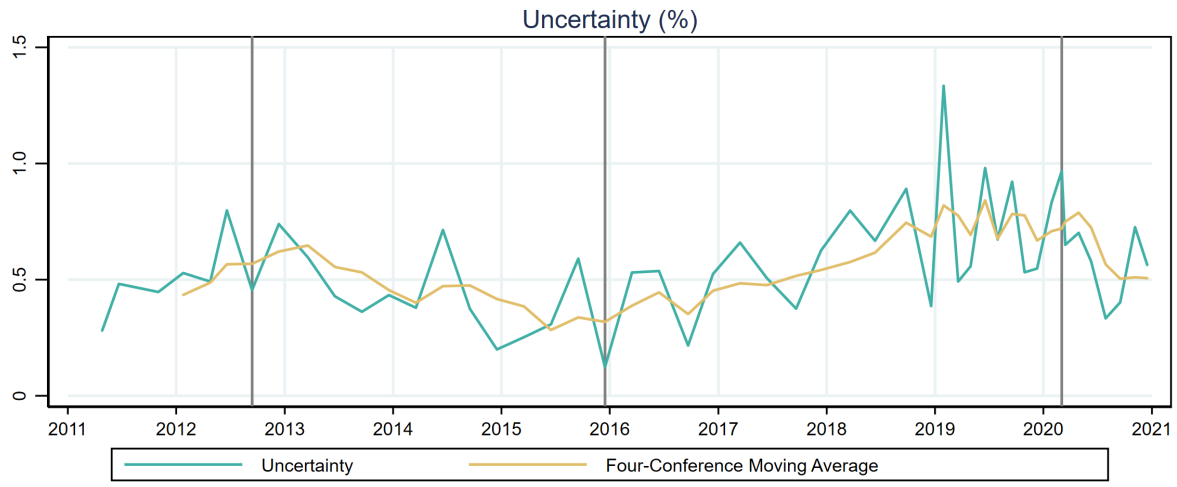

Figure 3: FOMC press conference uncertainty over time. The gray lines mark important events in the history of monetary policy. September 13, 2012: The FOMC announces the third LSAP program. December 16, 2015: The FOMC announces the first interest rate hike after the financial crisis. March 3, 2020: The FOMC holds their first unscheduled press conference to respond to the COVID-19 pandemic.

4.4 Latent Dirichlet Allocation

Latent Dirichlet Allocation (LDA) is a fully probabilistic topic modeling approach first applied by Blei et al. (2003). In contrast to the two previous dictionary methods, LDA does not require assumptions on what words are relevant. Intuitively, LDA divides all responses given by the chair into a predefined number of topics. The algorithm can be viewed as a form of principal component analysis (PCA), where the topics explain as much variation as possible while being most heterogeneous to each other. Every topic receives a probability of appearing in a response, and every word receives a probability of appearing in a topic. While the same word can appear in multiple topics, the probability of appearing will differ from topic to topic. LDA found recent applications in monetary economics, notably Hansen and McMahon (2016) and Hansen et al. (2018).

The LDA model requires three hyperparameters. I set the *document topic prior* θ to $1/n$, where n is the number of topics.[10] I follow Hansen et al. (2018) by setting the *topic word prior* β to 0.025. The low β ensures that topics are identified by relatively few, distinctive words. Finally, I chose the number of topics n to be 10 based on evaluating the approximate

[10]This is a standard choice. Intuitively, telling the algorithm that all topics could be equally likely.

log-likelihood at different numbers of topics.[11] See Appendix Figure A.3 for a plot of the likelihood function.

The input to LDA is the preprocessed corpus of the Fed chair's press conference speeches. I treat every response given as a paragraph, and the model outputs a probability distribution over topics for each paragraph. For example, the model could predict that a given response by the chair is 60% about topic A and 10% about topic B, and so on. I then aggregate these predicted shares for each paragraph in a press conference to determine the total share devoted to each topic.

Predicted topics

Table 3 shows the resulting 10 topics from the estimated LDA model. The topics are sorted by their correlation with a recession indicator, following the National Bureau of Economic Research (NBER)'s classification. The last seven columns show the most likely words to appear in a topic in decreasing frequency. I.e., starting from the most likely term to the seventh most likely term. LDA does not prescribe any natural ordering in their topic numbering, so the assigned topic numbers are only for reference. For each topic, I looked at the chair's responses with the highest probability of being about the topic. Then, I manually attributed them economic *meanings*, which are presented in the second column. Table 4 shows the chair's response with the strongest loading on topics 3, 5, and 9, respectively. These responses highlight how well the algorithm captured the economic meaning of the chair's responses.[12]

Most topics are already identifiable by only looking at the most prominent words. For example, the *inflation* topic is most associated with "inflation, percent, inflation expectations, target, low", whereas the *LSAP* topic talks about "interest rates, economy, balancesheet, tools, reserves". These most likely words give a good impression of what the topic conveys. Nevertheless, they provide an incomplete description of the topic's complexity. For example, it is only the analysis of the chair's responses with the strongest loading on topic 10 and the usage of the topic over time that clearly link topic 10 to *recovery*.

[11] I estimate the LDA model with the scikit-learn machine learning package in Python.

[12] Note that there is no inherent tendency in the algorithm to create meaningful topics. The model simply observes patterns of co-occurrence. It is by the nature of the press conferences that the resulting topics are meaningful.

T.	Meaning	R.	1	2	3	4	5	6	7
6	Corona pandemic/Misc.	.80	support	economy	credit	businesses	many	people	recovery
3	Fiscal stimulus/Recession	.33	economy	people	going	time	way	fiscal	like
8	Financial stability/Banks	.11	banks	capital	financialstability	important	financialsystem	financial	lot
1	Strong economy	-.23	economy	growth	outlook	strong	risks	policy	global
4	Long-term strategy/LSAP	-.33	interestrates	rates	economy	balancesheet	tools	reserves	level
5	Labor market/Consumers	-.35	labormarket	growth	people	unemployment	seen	economy	rate
9	Inflation	-.42	inflation	percent	move	inflationexpectations	target	low	time
2	Foreign markets / Currency	-.45	market	prices	markets	economy	financial	dollar	effects
7	Recovery	-.49	policy	appropriate	going	time	committee	economy	looking
10	Recovery/Miscellaneous	-.51	percent	inflation	committee	federalfundsrate	projections	participants	policy

Table 3: An overview of the FOMC press conference topics as determined by LDA. The first column shows the topic number as assigned by the algorithm. There is no economic or linguistic interpretation in the assigned topic numbers. The second column shows the economic meaning of the topic as identified by manual inspection. Topics are ordered by their correlation with recessions as assigned by the NBER. The last seven columns show the most likely tokens in each topic ordered from the most likely token to the seventh most likely token.

Topic	Meaning	Most significant quote
3	Fiscal stimulus / Recession	*"In terms of fiscal concern, so I—you know, I'm—for many years, I've been, before the Fed, I have long time been an advocate for the need for the United States to return to a sustainable path from a fiscal perspective at the federal level. We have not been on such a path for some time, which means—just means that the debt is growing faster than the economy. This is not the time to act on those concerns. This is the time to use the great fiscal power of the United States to—to do what we can to support the economy and try to get through this with as little damage to the longer-run productive capacity of the economy as possible."* **Jerome Powell** — (29 April 2020)
5	Labor market / Consumers	*"Yes. Well, you know, you can see the comparison by looking, for example, at the household survey, which gives estimates of how many people are added to the labor force, how many are added to the employed, how many people are leaving the labor force, and it's true that part of the decline in unemployment—and indeed all of it in the last reading, but over the recovery, part of the decline in unemployment has come from declines in participation rates, that is, people leaving the labor force."* **Ben Bernanke** — (12 December 2012)
9	Inflation	*"Well, we recognize that inflation is well below our 2 percent goal. The entire Committee is committed to achieving our 2 percent inflation objective over the medium term, just as we want to make sure that inflation doesn't persist at levels above our 2 percent objective. The Committee is equally committed—this is a symmetric goal—and the Committee is equally committed to not allowing inflation to persist below our 2 percent objective. Now, I've tried to explain—and many of my colleagues have as well—why we have reasonable confidence that inflation will move up over time, and the Committee declared it had reasonable confidence."* **Janet Yellen** — (16 December 2015)

Table 4: This table shows the most significant quote for each of the three topics selected by Lasso regression. The most significant quote is defined as the response with the highest likelihood assigned to a given topic out of all chair's press conference responses.

Topic selection

In the next section, I will use the change in the chair's topic coverage as an instrument for communicated monetary policy surprises. However, given the small sample of FOMC press conferences, adding all ten topics into the regression poses a serious risk of overfitting. Therefore, I subset the relevant topics by Lasso regression feature selection. For each ETF, I estimate the following Lasso regression:

$$\min_{\beta_1,\ldots,\beta_{10}} \left\{ \left(\text{Return}_{-10,+60} - \sum_{i=1}^{10} \beta_i \Delta \text{Topic } i \right)^2 \right\} \text{ s.t. } \sum_{i=1}^{10} \left| \beta_i \right| \leq t, \tag{6}$$

where ΔTopic i is the change in topic i coverage from one press conference to another, $\text{Return}_{-10,+60}$ is the ETF return in a window starting 10 minutes before the press conference up to 60 minutes after the beginning of the press conference, and t is a hyperparameter. I select t according to the Akaike information criterion (AIC). The selected topics are displayed in Table 5. Based on this table, I continue with topics 3, 5, and 9 for two reasons. First, it is natural to assume that monetary policy shocks transmit through treasury yields. Second, these three topics were also mostly selected as predictors of the stock market. Hence, the following analysis continues with the change in topic coverage of *fiscal stimulus* – mostly a request for more governmental aid, *labor market/consumers* – a discussion of the consumer side, and *inflation* – a topic talking about low inflation and the imminent threat of high inflation.

Topic	1	2	3	4	5	6	7	8	9	10
SHY	-	-	-	-	-	-	-	-	Y	-
IEI	-	-	-	-	Y	-	-	-	Y	-
IEF	-	-	Y	-	Y	-	-	-	Y	-
LQD	-	Y	Y	Y	Y	Y	Y	Y	Y	Y
SPY	-	Y	Y	Y	Y	Y	Y	Y	-	-
QQQ	Y	-	Y	Y	Y	-	Y	Y	-	-

Table 5: FOMC press conference topic selection by Lasso regression as in Equation (6).

Figure 4 shows the coverage of the three topics over time. While the labor market is a recurrent theme, the request for fiscal stimulus peaks after the financial crisis and during the Coronavirus pandemic, and inflation becomes most prominent during the first interest rate hike after the financial crisis.

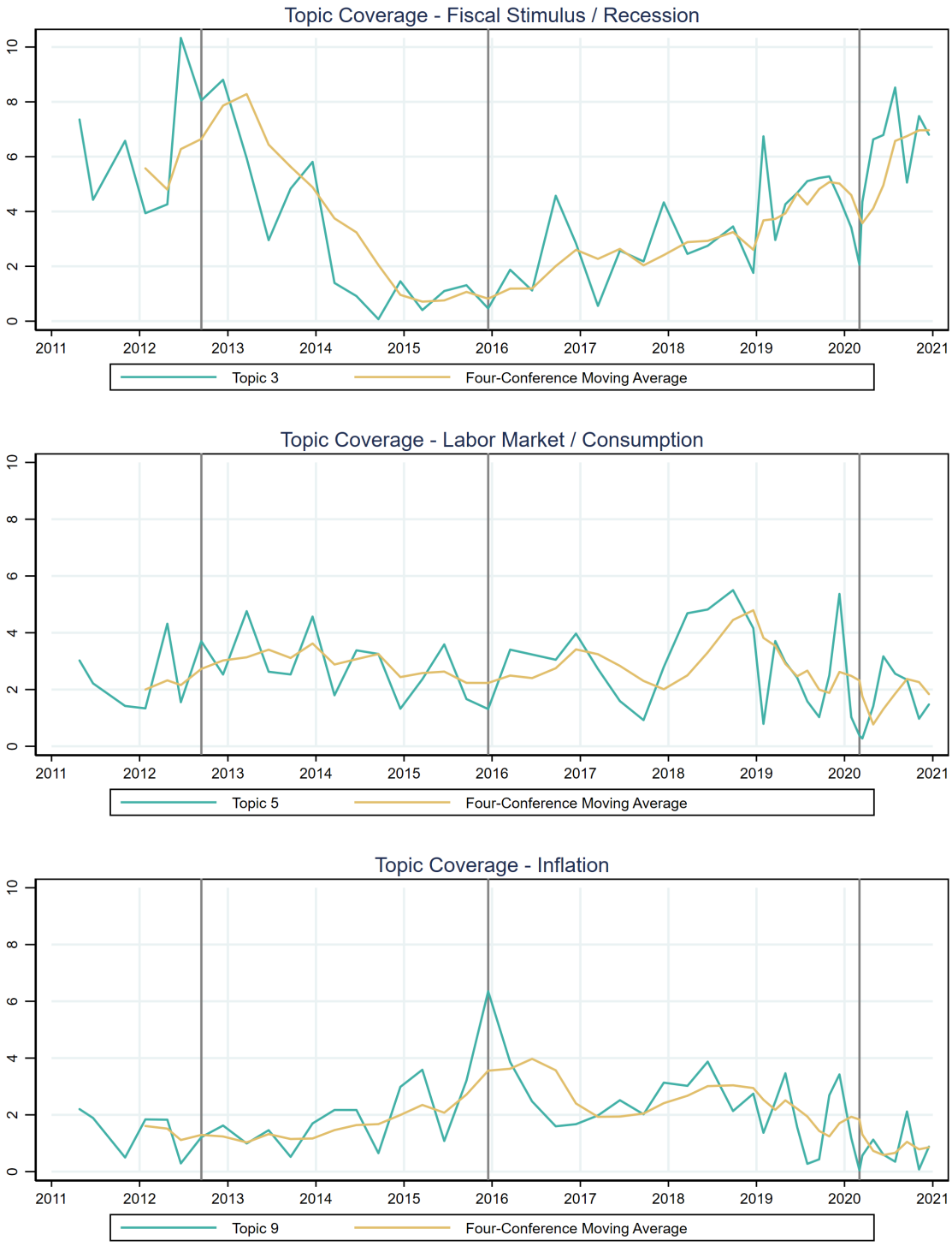

Figure 4: Time series of FOMC press conference topic coverage of topics 3, 5, and 9. That is, the *fiscal stimulus*, *labor market/consumers*, and *inflation* topic, respectively. The y-axis shows the aggregated share of each paragraph devoted to the topic. The gray lines mark important events in the history of monetary policy. September 13, 2012: The FOMC announces the third LSAP program. December 16, 2015: The FOMC announces the first interest rate hike after the financial crisis. March 3, 2020: The FOMC holds their first unscheduled press conference to respond to the COVID-19 pandemic.

5 Instrument Relevance

In this section, I will validate the relevance of the semantic instruments on their ability to predict treasury, corporate bond, or stock market reactions. Note that the purpose of those instruments is to identify monetary policy *surprises*. Hence, for each regression, I will use the change in the semantic measure from one press conference to another, i.e., changes in tone, uncertainty, and topic coverage.

5.1 Relevance

Tables 6 and 7 show a regression of the 70-minute window conference return on the change in tone and the change in uncertainty, respectively.[13,14] The change in tone has a relatively strong effect on stock markets but no effect on treasury yields. An increase in tone by 50 bps, which is one standard deviation, is associated with a rise in the S&P500 by 12.5 bps. The change in uncertainty, however, appears to have an effect on medium-term treasuries but no effect on stock markets. An increase in uncertainty by 30 bps, which is one standard deviation, increases 1-3 year treasury prices by 1.5 bps and 3-7 year treasury prices by 3 bps. The economic relevance and the R^2 of these effects are relatively small. However, the sign is clear: an increase in tone during the press conference is good news for the stock market, and an increase in conveyed uncertainty is tantamount to expansionary monetary policy.

	Conference 70min Returns, [14:20 - 15:30]					
	SHY	IEI	IEF	LQD	SPY	QQQ
ΔTone	−0.4	−0.7	2.6	5.3	25.0**	36.7**
	(1.6)	(4.3)	(5.7)	(5.4)	(12.2)	(14.4)
R^2	0.00	0.00	0.00	0.02	0.07	0.11
Adjusted R^2	−0.02	−0.03	−0.02	−0.01	0.05	0.09
N	39	35	39	39	39	39

Table 6: Regression of 70-minute window conference returns on the change in tone. Standard errors are below the coefficients in parenthesis. Standard errors use the heteroskedasticity robust Huber/White/sandwich estimator. Significance levels: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

[13] As always, the 70-minute window begins 10 minutes before the press conference and ends 60 minutes after the start of the press conference.

[14] Due to missing prices in the TAQ data, IEI has four observations less than the other tickers. This is the case in this regression table as in all subsequent regression tables.

	Conference 70min Returns, [14:20 - 15:30]					
	SHY	IEI	IEF	LQD	SPY	QQQ
ΔUnct	5.0**	10.0*	9.6	13.9*	9.1	26.6
	(2.3)	(5.1)	(7.7)	(8.2)	(31.8)	(35.2)
R^2	0.07	0.05	0.02	0.04	0.00	0.02
Adjusted R^2	0.05	0.02	−0.01	0.02	−0.02	−0.01
N	39	35	39	39	39	39

Table 7: Regression of 70-minute window conference returns on the change in uncertainty. Standard errors are below the coefficients in parenthesis. Standard errors use the heteroskedasticity robust Huber/White/sandwich estimator. Significance levels: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table 8 shows the same regression table for the three topic changes selected by Lasso regression. Topic 9, the inflation topic, significantly reduces treasury prices and, thus, acts as a contractionary monetary policy surprise. The sign is intuitive: a higher discourse about the dangers of inflation signals a stronger emphasis on keeping inflation in check. Topic 5, the labor market/consumers topic, increases long-run treasury and corporate bond prices and is good news for the stock market. This co-movement could be explained by the presence of a *portfolio-rebalancing* channel. First, the chair voices concern about consumption, which increases the market's perceived likelihood of future quantitative easing (QE). The portfolio-rebalancing channel helps bond yields fall in line with long-term treasury yields and, thus, increasing the attractiveness of stocks. Finally, topic 3, the fiscal stimulus topic, increases stock prices. Intuitively, stock markets could see the emphasis on fiscal stimulus as a nudge towards the government to stimulate the economy. Markets appear to believe that this nudge is, at least to some extent, convincing and anticipate future stimulus. This channel could be due to the *information effect* of FOMC announcements (Campbell et al., 2012; Nakamura and Steinsson, 2018).

The R^2s of the topic change regressions in Table 8 are multiple times larger than the R^2s of the tone and uncertainty change regressions in Tables 6 and 7. Also, the Adjusted R^2s of the topic change regressions are larger in every case.[15] The magnitudes are also more economically relevant: an increase in the coverage of topic 9 by 1.4 paragraphs, which is one standard deviation, decreases 7-10 year treasury prices (IEF) by 6 bps. An increase in the coverage of topic 5 by 1.7 paragraphs, which is one standard deviation, is associated

[15]This is even disregarding that the Adjusted R^2 is often negative in Tables 6 and 7.

with an increase of the S&P500 by 18.5 bps. Lastly, an increase of topic 3 by 2 paragraphs (one standard deviation) increases the S&P500 by 20 bps. From now on, I restrict my analysis to the change in topic measures because they dominate both the uncertainty and tone instrument.

	Conference 70min Returns, [14:20 - 15:30]					
	SHY	IEI	IEF	LQD	SPY	QQQ
ΔTopic 3	0.1	−0.4	1.4	2.2	9.8***	10.9***
	(0.4)	(1.2)	(1.7)	(1.6)	(3.2)	(4.0)
ΔTopic 5	0.7	2.4	3.4*	4.0**	10.9***	12.3**
	(0.5)	(1.4)	(2.0)	(1.7)	(4.0)	(4.6)
ΔTopic 9	−1.3*	−3.6*	−4.3*	−3.3	1.2	0.5
	(0.7)	(1.9)	(2.3)	(2.3)	(5.4)	(6.4)
R^2	0.13	0.18	0.14	0.18	0.24	0.22
Adjusted R^2	0.06	0.10	0.07	0.11	0.18	0.16
N	39	35	39	39	39	39

Table 8: Regression of 70-minute window conference returns on the change in topic coverage. Standard errors are below the coefficients in parenthesis. Standard errors use the heteroskedasticity robust Huber/White/sandwich estimator. Significance levels: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

5.2 Relation to intraday effects

There are two major concerns when looking at the previous regressions in isolation. First, the topics covered during the press conference could reflect the policy communicated in the statement or the information released in the SEP. If that is the case, the chair's topic coverage should have no effect on prices, and every effect observed would be spurious. Second, the exceptional returns during the press conference could result from endogenous intraday effects that are the consequence of earlier news. In that case, again, any observed relationships between the topic coverage and returns would be spurious. However, in this subsection, I argue that neither of those hypotheses suffices to explain the results in Subsection 5.1.

Table 9 shows the explanatory power of Swanson (2021)'s monetary policy surprise measures on returns during the press conference. Note that Swanson's measures are based only on a 30-minute window around the statement release. All Swanson surprises are coded to be contractionary. The Adjusted R^2 is very low for short- to medium-term treasuries and the stock markets. However, the Swanson forward guidance and LSAP factor explain a substan-

tial portion of the 7-10 year treasury and corporate bond price changes. While this could be coincidental, this is evidence that the threat to causality by intraday effects is real.[16]

	Conference 70min Returns, [14:20 - 15:30]					
	SHY	IEI	IEF	LQD	SPY	QQQ
Swanson FFR	−1.0	4.0	8.8	−11.0	−39.5	−58.9
	(4.0)	(10.9)	(13.3)	(10.6)	(80.5)	(83.1)
Swanson FG	−1.7	−3.4	−5.2	−8.8**	−14.1	−17.4*
	(1.4)	(3.2)	(3.7)	(3.8)	(9.9)	(9.6)
Swanson LSAP	−0.7	−11.7	−22.4***	−13.8***	0.6	−0.8
	(1.5)	(11.1)	(4.4)	(4.2)	(16.3)	(18.3)
R^2	0.11	0.14	0.52	0.47	0.09	0.13
Adjusted R^2	−0.00	0.01	0.46	0.40	−0.02	0.02
N	28	24	28	28	28	28

Table 9: Regression of 70-minute window conference returns on Swanson (2021) monetary policy surprises. Standard errors are below the coefficients in parenthesis. Standard errors use the heteroskedasticity robust Huber/White/sandwich estimator. Significance levels: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Nevertheless, the change in topic coverage remains significant even after controlling for Swanson's monetary policy surprises, as shown in Table 10.[17] The Adjusted R^2 is higher in all specifications – on average, by more than 0.1. Notably, even in the IEF and LQD regressions, which are well explained by Swanson's surprises, the Adjusted R^2 increased considerably. Therefore, intraday effects are unable to sufficiently explain the returns during the press conference window.

[16]For example, markets could have repeatedly underestimated the impact of FG and LSAP from the statement but realized the extent after the chair affirms the commitment. In this case, the Swanson surprises would still miss out on this surprise component, although they are correlated with it.

[17]Note that Swanson's monetary policy surprises are only available up to June 2019. Thus, coincidentally, they show that the topic change instrument is also significant within the subset of conferences covered by Swanson's shocks.

	Conference 70min Returns, [14:20 - 15:30]					
	SHY	IEI	IEF	LQD	SPY	QQQ
Swanson FFR	−0.7	7.1	8.0	−13.0	−31.9	−54.1
	(5.1)	(10.0)	(12.5)	(9.9)	(69.9)	(74.5)
Swanson FG	−1.5	−2.7	−4.8	−8.5**	−10.7	−14.4*
	(1.4)	(2.7)	(3.7)	(3.2)	(8.7)	(8.4)
Swanson LSAP	−1.1	−23.2***	−24.3***	−15.3***	8.2	6.2
	(1.7)	(7.8)	(4.1)	(3.8)	(17.8)	(21.0)
ΔTopic 3	−0.2	−1.3	−1.6	−1.6	7.6*	6.3
	(0.5)	(1.3)	(1.5)	(1.8)	(4.2)	(4.8)
ΔTopic 5	0.4	0.5	1.3	2.1	13.4*	13.8*
	(0.6)	(1.7)	(1.8)	(1.9)	(6.5)	(7.1)
ΔTopic 9	−1.9**	−7.2***	−6.7**	−5.5**	1.8	1.9
	(0.9)	(2.4)	(2.7)	(2.5)	(8.0)	(9.0)
R^2	0.30	0.48	0.66	0.61	0.27	0.26
Adjusted R^2	0.11	0.30	0.57	0.51	0.07	0.06
N	28	24	28	28	28	28

Table 10: Regression of 70-minute window conference returns on Swanson (2021) monetary policy surprises and changes in topic coverage. Standard errors are below the coefficients in parenthesis. Standard errors use the heteroskedasticity robust Huber/White/sandwich estimator. Significance levels: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Appendix Tables A.3 and A.4 put those numbers into perspective by applying the same analysis to returns during the statement release window. Swanson's surprise measures explain about 40% of the variation in stock market prices during the statement window, although the surprises were constructed as principal component of price changes during the same window. Hence, the explanatory power of 24% by the topic changes in Table 8 is impressive. Moreover, measuring the semantic content of statements and using them to predict statement returns scores even more modestly. The change in the first federal funds future and the statement's change in tone, uncertainty, cosine-similarity, and an indicator for previously high cosine-similarity collectively achieve an R^2 of between 0.08 and 0.14.[18] Therefore, the semantic instruments I constructed are highly meaningful when compared to previous research. Nevertheless, the topic measures are just a crude approximation of the information conveyed by the press conference. I conclude that they provide a lower bound of the effects of the press conference on treasuries, corporate bonds, and stock markets.

[18]Refer to Ehrmann and Talmi (2020) for an explanation of the cosine-similarity measures.

5.3 Robustness

Tables 11 and 12 show that the ΔTopic coefficients are robust to various specifications for the 3-7 year treasury and the S&P500 ETF. The first column shows the baseline regression from Table 8. One concern is the small sample size. Column *LAV* and Column *Robust* address this concern with two popular approaches. LAV uses a least absolute value regression. Intuitively, least absolute values decreases the impact of outliers by not squaring their residuals. Robust uses a robust regression specification as in Li (1985), which is based on omitting the most important observations.

Column *Return* controls for the observed return during the statement release window, i.e., from 13:40 to 14:20. Including this coefficient would make ΔTopic insignificant if the return would be purely the result of market momentum or mean reversion. Column *Swanson* shows the effect of including the Swanson surprises again, for reference, as in Table 10. Column *Semantic* includes semantic instruments constructed from the statements to show that the semantic measures of the press conference do not merely reflect the statement. Finally, the last two columns, *SEP Y0* and *SEP Y2*, include the announced change in the median SEP current year and two-year ahead projection of GDP, unemployment, and PCE inflation. Hence, the topic changes do not merely reflect changes in the announced economic projections. Even more, these columns show that the relationship is robust to restricting the sample even further because not every press conference came with a preceding SEP release.

The coefficients remain mostly significant across all robustness specifications. Hence, the semantic instrument ΔTopic is highly robust to a variety of controls for intraday, statement, and SEP characteristics.

	IEI – Conference 70min Returns, [14:20 - 15:30]							
	Baseline	LAV	Robust	Return	Swanson	Semantic	SEP Y0	SEP Y2
ΔTopic 3	−0.4	0.4	−0.1	−0.9	−1.3	−0.3	−0.9	−0.6
	(1.2)	(1.6)	(1.4)	(1.1)	(1.3)	(1.2)	(1.6)	(1.6)
ΔTopic 5	2.4	2.9*	2.3	2.1	0.5	2.9*	3.4*	3.7*
	(1.4)	(1.7)	(1.5)	(1.5)	(1.7)	(1.5)	(1.9)	(2.1)
ΔTopic 9	−3.6*	−0.8	−3.2*	−3.5*	−7.2***	−2.2	−3.3	−2.6
	(1.9)	(1.8)	(1.8)	(2.0)	(2.4)	(2.1)	(2.0)	(2.3)
$\text{Return}_{13:40,14:20}$				0.2				
				(0.1)				
Swanson FFR					7.1			
					(10.0)			
Swanson FG					−2.7			
					(2.7)			
Swanson LSAP					−23.2***			
					(7.8)			
ΔFFF 1						−4.2	1.1	1.6
						(4.8)	(3.5)	(3.8)
Statement ΔTone						−1.2		
						(4.3)		
Statement ΔUnct						12.3*		
						(7.1)		
ΔSEP GDP0							−6.9	
							(9.8)	
ΔSEP Unempl0							−13.6	
							(13.9)	
ΔSEP PCE0							−14.9	
							(13.3)	
ΔSEP GDP2								−1.7
								(17.5)
ΔSEP Unempl2								6.9
								(19.2)
ΔSEP PCE2								51.2
								(87.6)
R^2	0.18		0.14	0.24	0.48	0.26	0.33	0.26
Adjusted R^2	0.10		0.06	0.14	0.30	0.11	0.10	0.00
N	35	35	35	35	24	35	27	27

Table 11: Various robustness tests for the IEI column regression in Table 10, i.e., the return in 3-7 year treasuries. LAV shows a least absolute value regression. Column Robust shows a robust regression as in Li (1985). The other columns include various controls for the statement window return, Swanson (2021) surprises, the statement's semantics, and SEP median forecast changes. Standard errors are below the coefficients in parenthesis. Standard errors use the heteroskedasticity robust Huber/White/sandwich estimator. Significance levels: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

	SPY – Conference 70min Returns, [14:20 - 15:30]							
	Baseline	LAV	Robust	Return	Swanson	Semantic	SEP Y0	SEP Y2
ΔTopic 3	9.8***	9.3*	7.6**	8.8***	7.6*	9.4***	11.2**	10.9*
	(3.2)	(4.9)	(3.4)	(3.1)	(4.2)	(3.1)	(5.3)	(5.4)
ΔTopic 5	10.9***	11.0*	8.9**	9.6***	13.4*	9.9**	11.1	11.4
	(4.0)	(5.5)	(3.9)	(3.5)	(6.5)	(4.7)	(6.5)	(6.7)
ΔTopic 9	1.2	1.0	0.4	1.0	1.8	0.6	1.2	0.7
	(5.4)	(7.5)	(4.9)	(5.4)	(8.0)	(5.8)	(7.6)	(8.2)
$\text{Return}_{13:40,14:20}$				0.2				
				(0.2)				
Swanson FFR					−31.9			
					(69.9)			
Swanson FG					−10.7			
					(8.7)			
Swanson LSAP					8.2			
					(17.8)			
ΔFFF 1						−3.1	5.7	5.4
						(12.7)	(13.6)	(13.9)
Statement ΔTone						10.6		
						(9.7)		
Statement ΔUnct						−1.5		
						(30.8)		
ΔSEP GDP0							−21.7	
							(36.1)	
ΔSEP Unempl0							−38.5	
							(50.8)	
ΔSEP PCE0							−3.0	
							(45.5)	
ΔSEP GDP2								−18.7
								(63.6)
ΔSEP Unempl2								−4.8
								(62.7)
ΔSEP PCE2								−29.8
								(278.1)
R^2	0.24		0.21	0.28	0.27	0.25	0.27	0.25
Adjusted R^2	0.18		0.14	0.20	0.07	0.12	0.05	0.03
N	39	39	39	39	28	39	31	31

Table 12: Various robustness tests for the SPY column regression in Table 10, i.e., the S&P500 return. LAV shows a least absolute value regression. Column Robust shows a robust regression as in Li (1985). The other columns include various controls for the statement window return, Swanson (2021) surprises, the statement's semantics, and SEP median forecast changes. Standard errors are below the coefficients in parenthesis. Standard errors use the heteroskedasticity robust Huber/White/sandwich estimator. Significance levels: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

6 Economic Relevance

Section 5 showed that the change in topic coverage is a relevant and robust semantic instrument for press conference news. This section measures the relevance of those surprises in the context of the total monetary surprise of the FOMC announcement.

In line with my previous analysis and the work of Gu et al. (2018), I define the total event window from 13:50 to 15:30. In other words, 100 minutes that start 10 minutes before the release of the statement and end 60 minutes after the start of the press conference. Table 13 shows the explanatory power of the Swanson monetary policy surprises for the total event window. The Adjusted R^2 ranges from 0.68 to 0.82 for the treasury and corporate bond ETFs but is around 0.14 for the stock market ETFs. Note that the Swanson surprises are constructed to explain treasury and currency changes, which are likely transmitters of monetary policy, and not stock market changes.

	Statement + Conference 100min Returns, [13:50 - 15:30]					
	SHY	IEI	IEF	LQD	SPY	QQQ
Swanson FFR	−2.7	6.3	19.2	−1.8	−34.3	−77.8
	(4.0)	(11.8)	(15.5)	(24.0)	(127.5)	(134.0)
Swanson FG	−9.4***	−24.1***	−29.1***	−31.1***	−38.7**	−46.0***
	(1.3)	(3.1)	(4.4)	(5.1)	(14.3)	(15.2)
Swanson LSAP	0.2	−20.9*	−39.5***	−35.8***	−2.9	6.3
	(1.4)	(11.3)	(5.9)	(7.9)	(25.6)	(29.1)
Constant	0.4	−2.9	−0.8	5.2	12.5	18.9
	(1.2)	(4.0)	(4.4)	(4.9)	(16.0)	(15.6)
R^2	0.73	0.72	0.84	0.82	0.23	0.24
Adjusted R^2	0.70	0.68	0.82	0.80	0.13	0.14
N	28	24	28	28	28	28

Table 13: Regression of 100-minute window statement + conference returns on Swanson (2021) monetary policy surprises. Standard errors are below the coefficients in parenthesis. Standard errors use the heteroskedasticity robust Huber/White/sandwich estimator. Significance levels: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table 14 shows the same regression with added ΔTopic coefficients. The Adjusted R^2 of the treasury ETFs is, on average, 0.08 larger. The biggest improvement was achieved for the 3-7 year treasury bonds, with an Adjusted R^2 growth of 20%.[19] The adjusted R^2 increase

[19]Henceforth, I denote R^2's magnitude in decimals and growth in percentage points.

of 0.04 for corporate bonds is smaller, although not negligible. Moreover, the explained sum of squares for the S&P500 ETF increased by 0.06, which is an increase of 46%, and for the Nasdaq 100 ETF, it rose by 21%. Still, the high increase in Adjusted R^2 for the stock market returns should be treated with caution because it could be contaminated by the information channel effect.

	Statement + Conference 100min Returns, [13:50 - 15:30]					
	SHY	IEI	IEF	LQD	SPY	QQQ
Swanson FFR	−2.0	14.2	20.4	1.2	−24.5	−72.4
	(6.0)	(11.0)	(15.9)	(20.3)	(110.2)	(120.6)
Swanson FG	−9.0***	−22.6***	−27.8***	−29.4***	−32.8**	−40.7**
	(1.1)	(2.4)	(3.9)	(4.2)	(14.5)	(14.9)
Swanson LSAP	0.1	−33.9***	−40.8***	−36.3***	9.0	17.9
	(1.6)	(7.8)	(5.0)	(7.1)	(30.6)	(35.0)
ΔTopic 3	0.2	0.2	−0.5	0.7	12.5	11.2
	(0.6)	(1.4)	(1.8)	(2.1)	(7.5)	(8.3)
ΔTopic 5	0.7	1.6	2.6	2.7	18.4*	19.8
	(0.7)	(1.9)	(2.2)	(2.5)	(10.7)	(11.8)
ΔTopic 9	−1.9**	−8.5***	−8.6***	−7.6**	4.0	5.4
	(0.9)	(2.4)	(2.9)	(3.3)	(10.4)	(11.9)
Constant	0.5	−3.4	−0.6	5.4	14.9	21.5
	(1.3)	(3.4)	(4.4)	(4.6)	(13.7)	(14.4)
R^2	0.81	0.87	0.90	0.88	0.37	0.36
Adjusted R^2	0.75	0.82	0.87	0.84	0.19	0.17
N	28	24	28	28	28	28

Table 14: Regression of 100-minute window statement + conference returns on Swanson (2021) monetary policy surprises and changes in topic coverage. Standard errors are below the coefficients in parenthesis. Standard errors use the heteroskedasticity robust Huber/White/sandwich estimator. Significance levels: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

While an increase in explanatory power by 20% for the 3-7 year treasury ETF seems modest, I view this as a lower bound of the press conference's monetary policy shock. The standard approach of high-frequency identification uses all returns realized during the event window instead of instrumenting them. Appendix Table A.5 shows how much the latter approach would add in explanatory power. Defining the full press conference return as news shock, on average, increases the Adjusted R^2 for the treasuries by about 30% and for the stock markets by 500% compared to the Swanson instruments alone. As previously explained, this approach cannot be applied here without precautions regarding intraday effects and the

information channel. However, this still provides an upper bound on the magnitude of the press conference's monetary policy shock.

7 Conclusion

During FOMC press conferences, treasuries, corporate bonds, and stock markets exhibit abnormal returns and realized variance. While this result is partially due to intraday effects, a significant portion can be explained by semantic instruments of monetary policy shocks. I speculate that the semantic instruments capture an inflation hawk, portfolio-rebalancing, and information channel through which press conferences affect markets. The magnitude of these channels is meaningful – when defining the total event window to include the statement and the press conference, incorporating the semantic instruments increases the explained variation in 3-7 year treasury prices by 20% over the traditional high-frequency identification approach. Because these instruments capture only a subset of the multifaceted press conference news, the 20% increase provides a lower bound for the true relevance. Ignoring the press conference window causes any monetary policy shock identification to be imprecise. In other words, *FOMC press conferences matter*.

These conclusions open up a new field of research but also raise caution in how to treat press conferences. While Swanson (2021)'s work could be improved by adding press conferences to the event window, the identifying assumptions must ensure no contamination by intraday effects or the information channel. These new, more precisely measured, monetary policy shocks can then be used for proxy-SVARs or in policy work. In any case, press conferences now follow every FOMC meeting, and they are here to stay. They can no longer be ignored.

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A Appendix

A.1 Tables

		IEF			LQD		
Statistic	N	return	realvar	volume	return	realvar	volume
all, 2000-2018	205,046	0.0	0.3	0.9	0.0	0.2	1.6
[30min]		(7.9)	(1.0)	(2.8)	(10.6)	(1.0)	(2.6)
statements, 2000-2018	152	2.0***	3.7***	1.7***	2.4**	1.3***	2.5***
[30min]		(35.2)	(4.9)	(1.8)	(38.9)	(3.4)	(2.9)
statements, 2000-2010	88	2.1*	4.6***	0.8	2.8*	2.3***	0.6**
[30min]		(44.0)	(6.1)	(0.7)	(51.7)	(5.2)	(0.7)
statements, 2011-2018	32	−0.2	1.7***	1.7*	−0.7	0.3	3.0***
[without conference, 30min]		(15.7)	(2.0)	(1.2)	(16.2)	(0.3)	(2.6)
statements, 2011-2018	32	4.0***	4.2***	3.1***	5.0***	0.9***	4.3***
[with conference, 30 min]		(33.8)	(4.5)	(2.5)	(33.5)	(1.5)	(3.5)
all, 2013-2018	64,906	−0.1	0.4	3.1	−0.1	0.4	5.6
[70min]		(9.2)	(1.0)	(6.8)	(8.9)	(1.0)	(5.6)
proxy 14:20-15:30, 2013-2018	23	5.3***	1.0**	4.0	5.8***	1.4***	6.4
[70min]		(13.1)	(0.7)	(2.5)	(14.7)	(2.4)	(4.7)
conference, 2013-2018	24	1.5	3.4***	6.0**	2.7	2.4***	11.6***
[70min]		(26.6)	(3.5)	(3.5)	(23.0)	(2.1)	(7.7)

Table A.1: Average return, realized variance, and trading volume for various time windows of IEF (7-10 year treasuries) and LQD (investment-grade corporate bonds). Standard deviations are in parenthesis below. Asterisks show the p-value of a difference-in-means t-test between a subset of returns and their benchmark. Significance levels: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. For details, refer to Table 2.

Statistic	N	SPY return	SPY realvar	SPY volume	QQQ return	QQQ realvar	QQQ volume
all, 2000-2018 [30min]	205,046	0.2 (25.0)	0.3 (1.0)	66.6 (78.1)	−0.1 (39.2)	0.3 (1.0)	29.9 (26.4)
statements, 2000-2018 [30min]	152	−1.1 (47.0)	1.6*** (2.6)	197.8*** (173.6)	−8.1** (58.4)	1.5*** (3.2)	74.5*** (55.1)
statements, 2000-2010 [30min]	88	−6.1** (51.9)	2.0*** (2.9)	202.0*** (194.3)	−29.3*** (73.6)	3.2*** (4.6)	109.3*** (59.0)
statements, 2011-2018 [without conference, 30min]	32	−8.7** (30.7)	0.9*** (2.0)	171.5*** (156.0)	−9.1 (34.2)	0.5 (1.0)	46.2*** (44.5)
statements, 2011-2018 [with conference, 30 min]	32	19.9*** (40.8)	1.2*** (2.0)	212.7*** (124.7)	18.8*** (44.0)	0.6 (1.3)	58.7*** (33.7)
all, 2013-2018 [70min]	64,906	0.2 (24.4)	0.4 (1.0)	129.4 (92.0)	0.1 (29.9)	0.3 (1.0)	42.5 (31.8)
proxy 14:20-15:30, 2013-2018 [70min]	23	−4.2 (39.4)	0.8* (0.9)	203.4*** (118.0)	−4.0 (45.9)	0.5 (0.6)	59.5** (25.6)
conference, 2013-2018 [70min]	24	−3.0 (59.1)	2.2*** (3.9)	376.2*** (215.6)	0.1 (66.1)	1.4*** (3.1)	112.3*** (58.7)

Table A.2: Average return, realized variance, and trading volume for various time windows of SPY (S&P500) and QQQ (Nasdaq 100). Standard deviations are in parenthesis below. Asterisks show the p-value of a difference-in-means t-test between a subset of returns and their benchmark. Significance levels: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. For details, refer to Table 2.

	Statement 30min Returns, [13:50 - 14:20]					
	SHY	IEI	IEF	LQD	SPY	QQQ
Swanson FFR	0.1	1.7	10.9	18.4	25.2	19.3
	(1.4)	(4.9)	(7.4)	(11.5)	(29.1)	(35.5)
Swanson FG	−7.6***	−19.1***	−22.4***	−22.0***	−27.4***	−31.8***
	(0.5)	(1.7)	(2.4)	(2.7)	(6.3)	(6.3)
Swanson LSAP	0.7	−7.0	−16.4***	−20.6***	−2.4	6.9
	(0.8)	(4.5)	(4.5)	(6.9)	(10.8)	(11.1)
R^2	0.88	0.85	0.79	0.78	0.39	0.40
Adjusted R^2	0.88	0.84	0.78	0.76	0.35	0.36
N	51	44	51	51	51	51

Table A.3: Regression of 30-minute window statement returns on Swanson (2021) monetary policy surprises. Standard errors are below the coefficients in parenthesis. Standard errors use the heteroskedasticity robust Huber/White/sandwich estimator. Significance levels: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

	Statement 30min Returns, [13:50 - 14:20]					
	SHY	IEI	IEF	LQD	SPY	QQQ
ΔFFF 1	1.0	3.0	1.2	1.0	−5.2	−2.8
	(1.3)	(3.4)	(4.3)	(4.5)	(10.4)	(10.9)
ΔTone	0.1	−0.2	0.4	0.5	−1.3	−2.0
	(1.0)	(2.7)	(3.7)	(4.4)	(6.4)	(7.0)
ΔUnct	7.8*	17.4	18.4	28.4	18.8	23.5
	(4.4)	(12.2)	(14.4)	(20.4)	(16.4)	(17.3)
Similarity	3.8**	11.0**	13.1**	11.9**	24.5*	24.8*
	(1.6)	(4.4)	(5.3)	(5.2)	(13.3)	(13.3)
$\text{Sim}_{t-1} \geq$ 66th pct	−3.4**	−10.4**	−10.9*	−7.6	−15.4	−13.9
	(1.7)	(4.6)	(6.2)	(6.7)	(15.4)	(15.4)
R^2	0.13	0.14	0.08	0.08	0.08	0.08
Adjusted R^2	0.05	0.05	−0.00	−0.00	0.00	−0.00
N	63	56	63	63	63	63

Table A.4: Regression of 30-minute window statement returns on the statement's semantic measures and the change in the first federal funds future. Standard errors are below the coefficients in parenthesis. The semantic measures use the change in tone, change in uncertainty, and cosine similarity as in Ehrmann and Talmi (2020). Standard errors use the heteroskedasticity robust Huber/White/sandwich estimator. Significance levels: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

	Statement + Conference 100min Returns, [13:50 - 15:30]					
	SHY	IEI	IEF	LQD	SPY	QQQ
Swanson FFR	−3.1	−2.2	6.0	10.8	7.8	8.8
	(1.9)	(10.1)	(12.0)	(17.3)	(23.1)	(24.6)
Swanson FG	−7.7***	−20.1***	−23.4***	−22.6***	−18.0**	−22.3***
	(0.6)	(1.8)	(2.8)	(3.0)	(7.3)	(7.9)
Swanson LSAP	0.9	−8.6	−17.3***	−22.2***	−3.9	7.5
	(0.8)	(6.1)	(5.1)	(7.5)	(8.8)	(8.7)
$\text{Return}_{14:20,15:30}$	0.9***	1.0***	1.0***	1.0***	1.4***	1.4***
	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)
Constant	1.1*	−0.1	1.7	4.2	19.0***	16.3**
	(0.6)	(2.4)	(3.2)	(3.4)	(5.3)	(6.0)
R^2	0.96	0.94	0.95	0.93	0.89	0.91
Adjusted R^2	0.95	0.93	0.94	0.92	0.88	0.89
N	28	24	28	28	28	28

Table A.5: Regression of 100-minute window statement + conference returns on Swanson (2021) monetary policy surprises and the return achieved during the press conference window. Standard errors are below the coefficients in parenthesis. Standard errors use the heteroskedasticity robust Huber/White/sandwich estimator. Significance levels: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

A.2 Graphs

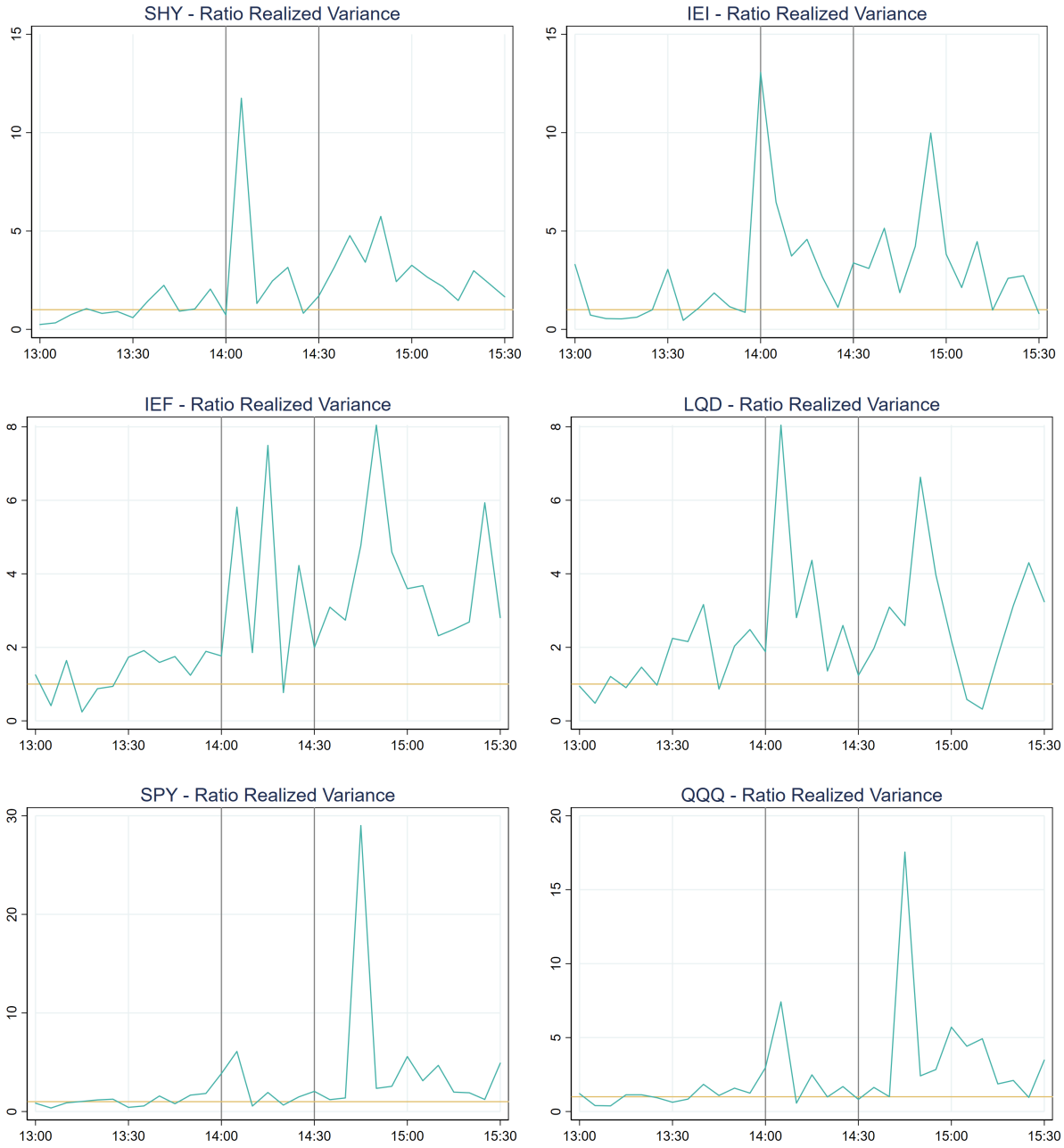

Figure A.1: The graphs show the ratio between the realized variance on FOMC days with press conference and without during each five-minute window between 13:00 and 15:30 between 2013 and 2018. The ratio is shown in turquoise, whereas the horizontal yellow line indicates a ratio of 1. During this window, all statements were released at 14:00, and all press conferences started at 14:30. The vertical gray lines mark the statement and press conference start times. Press conferences took, on average, 60 minutes.

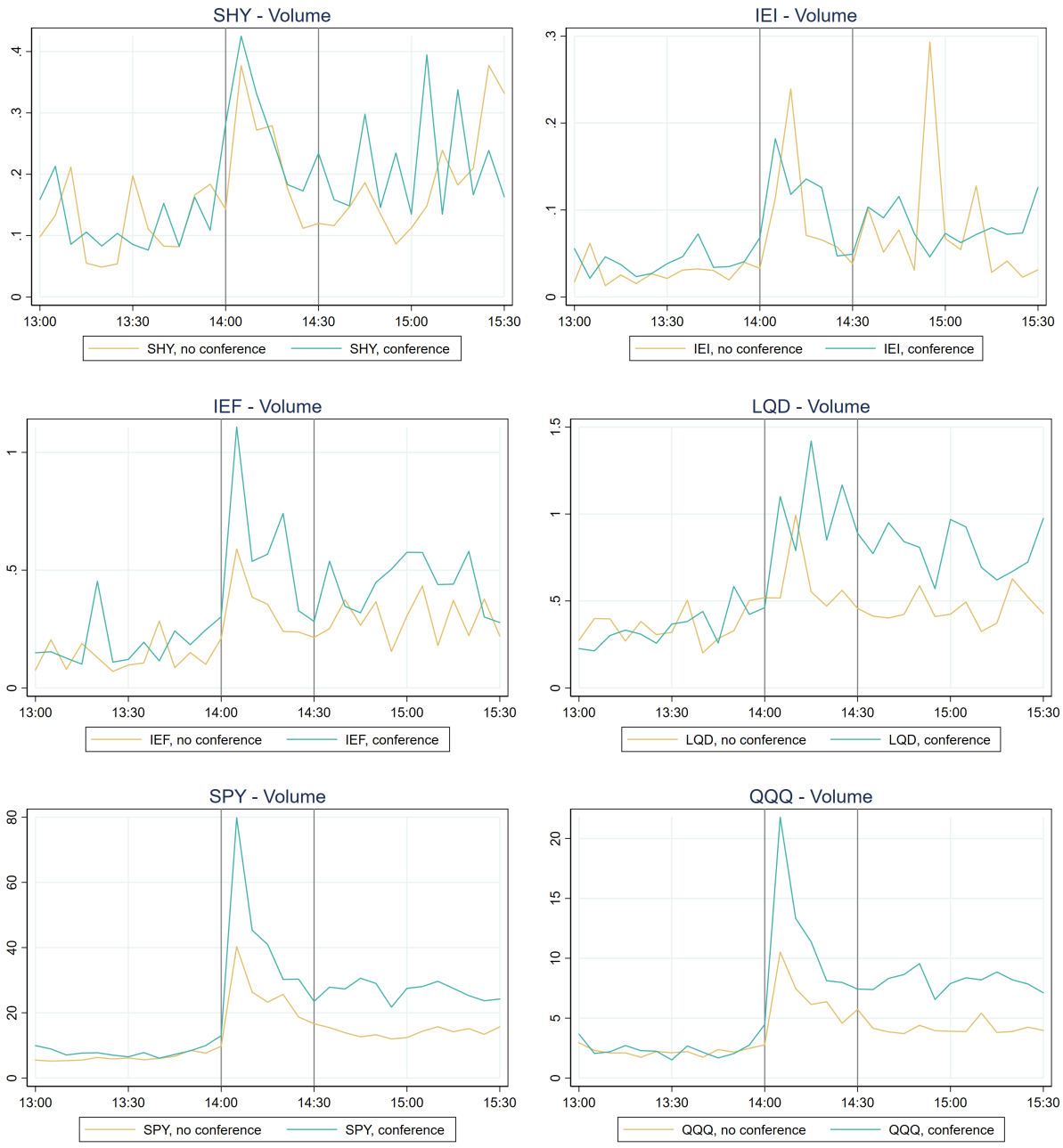

Figure A.2: The graphs show the trading volume in 100,000 shares during each five-minute window between 13:00 and 15:30 on statement release days between 2013 and 2018. FOMC days with subsequent press conferences are shown in turquoise, whereas FOMC days without press conferences are shown in yellow. During this window, all statements were released at 14:00, and all press conferences started at 14:30. The vertical gray lines mark the statement and press conference start times. Press conferences took, on average, 60 minutes.

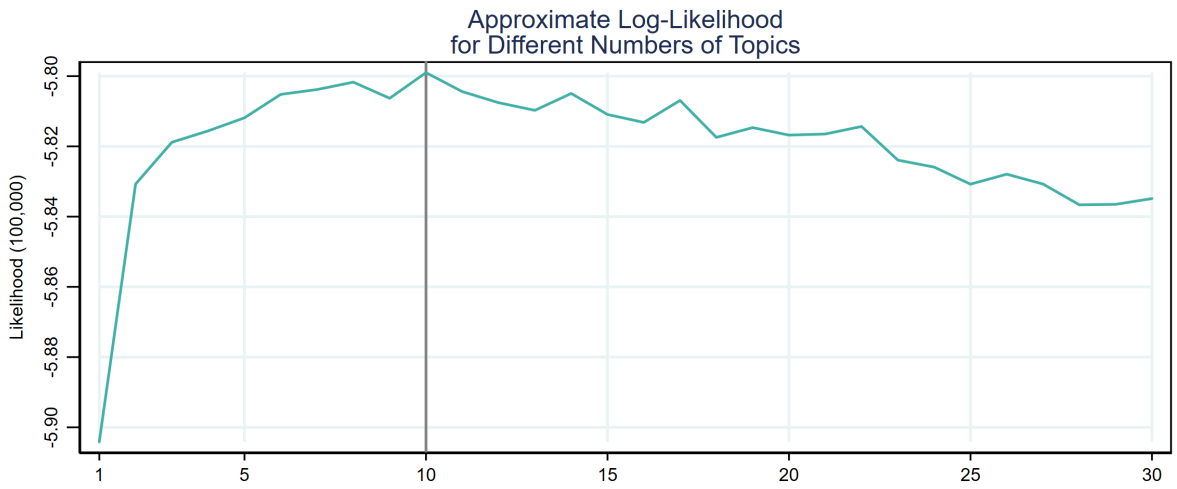

Figure A.3: Approximate log-likelihood for a varying number of included topics n in the LDA model. The gray line marks the local maximum at $n = 10$.

A.3 List of concatenated phrases

This is the full list of concatenated phrases. The concatenation was done in the order in which the phrases are presented here. This means that, e.g., *stance of monetary policy* has precedence over *monetary policy*. The list of concatenated phrases was chosen by how often these phrases occurred.

"federal funds rate, target range, labor force participation, labor market, stance of monetary policy, monetary policy, unemployment rate, interest rates, maximum employment, balance sheet, financial conditions, inflation expectations, asset purchases, federal reserve bank, fiscal policy, financial stability, united states, price stability, percent objective, financial system, economic activity, economic growth, interest rate, economic outlook, fomc participants, central tendency, longer-run, economic projections, percent inflation objective, financial markets, financial crisis, make sure, going forward, economic conditions, labor force, oil prices, next year, job market, little bit, forward guidance, around the world, last year, incoming data, longer run, longerrun normal, central banks, central bank, per month, don't want, get back, long time, job gains, federal reserve, federal open market committee, new york, bank of mexico, board of governors, system open market account, monetary affairs, open market operations, bank of canada, bank of england, bank of japan, european central bank, swiss national bank, going on, intermeeting period, division of monetaryaffairs, treasury securities, recent months, energy prices, real gdp, mortgagebacked securities, consumer spending, foreign currency, fomc meeting"

A.4 List of tone words

This is the full list of hawkish and dovish words used for the tone measure.

Hawkish:

"increase, expanding, rising, risen, higher, high, heightened, gain, strong, accelerating, fast, faster, stronger, strength, more, improve, foster"

Dovish:

"moderate, slow, slower, low, lower, subdued, fall, fell, weak, weaker, weaken, decreasing, contracting, softening, decelerating, cooling, less"

A.5 List of uncertainty words

This is the full list of words associated with ambiguity used for the uncertainty measure.

"uncertain, uncertainty, ambiguous, ambiguity, confusion, confusing, distrust, ambivalence, skepticism, unpredictable, mistrust, vague, obscure, unclear, blurred, indeterminate, indefinite, insecure, erratic, inexplicit, questionable, undecided, unreliable, unresolved, unsure, inconsistent"

Acronyms

AIC Akaike information criterion

bps basis points

Fed Federal Reserve

FG forward guidance

FOMC Federal Open Market Committee

LDA Latent Dirichlet Allocation

LSAP large-scale asset purchases

NBER National Bureau of Economic Research

PCA principal component analysis

PCE personal consumption expenditures

proxy-SVAR proxy structural vector autoregression

QE quantitative easing

SEP Summary of Economic Projections

VAR vector autoregression

ZLB zero lower bound