Information Transmission from the Federal Reserve to the Stock Market: Evidence from Governors' Calendars

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Abstract: We analyze 29,000 entries in Federal Reserve governors' calendars from 2007-2018 to understand how information flows from the Federal Reserve to stock markets. By studying which of 47 types of counterparties are more likely to be on governor calendars in crucial times for policy (days with high values of VIX), we document that interactions with Federal Reserve Bank presidents and the FOMC are viewed as important by governors. Consistent with this, we show that communication between Federal Reserve governors and Federal Reserve Bank presidents are a central driver of the high stock returns in even weeks in FOMC cycle time documented by Cieslak, Morse, and Vissing-Jorgensen (2019). This implies that information is disseminated around the time of policymaker interactions. We document that the media plays a role in information transmission on even-week days with policy-maker interactions. Since the times of governor-president interactions are not publicly known ahead of time, the results furthermore indicate that the FOMC cycle in stock returns is not a risk premium, but instead reflects unexpectedly positive policy news.

1. Introduction

Recent work in asset pricing has documented that since 1994, average stock returns have been high in the 24 hours leading up to scheduled Federal Open Market Committee (FOMC) announcements (Lucca and Moench, 2015) and in even weeks relative to FOMC meetings (Cieslak, Morse, and Vissing-Jorgensen, 2019).[1] Neither fact appears related to formal communication from the Federal Reserve. The 24-hour pre-FOMC period falls in the Federal Reserve blackout period during which policy-makers and staff are required to abstain from policy-related interactions with the public. Similarly, Cieslak, Morse and Vissing-Jorgensen (2019) document that high returns in even weeks in FOMC cycle time are robust to controlling for Fed information releases and speeches. They further provide evidence that Federal Reserve governor interactions are a key forum for information production, by documenting that even-week returns are particularly high following their board meetings. They argue for a central role for informal communication in delivering policy news to markets, providing evidence from leaks that became public.[2]

Two central issues emerge from this prior work. First, what are the main forums for information creation and sharing within the Fed, leading to dissemination of information from the Fed to markets? Second, do the high returns pre-FOMC or in even weeks in FOMC cycle time represent a risk premium for monetary policy news, or are they due to monetary policy news on average being surprisingly accommodating over the post-1994 period?

This paper contributes to answering these questions by obtaining and studying calendars of Federal Reserve governors (including the chair and vice-chair). We first document what types of interactions Fed policy makers themselves find most important by studying meeting counterparty incidence during stressed times. We then turn to our main tests documenting which counterparties' meetings/calls drive the high even-week returns of Cieslak, Morse, and Vissing-Jorgensen (2019) in daily and hourly regressions. Our evidence will speak to the unexpectedly

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[1] These papers build on earlier work by Savor and Wilson (2013) showing that average stock returns are higher on days with scheduled macro news about inflation, unemployment or interest rates.

[2] Cieslak, Morse and Vissing-Jorgensen (2019) suggest that the importance of even weeks in FOMC cycle time stems from Reserve Banks having to submit discount rate requests to the Board of Governors at least every two weeks. These are considered prior to the FOMC meetings by the Board of Governors, who subsequently has a full new set of discount requests to consider every two weeks following that.

accommodating policy versus risk premium debate since a risk premium explanation for the high even-week returns is unlikely if these returns are earned around types of interactions that are not known publicly ahead of time.

We obtain the calendars by Freedom of Information Request to the Board of Governors of the Federal Reserve. The available calendars cover the period from February 2007 to November 2018. They cover most of the tenure of Ben Bernanke as chair, Janet Yellen as vice-chair and chair, Jerome Powell as governor (and first year as chair), as well as governors Brainard, Fischer, and Tarullo. We convert calendars to delimited text and create a dataset of 28,771 entries in the calendars (denoted "calendar items" below). Based on a combination of manual reading and computer coding, we classify these items into categories based on the counterparty with whom the Fed governor is interacting. The resulting dataset is a comprehensive view of Fed governors' interactions with internal and external counterparties, divided into 47 groups including such groups as Board staff, staff or presidents at the Federal Reserve Banks, the legislative and executive branches of U.S. government, regulators, foreign central bankers, financial and non-financial corporations and interest groups, Fed watchers, and the media. Included also are a material number of redacted meeting counterparties.

As a measure of interactions important for policy-makers, we document which counterparties are more likely to be in meetings or calls with governors in more stressed times, defined based on the value of options-implied volatility on the stock market (VIX). If important interactions are more likely to be scheduled (and unimportant ones more likely not to be scheduled or to be cancelled) in stressed times, this approach identifies the relative importance of the 47 categories of counterparties. We define a daily counterparty dummy for each of the 47 categories based on whether one or more calendar items of a given type happened between 4 pm the previous day and 4 pm of this day. We then estimate a probit model predicting this counterparty dummy by prior-day VIX and year dummies. We find that VIX has the strongest predictive power for interactions between governors and three sets of counterparties -- redacted counterparties, Reserve Bank presidents, and the FOMC. The importance of governor-president interactions, during meetings/calls or during FOMC meetings, reinforce the central role for policymaker interactions suggested by Lucca and Moench (2105)'s pre-FOMC drift (taking place while governors and presidents interact at the FOMC meeting) and Cieslak, Morse, and Vissing-Jorgensen (2019)'s finding that even-week returns are higher following Board of Governors board meetings.

We then test whether the calendar items in any of the 47 counterparty categories are associated with abnormal stock returns, to document what lines up with information flow from the Fed to markets. We are particularly interested whether any meetings relate to high returns during even weeks in FOMC cycle time. Using our daily counterparty category dummies, we regress daily (4 pm to 4 pm) excess stock returns over T-bills on an even-week dummy, the interaction of an even-week dummy and the category dummy, and the interaction of an odd-week dummy and the category dummy. We find that compared to other even-week days, even-week excess returns are 22 basis points (bps) higher on days with FOMC items, 15 bps higher on days with Reserve Bank president items, and 26 bps higher on days with Fed conference items (all significant at the 10% level or better). Excess returns on even-week days without interactions in these three categories are not associated with significantly higher returns than odd-week days. Aside from two categories with very few observations, no categories are associated with higher returns in odd weeks, compared to other odd-week days.

Exploiting the three significant categories in one regression allows us to decompose how much of the even-week returns over our February 2007 to November 2018 sample can be explained by high returns on even-week days with interactions in either of these categories. Over this sample, excess returns are 11 bps higher on even-week than odd-week days. With 1,453 even-weeks days, the total even-week effect is 164%. Since odd-week returns are slightly negative, this represents a bit more than the entire excess stock return over this period. Of the 164%, we estimate that 54% is due to high even-week returns on days with Reserve Bank president calendar items, 39% to even-week days with FOMC calendar items, 22% to even-week days with Fed conference items, leaving only 34% unaccounted for.

To ensure that governor-president interactions lead to information dissemination, as opposed to governors scheduling calls/meetings endogenously following high returns, we repeat our regressions at the hourly frequency. We document that for both FOMC counterparties and Reserve Bank counterparties, hourly excess stock returns for hours after (or equal to) the hour of the first calendar item in the category are significantly positive, while the same is not the case for hours prior to calendar items in either of these categories.

Reserve Bank president items and FOMC items represent interactions between governors and Reserve Bank presidents. Both our return analysis and our study of what item categories are more likely to be on calendars in stressful times thus point to governor-president interactions as

important forums for production or sharing of for policy information. To understand how information flows to markets around policymaker interactions we study whether information flows via speeches or the media. Like Cieslak, Morse and Vissing-Jorgensen (2019), we find no role for speeches in that these are not associated with higher average stock returns unconditionally, or on even-week days, or on even-week days with governor-president interactions. By contrast, communication via the media is associated with higher returns on even-week days with governor-president interactions. We show this by exploiting media items in the governor calendars (very few of these identify the news outlet and most are thus not on-the-record interviews) as well as a data set on public appearances of FOMC participants.[3]

Our results are informative for interpreting what drives high even-week returns in FOMC cycle time. While it is well understood in markets that governors and presidents interact on the days of FOMC meetings (and thus during the 24-hour pre-FOMC announcement period), the timing of other governor-president interactions are not publicly known in real time. This fact allows us to make progress on the debate as to the cause of abnormally high stock returns in even weeks in FOMC cycle time.

Cieslak, Morse and Vissing-Jorgensen (2019) argue for on-average unexpectedly-positive policy news over the period because no one appears to have been aware of the even-week effect prior to their documenting it and announcement dates of other major central banks do not appear associated with high returns (Brusa, Savor and Wilson (2018)). By itself, this does not rule out that the pre-FOMC drift could represent a risk premium since the scheduled FOMC announcement times are known ahead of time. Hu, Pan, Wang and Zhu (2019) and Laarits (2019) provide different explanations for how the pre-FOMC drift could be a risk premium. In Hu et al (2019) the risk-premium is for news coming from the Fed and this explanation is thus consistent with informal information dissemination in the pre-FOMC announcement period being important. Laarits (2019) argues that the pre-FOMC drift represents a risk premium for macro-news arriving in the pre-FOMC announcement period, with this macro-news being particularly important to investors

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[3] While we can document the importance of non-public interactions between the governors and the media we do not have data on such interactions between the Reserve Bank presidents and the media since we do not have calendars of Reserve Bank presidents. Reserve Banks are not government agencies and we have unsuccessfully submitted FOIA requests to many of the Reserve Banks to obtain president calendars. The New York Fed president calendar is available on the New York Fed web page and many of the redacted items in governor calendars involve the New York Fed president (and possibly others).

because it determines which type of news (policy or internally known macro information) will be released by the Fed at the FOMC announcement.

Given that the timing of the president-governor interactions outside of FOMC meetings are not known publicly ahead of time, our results that such meetings are predictive of the high even-week returns implies that these high even-week returns cannot represent a risk premium (since investors are not aware of the timing of the associated information dissemination prior to it happening). The vast majority of the 1,484 interactions we document between governors and Reserve Bank presidents are one-on-one calls or meetings. These are spread out over the FOMC cycle and are associated with high even-week returns even when we drop days -1 and 0 in FOMC cycle time and thus focus on meetings the general public could not be aware of in real time. Instead of a risk premium, high even-week returns are thus likely to represent a trickle of monetary policy news that has been unexpectedly accommodating on average over our sample period (and back to 1994).

In a companion paper, Vissing-Jorgensen (2019) studies FOMC transcripts to learn what may motivate the use of informal communication. Going back to 1948, she document over 100 documents with some discussion of Fed leaks. These documents reveal that informal communication appears to be motivated by disagreement between policymakers and used by individual policymakers for tactical advantage in the policymaking process. Disclosure about policy appears to tie policymakers' hands implying that both hawks and doves have an incentive to move market expectations in their preferred direction prior to policy decisions. Vissing-Jorgensen (2019) provides a game-theoretic model in which two policy makers decide what to communicate about policy preferences to the public at an intermediate date between policy meetings. Selective disclosure of confidential information (spin) is possible, with a given policy maker only disclosing internally known views or analysis that support his/her case. If disagreement is sufficiently strong and sufficient spin is possible, the unique Nash equilibrium is that each policy maker communicates informally. As in the prisoners' dilemma, both policymakers are worse off than if they could commit to not using informal communication because of the associated loss in policy flexibility. If the theory is correct, many policymakers may be involved in informal communication with markets, either directly or via their staff. In addition to individual policymaker use of informal communication, Vissing-Jorgensen (2020) discusses why a central bank as an institution may use informal communication. This may retain more policy flexibility

than formal communication (but less than no communication), may allow the central bank to explain policy without time-consuming public debate, and may be a convenient way to gauge public support for a potential policy change. However, both individual and institutional use of informal communication stands in sharp contrast to the traditional role for central bank communication according to which it serves to ensure transparency and accountability, and informal communication risks damaging the Fed's reputation and its decision-making process.

2. New facts: Who do governors interact with?

a. Available calendars

In August 2014, we submitted a Freedom of Information Request to the Board of Governors for all governor calendars for 1994 onward. In September 2014, we received calendars for four governors, with two additional sets of calendars received in February 2018. FOIA replies informed us that only calendars cleared by a particular governor prior to his/her departure from the Board of Governors would be made available to us. We supplemented the calendars received with publicly available calendars for Yellen and Powell during their period as chair, available from the Board's web page.[4] Our resulting dataset covers six governors: Bernanke, Brainard, Fischer, Powell, Tarullo, and Yellen.[5]

Appendix exhibit 1 provides a typical example of what calendars look like, showing a page of Bernanke's calendar from April 2011 with three calendar items on April 22, 2011, two items on April 25, 2011, and four items on April 25, 2011. We code up all available 28,771 calendar items and tabulate the number of items available by person-year in Table 1. The varying number of observations across person-years is due to a mix of genuine differences in the number of items and missing calendars. For each of the six sets of calendars, we list below the positions the person served in as governor (chair, vice-chair, or "regular" governor) and the dates of the calendars available.

Ben Bernanke:
- Governor: Aug 5, 2002 - Jun 21, 2005
  Chair: Feb 1, 2006 - Jan 31, 2014
- Calendars: Feb 2007 - Nov 2013.

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[4] https://www.federalreserve.gov/foia/chairscalendar.htm
[5] We also received a sparsely populated version of Alan Greenspan's calendar which we do not use.

   Exceptions: Jan-Apr, Sep 2010. Nov 2011, May-Jul 2012, Jan 2013.

Lael Brainard:
- Governor: Jun 16, 2014 - present
- Calendars: Jun 2014-Nov 2017. Exceptions: Sep-Dec 2016.

Stanley Fischer:
- Governor: May 28, 2014 - Jun 15, 2014
 Vice-Chair: Jun 15, 2014 - Oct 16, 2017
- Calendars: Jan-Nov, 2016

Jerome Powell:
- Governor: May 25, 2012 - Feb 4, 2018
 Chair: Feb 5, 2018 - present
- Calendars: Jun 2014-Nov 2018. Exceptions: Jan 2018.

Daniel Tarullo:
- Governor: Jan 28, 2009-Apr 5, 2017
 Calendars: Jan 2009-Mar 2017. Exceptions: Jan-Mar, 2011.

Janet Yellen:
- Governor: Aug 12, 1994 - Feb 17, 1997
 Vice-chair: Oct 4, 2010-Feb 3, 2014
 Chair: Feb 3, 2014-Feb 3, 2018
- Calendars: Jan 2011-Feb 2018.

After our initial coding of calendars, we submitted an additional FOIA request to obtain information about conference calls for which counterparties were redacted and to obtain the identity of which of the twelve Reserve Bank presidents a given governor-president calendar item involved. This request was denied.

b. Meeting frequency by counterparty

Using a combination of manual reading and computer code, we classify calendar items based on with whom governors interact. We define 47 categories of calendar items based on meeting counterparty and present the frequency of items of each category in Table 2.

About 16,700 (58%) of calendar items reflect internal Fed interactions. Of these, about 11,000 are interactions with Fed staff at the Board of Governors, while about 5,000 reflect internal interactions among Fed policy-makers, including 706 interactions with the Federal Open Market

Committee (FOMC), 1,484 interactions with Reserve Bank presidents, and 2,897 interactions among governors. Of the external meetings, over 4,000 are with various parts of the US government, about 1,500 with financial institutions or financial interest groups, and about 2,000 with foreign central banks or international organizations. To our knowledge, this is the first comprehensive account of how top Fed policy makers spend their time at work.

3. Which calendar items do governors find most important?

To assess which of the 47 categories of counterparties governors find the most important, we test when a given type of interaction (calendar item category) is more or less likely to appear on a governor's calendars. Specifically, we want to know which calendar items are more likely to appear on days where governors are particularly busy assessing the outlook for of the economy and how policy may need to adjust in response. We proxy such busy times with high equity implied volatility (VIX) and estimate the following regression for each of the 47 categories.

$$D(Calendar\ item\ of\ category\ i)_t = \alpha + \beta VIX_{t-1} + \varepsilon_t \qquad (1)$$

The dependent variable is a dummy equal to one if any of the governors interacted with a counterparty from category i on day t. Days are defined from 4 pm on calendar day t-1 to 4 pm on calendar day t, in order to match market hours (NYSE trading ends at 4 pm). VIX_{t-1} is the value of VIX as of the end of trade on day t-1. The regression is estimated as a probit model and includes year dummies to account for the different number of available calendars per year and for differences across governors in how much they tend to interact with a given counterparty category.

This approach will be powerful for identifying important cateogories of calendar items if these are somewhat flexible in that they can be added on short notice if needed and cancelled on short notice if not needed. Estimation results are presented in Table 3. One row in the table corresponds to one regression. In column (1) and (2), we report the marginal effect (dy/dx) of a change in lagged VIX, along with the t-statistic for this marginal effect. Based on the t-statistic on lagged VIX, the most important categories are redacted items and Reserve Bank president items, followed by FOMC items.[6] The lower t-statistic on FOMC items is likely due to the fact that many

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[6] 97% of the redacted items take place during the 2007-2009 crisis period and about half of them are unidentified conference calls.

FOMC items are prescheduled long in advance. In terms of economy magnitudes, a 10 percentage point increase in lagged VIX (about 1 standard deviation) predicts a 2.6 percentage points increase in the probability of a redacted item, 5.4 percentage points increase in the probability of a Reserve Bank president item, and 1.2 percentage point increase in the probability of an FOMC item. For comparison, the last column of the table gives the mean of the daily category dummy variables for each category. The economic magnitude of the lagged VIX effects are substantial relative to these dummy means. The fact that higher lagged VIX leads to more governor-president interactions both via calls/meetings between a governor and a president and on the FOMC, suggests that policymakers themselves find these interactions important. Another important category (based on the marginal effect being significant at the 5% level) is "Other international regulators and organizations" (the "Other" refers to those not explicitly categorized by name in our grouping, and the cateogory includes, among others, the OECD and the UK FSA). By contrast, the bottom of the table shows the least important interactions judged based on what is either deleted or not added when lagged VIX is higher. A high lagged VIX makes it significantly less likely that a calendar-day simply says "No appointments", supporting the validity of the VIX-approach to classifying what is important and what is not.

4. Calendar items associated with higher even-week stock returns

a. Daily data

To assess which calendar items may contribute to high even-week (including pre-FOMC announcement) returns, we estimate the following regression for each calendar item category i:

$$r_t^{stock} - r_t^{bill} = \alpha + \beta_1 D(Even\ week)_t \\ + \beta_{2,i} D(Even\ week)_t D(Calendar\ item\ of\ category\ i)_t \\ + \beta_{3,i} D(Odd\ week)_t D(Calendar\ item\ of\ category\ i)_t + \varepsilon_t \qquad (2)$$

where t denotes day t and returns are 4 pm to 4 pm (close to close) and daily calendar item category dummies are defined as for the VIX analysis above. Even and odd weeks are defined relative to scheduled FOMC announcement days as in Cieslak, Morse and Vissing-Jorgensen (2019). Week 0 runs from day -1 to +3 relative to the annoucement day, week 1 from day +4 to +8, week 2 from day +9 to +13 etc. (weekend days are omitted).

Table 4 presents the results. As a baseline, column 1 shows that even-week returns are 11 bps per day higher on even-week days over the 2007M2-2018M11 period, similar to the magnitude found by Cieslak, Morse and Vissing-Jorgensen (2019) for the longer 1994-2016 period. Columns (2)-(4) shows the estimation results of equation 2 for the catgories for which the interaction term $D(Even\ week)_t D(Calendar\ item\ of\ category\ i)_t$ is significantly positive. Consistent with Lucca and Moench (2015), days with FOMC interactions are associated with significantly higher even-week returns than other even-week days, plus 22 bps. The main novel result of this paper is column (3) which shows that days on which a Reserve Bank president item appears on one or more governor calendars are similarly associated with higher even-week day returns than other even week days, plus 15 bps. The same is the case for days with Fed conference items on governor calendars, column (4). None of these categories are assocated with higher returns on odd-week days, compared to other odd-week days (the omitted category in col (2)-(4) is odd-week days without calendar items in the particular category). These odd-week interaction terms are therefore omitted in the remaining columns. Column (5) combines categories from column (2)-(4) to assess whether they have independent explanatory power. This results in little change in any of the coefficients on the $D(Even\ week)_t D(Calendar\ item\ of\ category\ i)_t$. The fact that FOMC items and Reserve Bank president items are independently associated with higher even-week returns is likely due to them not being concentrated on similar days in FOMC cycle time. Of 706 FOMC calendar items, almost all are on day 0 (318) or -1 (360) in FOMC cycle time. By contrast, Reserve Bank president items are more spread out over the FOMC cycle. Of 1484 such items, only 24 are on day 0 and 141 on day -1 in FOMC cycle time. Column (5) furthermore includes the interaction term $D(Even\ week)_t D(None\ of\ the\ above\ items)_t$ to show that even-week returns on days without FOMC/Reserve Bank President/Fed conference items do not have returns that are significantly higher than do odd-week days.

Based on column (5) of Table 4 we can decompose how much of the even week effect in stock returns over the sample can be accounted for by even week days with various categories of calendar items. This decomposition is presented in Table 5. With 1,453 even-week days over the 2007M2-2018M11 sample and an even-week coefficient of 11 bps in Table 4 column (1), the total even-week effect amounts to 164%, meaning that even-week returns were cumulatively that much higher on even-week days than on odd-week days. Based on the number of even-week days with $D(Even\ week)_t D(Calendar\ item\ of\ category\ i)_t=1$ and the coefficent on this interaction term

in Table 4 column (5), we estimate that even-week days with FOMC items, Reserve Bank president items, and Fed conference items account for, respecitively, 39%, 54%, and 22% of the even-week effect. That leaves only 34% due to other even-week days, despite these days constituting two thirds (964/1,453) of even-week days.[7]

Finally, in column (6) of Table 4 we restrict the sample to days that follow within 5 days of a Board of Governors board meeting. Cieslak, Morse and Vissing-Jorgensen (2019) found that such days were associated with particularly high even week returns. If policy-maker interactions are important for information creation and dissemination one would expect particularly high even-week returns on even-week days that both following Board of Governors board meetings and have governors interaction with Reserve Bank presidents. Consistent with this idea, the coeffecient on the term $D(Even\ week)_t D(FR\ Bank\ President\ item)_t$ jumps from 15 bps in column (5) to 25 bps in column (6).[8]

b. Hourly data, event study

We want to make sure that our return results are due to information flowing to markets during/after particular types of calendar items, rather than governors scheduling calls/meetings endogenously following high returns. We therefore repeat the return analysis at the hourly frequency by estimating the following relation:

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\begin{aligned}
r_{t,h}^{stock} - r_{t,h}^{bill} = \alpha &+ \beta_1 D(Even\ week)_{t,h} \\
&+ \beta_{2,i} D(Even\ week)_{t,h} D(Post\ calendar\ item\ of\ cateogory\ i)_{t,h} \\
&+ \beta_{3,i} D(Even\ week)_{t,h} D(Pre\ calendar\ item\ of\ category\ i)_{t,h} \\
&+ \beta_{4,i} D(Odd\ week)_{t,h} D(Post\ Calendar\ item\ of\ category\ i)_{t,h} \\
&+ \beta_{5,i} D(Odd\ week)_{t,h} D(Pre\ calendar\ item\ of\ category\ i)_{t,h} + \varepsilon_{t,h} \quad (3)
\end{aligned}
$$

$D(Post\ calendar\ item\ of\ type\ i)_{t,h}$ is a dummy that equals one if there is one or more calendar items of category i on day t and hour h is after (or equal to) the hour of the first such calendar item.

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[7] These percentages do not sum to exactly 164 because the calendar item dummies are not mutual exclusive.
[8] We have also investigated whether any of the 47 categories of calendar items is associated with significantly *higher* or significantly *lower* odd-week returns. Two very small categories each with under 20 calendar items are associated with significantly higher or significantly lower odd-week returns (systemwide committee calendar items, public service calendar items). These relations are likely spurious.

Similarly, $D(Pre\ calendar\ item\ of\ type\ i)_{t,h}$ is a dummy that equals one if there is one or more calendar items of category i on day t and hour h is before the start of the first such calendar item.

The estimates are presented in Table 6 and exploit hourly stock market returns from S&P futures (we assume that bill-returns are earned evenly across hours of the day). The time stamp is missing for 38% of Fed conference calendar items, so we focus the hourly return analysis on FOMC items (column 2) and Reserve Bank items (column 3). For both these categories, hourly excess stock returns for hours after (or equal to) the hour of the first calendar item in the category are significantly positive, while the same is not the case for hours prior to calendar items in either of these categories.

Figure 1 shows the results of a corresponding event-study of cumulative hourly returns around FOMC items and Reserve Bank items. Hour 0 in event-time is the hour of the start of the first calendar item of a given type on this calendar day. The figure graphs the abnormal return from event time 0 to the event time k on the x-axis. This abnormal return is estimated based on a regression in hourly data of [cumulative return from t to t+k] on a dummy for the event having occurred at time t.[9] The regression uses even-week days only. We use Newey-West standard errors with k lags to account for overlapping cumulative returns. The blue line in each graph represents the cumulative stock return, with the green and red lines indicating the 90% confidence interval.

In Panel A and B we combine FOMC and FR Bank President items since both represent governor-president interactions. Panel A focuses on all even-week days and shows that cumulative returns are significantly higher -- by a few hours after the start of the governor-president interaction -- than cumulative returns over a similar-length time period (on even-week days) that did not follow a governor-president interaction. There is a bit of slope to the cumulative abnormal return line before the meeting start. This could be due to us missing the calendars of several governors in each year, and thus missing some governor-president interactions.

Panel B focuses on day 0 and -1 in FOMC cycle time to show that high returns on these days appear after the start of governor-president interactions. The pre-FOMC drift documented by Lucca and Moench (2015) is less puzzling from the perspective of our calendar analysis. Governor-president interactions during the scheduled FOMC meetings appear similar to governor-president interactions over the rest of the FOMC cycle in that both are followed by high returns after the start of the meeting/call, in our interpretation due to informal information flows.

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[9] If there are multiple events on a given day, we only use the first event of the day.

To show that the event-study is not driven only by the period right around the scheduled FOMC meetings, Panel C repeats the event study for even-week days other than day 0 and -1 in FOMC cycle time, focusing on Reserve Bank president interactions (since there are few FOMC interactions outside of day 0 and -1). Results are similar.

5. How does information flow to the market?

We now turn to how information flows from the Fed to the stock market on even-week days with governor-president interactions.

a. No role for speeches

We find little effect on the results of Table 4 if we control for governor or Reserve Banks president speeches. This is shown in Table 7. We obtain data on speeches from Cieslak, Morse and Vissing-Jorgensen (2019) up to August 2010 and from the FOMC Speak database after that. FOMC Speak is developed by the Federal Reserve Bank of St Louis and is intended to be a "comprehensive repository of FOMC participants' speeches, testimony, interviews and commentary".[10] FOMC participants' public remarks are posted shortly after they become available online. Our combined speech dataset contains 1,867 speeches of which 70% are by Reserve Bank Presidents.

We define a dummy variable equal to one for day t if there was one or more speeches by a president or governor on that day. We repeat the regression Table 4 column (5) but control for the speech dummy (Table 7, column (1)) or the speech dummy interacted with the even-week dummy (Table 7, column (2)). The speech variables are insignificant and the coefficients of interest on the first three regressors are similar. In Table 7, column (3) we test whether speeches are important on even-week days with governor-president interactions. This appears not to be the case. If anything, on even-week days with governor-president interactions, the excess return on stocks are higher on days without speeches than on days with speeches. This implies that information created or shared during policymaker interactions appears to reach markets via more informal communications channels than speeches.

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[10] https://www.stlouisfed.org/fomcspeak

b. Media interactions matter

To investigate whether information flow on even-week days with governor-president interactions may occur via media interactions we exploit two sources of information. The first is our calendars dataset in which we know governor interactions with the media for the set of governors covered. We describe these governor-media calendar items in Table 8, Panel A. Of the 789 items, 767 do not reveal the identity of the news organization. Calendars instead simply state "Meeting w/media" or "Telephone call w/media", or similar. We infer that these media interactions are not on-the-record, i.e., that the reporter obtains information but cannot quote the source.[11] Our second source for information on policymakers' media interactions is the above-mentioned FOMC Speak database. Table 8, Panel B describes the non-speech item in FOMC Speak. These items are all public on-the-record events. We refer to them as media items because most are interviews but other non-speech public appearance are included. Of 1,443 items in total, 1,251 (87%) are public appearances by a Reserve Bank president.

Table 9 analyzes the role of media interactions for stock returns. The first three columns follow the format of Table 7, but replacing speeches by media interactions. While media interactions are not associated with higher returns in general (column 1), or on even week days (column 2), the triple interaction D(Even)*D(FR Bank Pres item) *D(Media) is highly significant in column 3, with a coefficient of 27 bps. By contrast, the triple interaction D(Even)*D(FR Bank Pres item) *D(No Media) is insignificant. The interpretation is that our prior finding of high returns on even-week days with governor-president interactions is disproportionately due to even-week days where governors interact with both Reserve Bank presidents and the media. In Table 9, column 4 we drop day 0 in FOMC cycle time to ensure that the importance of media interactions is not simply due to the day 0 FOMC press conferences. In Table 9, column 5 we break media items into those from governors' calendars and those from FOMC Speak. The former appear economically and statistically more important but the coefficient of 15 bps on D(Even)*D(FR Bank Pres item) *D(Media, FOMC Speak) is also large in economic terms.

Figure 2 presents an hourly event study of returns around media items from governors' calendars. The figure focuses on even-week days, and the event is the occurrence of a media item

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[11] See Vissing-Jorgensen (2020) for information on types of interviews used in journalism, including on-the-record, to not-for-attribution, on-background, and off-the-record. These differ in how the reporter can use the information and what the reporter can reveal about the source.

in a governor calendar on a day with a governor-president interaction (by this or another governor). We have 116 events. We do the estimation using the same approach as for Figure 1, and the figure shows how cumulative returns following the event evolve compared to cumulative returns over a similar-length time period without an event. Figure 2 is consistent with governor media-interactions being an important information transmission channel on even-week days with governor-president interactions. The most natural explanation is that governors share information with the media around the same time as they discuss policy with Reserve Bank presidents. Since we do not have calendars of Reserve Bank presidents we cannot document whether their non-public media interactions also contribute to information flow.

6. Conclusion

We create a novel dataset of almost 29,000 calendar entries in calendars of Federal Reserve governors. We categorize these calendar items into 47 counterparty cateogories and show that results from predicting calendar item dummies with VIX and analyis of daily and hourly stock returns point to governor-president interactions as central forums for monetary policy decision making and subsequent information dissemination. Return analysis shows that even-week days in FOMC cycle time on which governor-president interactions take place are associated with particularly high returns.

Since the timing of govenor-president interactions outside of the scheduled FOMC meetings is not known by market participants in real time, high even-week returns associated with such calls/meetings are unlikely to represent a risk-premium. Instead, they are consistent with unexpectedly accommodating monetary policy news over the sample period. Furthermore, high returns on days of governor-president interactions are robust to controls for speeches, with important policy news instead communicated via the media (and possibly other informal channels).

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Appendix exhibit 1. A typical page in Bernanke's calendar

Friday, April 22, 2011

10:00 AM - 12:00 PM	Meeting w/staff *Location* : Anteroom
12:30 PM - 01:30 PM	Lunch: Sheila Bair, FDIC *Location* : Dining Room A
02:30 PM - 02:45 PM	Call from FRBank president *Location* : Chairman's Office

Monday, April 25, 2011

10:00 AM - 12:30 PM	Pre-FOMC Board Meeting *Location* : Board Room
02:30 PM - 03:30 PM	Meeting w/staff *Location* : Anteroom

Tuesday, April 26, 2011

08:00 AM - 08:05 AM	Telephone call from Mr. Alan Mullally (CEO Ford Motor Company) *Location* : Chairman's office
09:00 AM - 09:30 AM	Meeting w/FRBank president *Location* : Chairman's Office
10:30 AM - 05:45 PM	FOMC Meeting/Luncheon *Location* : Board Room
06:00 PM - 08:30 PM	FOMC Farewell Reception/Dinner for Gov. Warsh [immediately after FOMC meeting] *Location* : Reception: Cafeteria -- Dinner: Dining Rooms (D,E&F)

Table 1: Available Calendars Items by Governor-Year

Reported are the count of calendar items provided under the Freedom of Information Act, by Governor and year.

Year	Bernanke	Brainard	Fischer	Powell	Tarullo	Yellen	Total
2007	954	0	0	0	0	0	954
2008	1,203	0	0	0	0	0	1,203
2009	1,098	0	0	0	1,078	0	2,176
2010	518	0	0	0	937	0	1,455
2011	857	0	0	0	768	929	2,554
2012	640	0	0	0	864	801	2,305
2013	651	0	0	0	901	785	2,337
2014	0	571	0	587	997	1,043	3,198
2015	0	968	0	1,138	976	963	4,045
2016	0	552	704	983	964	939	4,142
2017	0	743	0	1,336	234	899	3,212
2018	0	0	0	1,103	0	87	1,190
Total	5,921	2,834	704	5,147	7,719	6,446	28,771

Table 2: Calendar Items by Counterparty

Presented are the counterparties with whom the Fed Governors interact. Our coding of the calendar records of Table 1.

Counterparty Type	Interaction with:	# obs	% of obs	Counterparty Type	Interaction with:	# obs	% of obs
Internal	FOMC	706	2.45	External	Fintech firms	37	0.13
Internal	Federal Reserve Banks, Presidents	1,484	5.16	External	Non-financial corporations	89	0.31
Internal	Federal Reserve Banks, directors	293	1.02	External	Non-financial interest groups	418	1.45
Internal	Federal Reserve Banks, staff	273	0.95	External	BIS	218	0.76
Internal	Federal Reserve Banks, meetings	132	0.46	External	Foreign central banks	715	2.49
Internal	Board of Governors, board meeting	961	3.34	External	Foreign governments	267	0.93
Internal	Board of Governors, committee meeting	384	1.33	External	G3/G4/G7/G10/G20/G30	272	0.95
Internal	Board of Governors, meeting with member	1,304	4.53	External	IMF	238	0.83
Internal	Board of Governors, other	248	0.86	External	Other intl. regulators and organizations	193	0.67
Internal	Staff at Board of Governors	10,696	37.18	External	Think tanks and conf. organizers	212	0.74
Internal	Top staff at Board of Governors	197	0.68	External	Academic conferences	51	0.18
Internal	System-wide committee	28	0.10	External	Academics	378	1.31
Mixed	Fed conferences (Board/FR Bank)	216	0.75	External	Fed watchers	137	0.48
External	Media	789	2.74	External	Former Fed governors/staff	80	0.28
External	Congress	1,082	3.76	External	Consultants, lawyers	51	0.18
External	White House and administration	249	0.87	External	Students	117	0.41
External	National Economic Council	141	0.49	Secret	Redacted	498	1.73
External	Council of Economic Advisers	275	0.96	Various	Travel	642	2.23
External	Treasury	897	3.12	Various	Personal	52	0.18
External	Treasury Borrowing Advisory Committee	82	0.29	Various	Photo	36	0.13
External	Federal Reserve advisory councils	381	1.32	Various	Public service	32	0.11
External	Agencies and regulators	1,403	4.88	Various	No appointments	195	0.68
External	Financial institutions	1,077	3.74	Various	Other (incl. hard to categorize)	86	0.30
External	Financial interest groups	459	1.60		Total	28,771	100.00

Table 3: Predicting Calendar Item Dummy Variable with Lagged VIX

Each row represents a probit model estimating in which a dummy variable for the category listed in the first column is regressed on VIX as of the prior day. Daily data, 2007M2-2018M11. Regressions include year dummies to account for different numbers of calendars across years. For a given regression, the probit model drops years for which the dummy is never equal to one. t-statistics are robust to heteroscedasticity. Significance levels: * 0.10, ** 0.05, *** 0.010.

Dependent variable: Dummy for calendar item category below	Marginal effect, VIX(t-1)	t-statistic	Obs	Pseudo R^2	Mean of left hand side variable
	(1)	(2)	(3)	(4)	(5)
Redacted	0.0026	4.85	2,324	0.382	0.097
Federal Reserve Banks, Presidents	0.0054	4.45	3,086	0.084	0.259
FOMC	0.0012	2.12	3,086	0.006	0.062
Other intl. regulators and organizations	0.0015	2.11	3,086	0.064	0.051
BIS	0.0010	1.80	2,824	0.032	0.025
Fintech firms	0.0016	1.66	1,780	0.121	0.009
Foreign central banks	0.0010	1.60	3,086	0.029	0.146
G3/G4/G7/G10/G20/G30	0.0007	1.37	3,086	0.047	0.038
Board of Governors, meeting with member	0.0018	1.32	3,086	0.129	0.266
Agencies and regulators	0.0015	1.18	3,086	0.102	0.321
Board of Governors, board meeting	0.0010	1.13	3,086	0.007	0.133
Federal Reserve advisory councils	0.0006	1.05	3,086	0.008	0.051
Board of Governors, other	0.0006	0.94	3,086	0.063	0.069
Financial institutions	0.0010	0.90	3,086	0.060	0.237
Fed watchers	0.0004	0.86	2,846	0.013	0.041
Financial interest groups	0.0006	0.75	3,086	0.026	0.111
Board of Governors, committee meeting	0.0008	0.66	2,584	0.098	0.087
Federal Reserve Banks, meetings	0.0003	0.48	2,824	0.080	0.032
White House and administration	0.0003	0.47	3,086	0.026	0.067
System-wide committee	0.0002	0.39	2,062	0.065	0.008
Think tanks and conf. organizers	0.0003	0.37	3,086	0.060	0.059
National Economic Council	0.0002	0.36	3,086	0.024	0.043
Consultants, lawyers	0.0002	0.35	2,585	0.037	0.016
Other (incl. hard to categorize)	0.0001	0.35	3,086	0.037	0.025
Council of Economic Advisers	0.0001	0.23	3,086	0.014	0.049
Personal	0.0001	0.20	2,063	0.106	0.016
Foreign governments	0.0001	0.17	3,086	0.013	0.065
Travel	0.0001	0.16	3,086	0.038	0.143
Media	0.0002	0.15	3,086	0.068	0.201
Treasury	0.0002	0.14	3,086	0.010	0.230
Former Fed governors/staff	0.0000	0.05	3,086	0.018	0.022
Staff at Board of Governors	0.0000	0.04	3,086	0.110	0.793
Treasury Borrowing Advisory Committee	0.0000	0.04	3,086	0.019	0.014

Congress	0.0000	-0.03	3,086	0.024	0.232
Students	0.0000	-0.03	3,086	0.011	0.034
Non-financial corporations	0.0000	-0.03	2,846	0.029	0.027
Academic conferences	0.0000	-0.07	2,846	0.034	0.013
IMF	-0.0002	-0.33	3,086	0.049	0.040
Fed conferences (Board/FR Bank)	-0.0002	-0.41	3,086	0.011	0.045
Non-financial interest groups	-0.0004	-0.46	3,086	0.021	0.100
Federal Reserve Banks, directors	-0.0003	-0.48	3,086	0.024	0.040
Federal Reserve Banks, staff	-0.0005	-0.77	3,086	0.028	0.075
Photo	-0.0004	-1.11	2,825	0.027	0.011
Public service	-0.0005	-1.12	2,324	0.018	0.009
Top staff at Board of Governors	-0.0010	-1.28	3,086	0.233	0.046
Academics	-0.0017	-1.95	3,086	0.029	0.095
No appointments	-0.0029	-2.67	2,824	0.134	0.056

Table 4: Calendar Items Associated with Higher Even-Week Returns in Daily Data

Each column represents an OLS regression of the daily excess return on stocks on a set of dummy variables and dummy variable interactions. The sample is 2007M2-2018M11. t-statistics are robust to heteroscedasticity. Significance levels: * 0.10, ** 0.05, *** 0.010.

	Dependent variable: Daily excess return on stocks over T-bills					
	(1)	(2)	(3)	(4)	(5)	(6)
D(Even)	0.11**	0.084*	0.069	0.11**		
	[2.54]	[1.84]	[1.33]	[2.32]		
D(Even)*D(FOMC item)		0.22*			0.22*	0.26*
		[1.88]			[1.84]	[1.90]
D(Even)*D(FR Bank President item)			0.15*		0.15**	0.25**
			[1.93]		[2.01]	[2.10]
D(Even)*D(Fed Conference item)				0.26*	0.32**	0.31
				[1.85]	[2.34]	[1.19]
D(Even)*D(None of the above items)					0.036	0.01
					[0.71]	[0.10]
D(Odd)*D(FOMC item)		-0.35				
		[-0.69]				
D(Odd)*D(FR Bank President item)			-0.028			
			[-0.45]			
D(Odd)*D(Fed Conference item)				0.12		
				[1.11]		
Constant	-0.018	-0.016	-0.01	-0.023	-0.013	-0.011
	[-0.63]	[-0.56]	[-0.30]	[-0.79]	[-0.43]	[-0.14]
R-Squared						
N (days)	3,087	3,087	3,087	3,087	3,087	803

Table 5: How Much of the Even-week Effect is Accounted for by Each Category?

Decomposition based on Table 4, column (5). The calendar item dummies are not mutually exclusive so rows 2 to 5 do not sum to row 1.

	Number of even-week obs=1	Total effect (sum)
D(Even)	1,453	164%
D(Even)*D(FOMC item)	180	39%
D(Even)*D(FR Bank President item)	347	54%
D(Even)*D(Fed Conference item)	67	22%
D(Even)*D(None of the above 3 items)	964	34%

Table 6: Calendar Items Associated with Higher Even-Week Returns in Hourly Data
Each column represents an OLS regression of the hourly excess return on stocks on a set of dummy variables and dummy variable interactions. The sample is 2007M2-2018M11. t-statistics are robust to heteroscedasticity. Significance levels: * 0.10, ** 0.05, *** 0.010.

	Dependent variable: Hourly excess return on stocks over T-bills		
	(1)	(2)	(3)
		All days	
D(Even)	0.0050***	0.0036*	0.0028
	[2.69]	[1.94]	[1.29]
D(Even)*D(Post FOMC item)		0.014*	
		[1.79]	
D(Even)*D(Pre FOMC item)		0.0067	
		[1.15]	
D(Even)*D(Post FR Bank Pres item)			0.012**
			[2.08]
D(Even)*D(Pre FR Bank item)			0.0032
			[0.92]
D(Odd)*D(Post FOMC item)		-0.04	
		[-0.27]	
D(Odd)*D(Pre FOMC item)		-0.0057	
		[-0.90]	
D(Odd)*D(Post FR Bank Pres item)			-0.0021
			[-0.45]
D(Odd)*D(Pre FR Bank item)			-0.0022
			[-0.79]
Constant	-0.0011	-0.00096	-0.00052
	[-0.90]	[-0.76]	[-0.34]
R-Squared			
N (hours)	74,037	74,037	74,037

Table 7: The Lack of Effect of Speeches

Each column represents an OLS regression of the daily excess return on stocks on a set of dummy variables and dummy variable interactions. The sample is 2007M2-2018M11. t-statistics are robust to heteroscedasticity. Significance levels: * 0.10, ** 0.05, *** 0.010.

	(1)	(2)		(3)
D(Even)*D(FOMC item)	0.20*	0.21*		0.20
	(1.65)	(1.76)		(1.62)
D(Even)*D(FR Bank Pres item)	0.16**	0.17**	D(Even)*D(FR Bank Pres item)*D(Pres/Gov Speech)	0.096
	(2.04)	(1.99)		(0.90)
			D(Even)*D(FR Bank Pres item)*D(No Pres/Gov Speech)	0.19*
				(1.89)
D(Even)*D(Fed Conference item)	0.34**	0.35**		0.33**
	(2.41)	(2.33)		(2.37)
D(Even)*D(None of above items)	0.038	0.051		0.035
	(0.75)	(0.90)		(0.69)
D(Pres/Gov speech)	-0.050			
	(-1.02)			
D(Even)*D(Pres/Gov speech)		-0.038		
		(-0.49)		
Constant	0.0056	-0.013		-0.012
	(0.18)	(-0.44)		(-0.43)
N (days)	3,087	3,087		3,087

Table 8: Available data on media interactions
Panel A. Media items in governors' calendars
The sample is 2007M2-2018M11.

Type of media interaction	Media organization/reporter identified		Total
	Yes	No	
Meeting	3	524	527
Phone call	2	153	155
Interview	8	19	27
Lunch	1	23	24
Conference call	0	15	15
Photo	0	10	10
Breakfast	0	9	9
Other	0	7	7
Dinner	2	2	4
Remarks	3	0	3
Luncheon	0	2	2
Briefing	0	1	1
Conference	0	1	1
Panel	1	0	1
Press conf	0	1	1
Speaker	1	0	1
Speech	1	0	1
Total	22	767	789

Panel B. Media items listed in FOMC Speak

The sample is Aug 26, 2010 to Nov 30, 2018. Speeches listed on FOMC Speak are not included in this table.

Type of media interaction	Position				Total
	Chair	Vice chair	Governor	President	
Video Interview	3	7	16	546	572
Remarks	19	2	7	135	163
Presentation	4	0	0	141	145
Transcript	12	4	10	77	103
Opening Remarks	13	0	10	49	72
Question and Answers	5	2	6	53	66
Video	13	0	1	36	50
Audio Interview	2	0	0	43	45
Panel Discussion	4	3	5	29	41
Welcoming Remarks	7	0	2	25	34
Q&A	1	0	0	30	31
Radio Interview	0	0	0	30	30
Editorial	1	0	0	20	21
Press Conference	12	0	0	3	15
Testimony	9	0	5	1	15
Comments	0	0	2	10	12
Essay	0	0	0	12	12
Interview	1	0	0	5	6
Brief Remarks	2	0	0	2	4
Statement	0	0	1	3	4
Press Conferences	1	0	0	1	2
Total	109	18	65	1,251	1,443

Table 9: Calendar Items Associated with Higher Even-Week Returns in Daily Data, Role of the Media

Each column represents an OLS regression of the daily excess return on stocks on a set of dummy variables and dummy variable interactions. The sample is 2007M2-2018M11. t-statistics are robust to heteroscedasticity. Significance levels: * 0.10, ** 0.05, *** 0.010.

	(1)	(2)	(3)	(4)	(5)
D(Even)*D(FOMC item)	0.23*	0.22**	0.27**	0.088	0.27**
	(1.91)	(2.22)	(2.14)	(0.41)	(2.14)
D(Even)*D(FR Bank Pres item)	0.15*	0.14*			
*[col 3-4 header: D(Even)*D(FR Bank Pres item) *D(Media)] / [col 5 header: D(Even)*D(FR Bank Pres item) *D(Media, gov's calendars)]*			0.27***	0.28***	0.25**
	(1.95)	(1.70)	(2.94)	(2.98)	(1.76)
D(Even)*D(FR Bank Pres item) *D(Media, FOMC Speak)					0.15
					(1.48)
D(Even)*D(FR Bank Pres item) *D(No Media)			0.050	0.12	0.049
			(0.44)	(0.88)	(0.43)
D(Even)*D(Fed Conf item)	0.32**	0.30*	0.32**	0.32**	0.32**
	(2.28)	(1.92)	(2.31)	(2.32)	(2.30)
D(Even)*D(None of above items)	0.035	0.019	0.038	0.042	0.037
	(0.69)	(0.35)	(0.76)	(0.84)	(0.73)
D(Media)	0.030				
	(0.70)				
D(Even)*D(Media)		0.045			
		(0.69)			
Constant	-0.024	-0.014	-0.016	-0.020	-0.014
	(-0.69)	(-0.47)	(-0.54)	(-0.69)	(-0.50)
Sample				Drop day 0	
N (days)	3,087	3,087	3,087	2,993	3,087

Figure 1. Event study of hourly returns around governor-president interactions
Panel A. All even-week days

FOMC and FR Bank President items, all even-week days

Event time: Hours from start of first calendar item of this type on this day
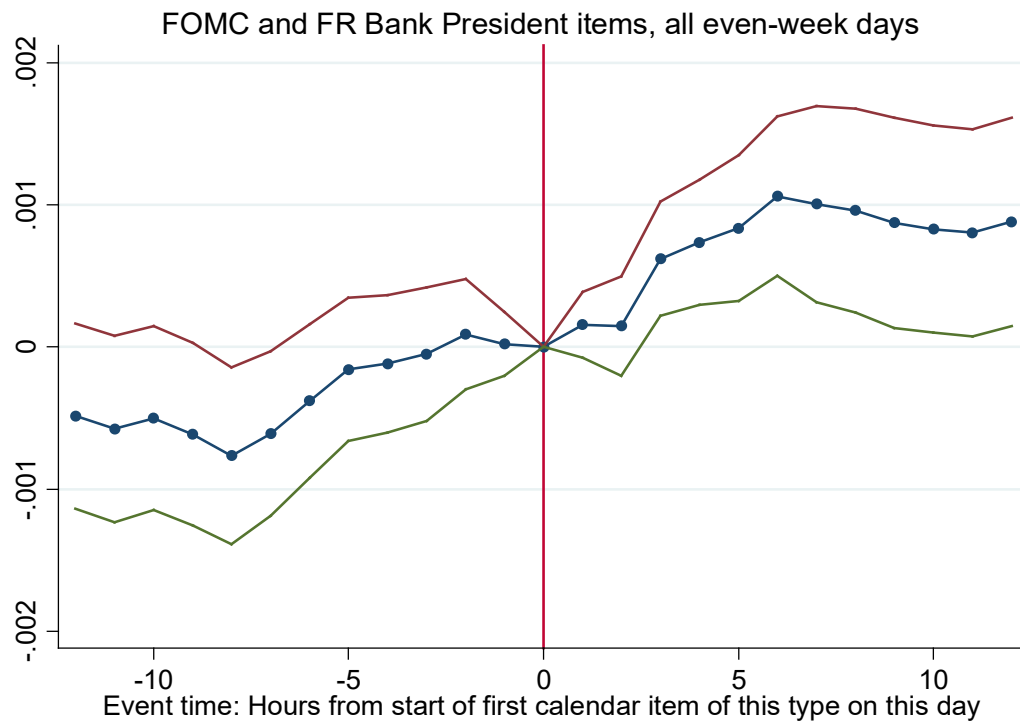
Panel B. Days 0 and -1 in FOMC cycle time only

FOMC and FR Bank President items, days 0,-1 only

Event time: Hours from start of first calendar item of this type on this day
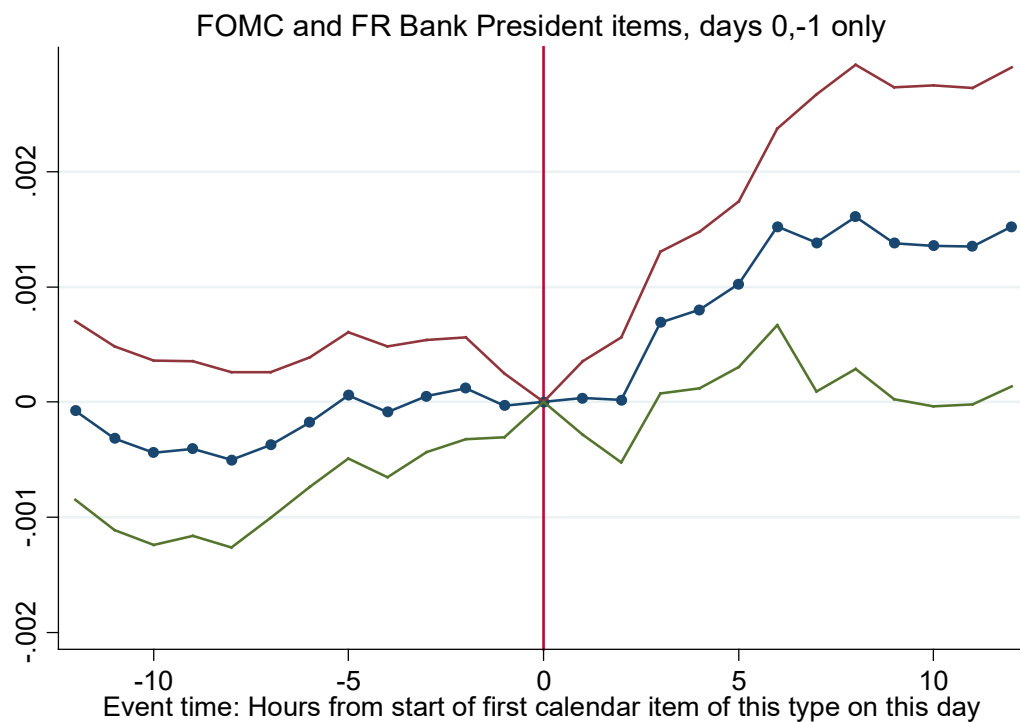
Panel C. Reserve Bank president items, dropping day 0 and -1 in FOMC cycle time

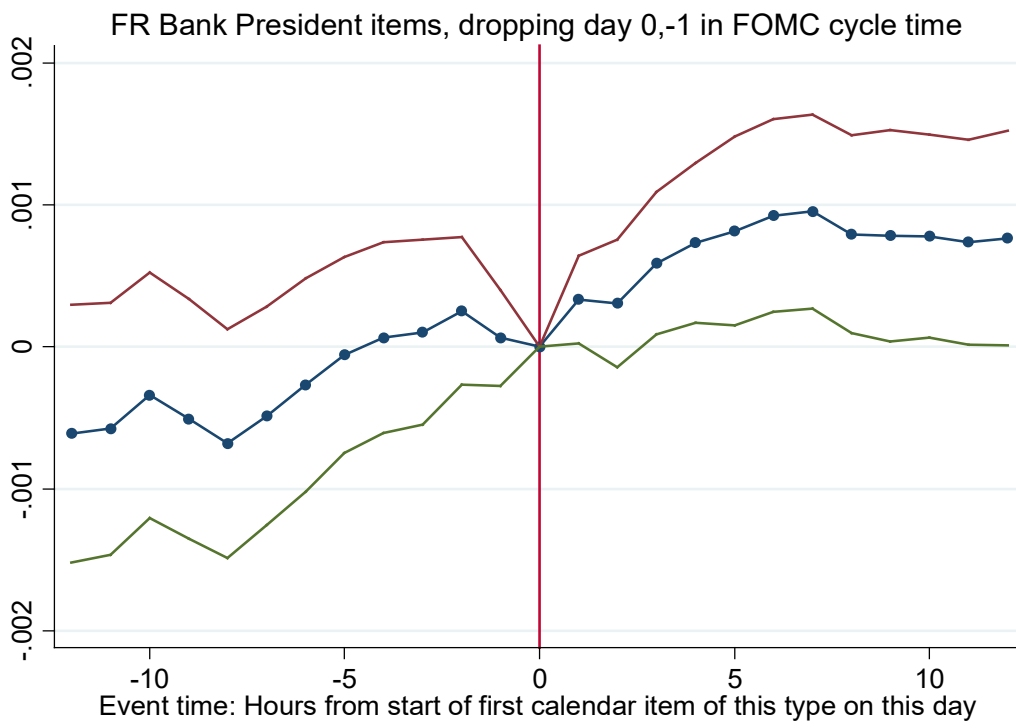FR Bank President items, dropping day 0,-1 in FOMC cycle time

Figure 2. Event study of hourly returns around governor media items

The figure is based on media items in governors' calendars and focuses on even-week days. The event is the occurrence of a media item in the governors' calendars, on a day with governor-president interaction.

Even-week days
Event: Governor media item on day with gov-pres interaction