

Stock Returns over the FOMC Cycle

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Abstract: We document that since 1994 the equity premium in the US and worldwide is earned entirely in weeks 0, 2, 4 and 6 in FOMC cycle time, i.e. in even weeks starting from the last FOMC meeting. We tie the even-week pattern causally to the Fed. The even-week returns are driven primarily by the Fed reacting to poor stock returns with more accommodation than expected (a “Fed put”). The timing comes from Fed monetary-policy decision-making tending to happen in even weeks. Evidence suggests systematic informal communication of Fed officials with the media and financial sector is the information transmission channel.

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1. Introduction

This paper documents a new fact about U.S. stock returns. Over the period from 1994 to 2015, the average excess return on stocks over Treasury bills follows a bi-weekly pattern over the Federal Open Market Committee (FOMC) meeting cycle. The equity premium over this 22-year period was earned entirely in weeks 0, 2, 4 and 6 in FOMC cycle time – which we refer to as “even weeks” in FOMC cycle time – where the FOMC cycle starts on the day before a scheduled FOMC announcement day and resets at each of the eight times the FOMC meets per year.

The fact that stocks do well in week 0 in FOMC cycle time has recently been established by Lucca and Moench (2015), who show that since 1994 stock returns have averaged about ½ percent over the 2pm to 2pm period prior to scheduled FOMC announcements.¹ Our novel finding is that the pre-FOMC announcement drift is part of a broader bi-weekly pattern in stock returns that reveals itself over the entire FOMC cycle. Average excess returns are statistically significantly higher in even weeks than in odd weeks in FOMC cycle time. Furthermore, the pattern is robust across the periods before and after the onset of the financial crisis and is also present in stock markets outside the United States.

To establish that the bi-weekly cycle in the excess return on stocks over Treasury bills is causally driven by news from the Fed and to document the mechanism through which the Fed has had such a dramatic effect on the stock market, we provide evidence in favor of a “Fed put” interpretation. The “Fed put” (originally called the “Greenspan put”) refers to actions by the Fed that react to poor stock returns with accommodating monetary policy. If policy has been on average more accommodating than expected in the post-1994 period, and if news about policy comes out mainly in even weeks, then a bi-weekly pattern of returns could result. Consistent with this, we show that the excess return on stocks has a put-shaped pattern as a function of lagged stock returns, but only in even weeks in FOMC cycle time. In particular, of the 191 percentage points of cumulative log stock returns since 1994, not only has all of it been earned in even weeks, but the majority (157 percentage points) has been earned on just 531 even-week Fed put days, i.e., days when the market is in the lowest quintile of performance over the past week, month, and quarter. Had it not been for the returns on these 531 “Fed put” days – accounting for less than 10 percent of all days over the 1994-2015 period – \$1 invested at the start of this period would have grown

¹ Lucca and Moench build on earlier work by Savor and Wilson (2014) who document a higher equity risk premium on days with macro announcements but do not separately focus on FOMC announcement and the exact timing of returns around FOMC announcements.

to only \$1.40 ($\exp(1.91-1.57)$) as opposed to the actual value of \$6.75 ($\exp(1.91)$). Furthermore, low stock returns are an economically and statistically strong predictor of reductions in the federal funds target rate.

We rule out that the even-week pattern is driven by other regular economic events, notably the calendars for reserve maintenance periods, macroeconomic news releases or corporate earnings announcements. Instead, we provide evidence of Fed causality by documenting that key monetary policy events at the Fed happen bi-weekly in FOMC cycle time. First, prior to 1994, the timing of Fed decision-making can be inferred from changes made to the federal funds target rate, which was frequently changed in between scheduled meetings. Over the 1982:9-1993 period, the frequency of target changes shows distinct peaks in even weeks in FOMC cycle time. In the 1994-2015 period, intermeeting target changes are rare (those that did happen all but one took place in even weeks in FOMC cycle time). However, it is still the case that information aggregation and important policy discussions within the Fed occur in between meetings. We document a special role for the board meetings of the Board of Governors (as opposed to the FOMC). We present extensive narrative evidence suggesting that these board meetings (also called the “discount rate meetings”) are an important venue for a free exchange and coalescing of monetary policy views among the chair, the vice-chair and the governors. We also explain why the bi-weekly frequency of those deliberations is a consequence of how the Federal Reserve System as a whole operates and aggregates information and show that the bi-weekly stock return cycle is driven mainly by even-week observations that follow board meetings.

While these various pieces of evidence document that the bi-weekly stock return pattern is driven by news coming from the Federal Reserve, they do not establish *how* information gets from the Fed to asset markets. We consider various possible channels. Based on detailed conversations with several Federal Reserve officials, we rule out that the Fed signals changes in its policy stance via open market operations. We then study the timing of public releases from the Federal Reserve (the various books of updates, the FOMC statement, minutes of the FOMC meeting and minutes of the Board’s board meetings) but fail to find significant excess stock returns on dates of these public releases. We argue that a more plausible channel for information getting to asset markets is systematic informal communication of the Fed with the media and the financial sector.

We collect evidence of outright leaks, lay out a framework for the Fed’s motives for informal communication, and provide asset pricing tests of this framework. Evidence on leaks comes from (i) the content of media and private newsletter advice to financial clients lining up

with the content of board meetings, (ii) the timing of Wall Street Journal articles on monetary policy, and (iii) examples characterizing the systematic access to the Fed that private parties (financial institutions) enjoy with regards to Fed policy decisions.

The events of October 28, 2008 offer a vivid example of jointly observing the Fed easing more than market participants' expectations following a dismal stock return and this information reaching markets via informal channels. On this day – the day before the FOMC announcement on October 29, 2008 – the stock market rallied by 9.8 percent. This followed a drop in the stock market of about 30 percent since the previous FOMC meeting which ended on September 16, 2008. Media interpretations of what drove the rally focus on the Fed. The WSJ online wrote (just after midnight the evening of October 28, 2008): “Shrugging off a flurry of grim economic news, stock investors pushed the Dow Jones Industrial Average up more than 10% as they anticipated new medicine from the Federal Reserve.” The WSJ graphic shows how the rally started right around 2 pm on October 28, perhaps not coincidentally the time the FOMC meeting started.

To analyze the Fed's motives for informal rather than formal communication, we rely on public statements made by Fed officials as well as our own conversations with current and former Fed officials. We document four motives for the use of informal communication. First, informal communication allows the Fed more *flexibility* to implement a more continuous policy, make incremental policy changes and convey more state-dependencies in the future path of monetary policy. Second, the informal communication provides the Fed with a tool for *explaining* Fed policy and the Fed's decision making process. This involves explaining the weights of various economic inputs in Fed decision making as they change dynamically in between meetings, thus reducing uncertainty about the policy rule and guiding policy expectations. Third, informal communication facilitates *learning* by the Fed from the financial sector about how the Fed's assessment of the economy compares to that of the financial sector and about how markets are likely to react to a particular policy decision. Fourth, informal communication – in the form of competitive leaking to drive the market's perception of likely Fed policy – results as an equilibrium outcome of *disagreement* among FOMC members. The framework of informal communication we lay out for the Fed is surprisingly similar to that documented in the political economy literature (notably Pozen (2013)) about leaks from other parts of the US government. We provide two tests of this communication framework. Both tests rely on a comparison of the period before and after 1994 when – following pressure from Congress – the Fed started to publicly announce changes to its policy stance. Within our communication framework, this change in disclosure should make

intermeeting target moves (i.e., changes to the Fed funds target in between scheduled FOMC meetings) less likely, and it should concentrate week 0 stock returns in the period prior to the announcement as policy makers seek to influence the public's interpretation of the FOMC statement. Both predictions hold up in the data.

We conclude the paper with a discussion of social welfare consequences of informal communication. We argue that informal communication with the private sector driven by the flexibility, explaining and disagreement motives is unlikely to be welfare enhancing. Furthermore, while informal communication to learn from private financial institutions could provide benefits, it also has costs both in that the Fed is giving a potentially very profitable information advantage to a subset of the financial sector and in that the practice erodes trust in the financial system and the credibility of the Fed.

A vindication for our concern with the Fed's informal communication comes with the transcripts of the October 15, 2010 FOMC conference call and November 3, 2010 FOMC meeting, both released to the public in January 2016 and after the working paper version of our article became publicly available. The transcripts give a direct record of a discussion among FOMC members, initiated by Chair Bernanke, about uncontrolled information flows in forms that are consistent with the concerns about informal communication we outline in this paper.² Specifically, the three issues brought to light are: (i) leaks to the press involving information about views expressed at the meetings, and confidential materials, (ii) inappropriate access to information by "well-connected" outsiders other than the media, including consultants and market participants, and (iii) the tendency of FOMC participants to take strong, inflexible policy positions before the meetings at which decisions are to be made. Concerns about negative consequences of such communication for Fed's reputation and credibility as an institution are openly expressed. We would add that the Fed should also be concerned about the impact of these informal information flows on investor confidence in markets and on inequality.

² See <http://www.federalreserve.gov/monetarypolicy/files/FOMC20101015confcall.pdf> and <http://www.federalreserve.gov/monetarypolicy/files/FOMC20101103meeting.pdf>.

2. The new fact: Stock returns over the FOMC cycle

a. Main result

Figure 1, Panel A, shows the main empirical result of the paper: the pattern of US stock excess returns over the FOMC cycle from 1994 through 2015. Date 0 on the horizontal axis is the day of a scheduled FOMC meeting.³ For two-day meetings, date 0 refers to the second day. The graph omits weekends and sets returns to zero on holidays. Therefore, 10 days on the horizontal axis represent 2 calendar weeks after an FOMC meeting, and so on. On the vertical axis, we graph the 5-day cumulative stock return returns from (and including) day t to day $t+4$ minus the 5-day cumulative return on 30-day Treasury bills from day t to day $t+4$.⁴ The vertical axis is in percent, so 0.5 means an excess return of a half percent. The figure shows a surprising regularity. 5-day stock market excess returns are high in even weeks in FOMC cycle time.

On average over the last 22 years (i.e., over 176 scheduled FOMC meetings), the average excess return has been 0.57 percent in week zero in FOMC cycle time (defined as days -1 to 3), 0.30 percent in week two in FOMC cycle time (defined as days 9 to 13), 0.45 percent in week four in FOMC cycle time (defined as days 19 to 23), and 0.64 percent in week six in FOMC cycle time (defined as days 29 to 33). In contrast, the average returns in odd weeks have been poor, with an average excess return around zero in week minus one (days -6 to -2), -0.15 percent in week 1 (days 4 to 8), -0.18 percent in week 3 (days 14 to 18), and -0.14 percent in week 5 (days 24 to 28). This implies that the *entire equity premium over the last 20 years* has been earned in even weeks in FOMC cycle time.^{5 6} While it is known from Lucca and Moench (2015) that on average since 1994, the excess return in the 24 hours from 2pm on day -1 to 2pm on day zero leading up to the FOMC announcement have been high, averaging 0.49 percent in their sample from September 1994 to March 2011, the bi-weekly pattern in the average excess return has not been previously documented. While most FOMC cycles include week 0, 2 and 4, the number of data points drop off quickly past week 4. There are 176 data points week 0 and for week 2, 161 data points for week

³ Since 1981, the Fed has held 8 scheduled meetings per year roughly 6 to 8 weeks apart. Since 1994, the Fed makes a public announcement of their decision following scheduled FOMC meeting.

⁴ For ease of replicating the result, we use stock returns and T-bill returns from the Fama-French factor file on Ken French's website.

⁵ When we refer to even and odd weeks in what follows, this will always refer to weeks in FOMC cycle time as opposed to weeks of the year.

⁶ There are 3 days over the last 22 years which fall into what would be week 7 in FOMC cycle time. For simplicity of interpretation, we drop these 3 days from our analysis throughout.

4 and 38 data points for week 6. Economically, the first three average return peaks are thus each about equally important whereas the fourth peak matters less given the smaller number of data points.

b. Statistical significance

To assess the statistical significance of our finding, we test whether the average excess return in even weeks in FOMC cycle time is statistically different from that in odd weeks in FOMC cycle time. The simplest approach is to run a regression in daily data of the stock market excess return on dummies for FOMC cycle weeks. We do this in Table 1. Since it is known that the average excess return in week 0 in FOMC cycle time is high, we are particularly interested in documenting whether the average excess returns in weeks 2, 4, and 6 are statistically different from those in odd weeks. In column (1), we thus include two dummies, one for being in week 0 and another for being in any of weeks 2, 4 and 6. Standard errors are robust to heteroscedasticity. The results show that the average excess return per day is 13.8 basis points (bps) higher on days that fall in week 0 in FOMC cycle time and 10.6 bps higher on days that fall in week 2, 4, or 6 compared to days that fall in odd weeks in FOMC cycle time. Importantly, both the week 0 and the weeks 2, 4 and 6 dummies are significant at the one percent level. In column (2), we ask whether the even weeks are individually significant, a less powerful specification. We include separate dummies for week 2, 4, and 6, two of which are significant at the 5 percent level and one at the 10 percent level.

We supplement the regression approach with a test of when during the FOMC cycle the average excess stock return is positive (as opposed to comparing whether it is higher in some weeks than others). In Figure 1, Panel B, we plot bootstrapped confidence intervals around the average 5-day excess return. The figure implies that 5-day excess returns are significantly positive at the 10 percent level or better at the start of weeks 0, 4 and 6, with the significance slightly worse for the 5-day excess return at the start of week 2. Excess returns in odd weeks are not significantly different from zero.

c. Sub-sample robustness

To further assess the robustness of our new fact, we break the 22-year sample period into two sub-periods split based on the onset of the financial crisis and calculate average 5-day excess returns in FOMC cycle time for each sub-period. The result is displayed in Figure 2 Panel A. The bi-weekly pattern is robust across the 1994-2006 and 2007-2015 sub-periods, with each of the sub-

periods showing four peaks in average excess returns at roughly the same bi-weekly frequency. In Figure 2 Panel B we consider the pre-1994 period back to September 27, 1982, the first day for which the federal funds rate target is available and thus the start of the period during which the Fed has been targeting interest rates as opposed to growth rates of money supply. The figure shows a bi-weekly pattern for the pre-1994 period. Notably, however, the week 1 average excess return is higher in the pre-1994 period compared to the post-1994 period. We later argue that before 1994 the timing of news related to the FOMC decisions was a less discrete event, with information trickling out gradually after an FOMC meeting.

Table 1 Panel B repeats the two regressions from Table 1 Panel A for the pre-1994 period and for each of the two sub-periods of the 1994-2015 period. From columns (1)-(3), the coefficients on the week 0 dummy and the week 2, 4, 6 dummy increase over time and are all significant at the 10 percent level or better in each sample. Columns (4)-(6) show that individual dummies for week 2, 4 and 6 are large in economic terms in each of the three samples though only statistically significant in about half the cases. Overall, the FOMC cycle appears to be a general phenomenon, present since 1982, but strengthening over time in economic magnitude.

d. International stock returns over the FOMC cycle

Motivated by Rey (2015), who discusses the interconnectedness of global finance via monetary policy of the center country (the US), in this subsection we study whether our return regularity arises with a similar strength in other stock markets outside the US. Table 2 presents the results for regressions of daily returns for various MSCI equity indices onto dummies for FOMC cycle weeks over the 1994-2015 sample. The table contains results for the developed market index excluding the US (DMxUS, columns (1)-(2)), the global emerging market index (EM, columns (3)-(4)), and the world index (WI) composed of stocks in both the developed markets (including the US) and emerging markets (columns (5)-(6)). We use returns for day $t+1$ since news from the US will only be reflected in most non-US markets on day $t+1$ due to the difference in time zones. The indices are in US dollars.

The results in Table 2 indicate that the FOMC cycle pattern of returns emerges in other markets as well. The returns earned in even weeks of the FOMC cycle are statistically significant and positive for both developed markets excluding the US and for emerging markets. Interestingly, our fact holds particularly strongly in both economic and statistical terms for emerging market stocks which earn a return that is on average 19 bps per day (t -statistic=3.95) higher in week 0 and

18 bps per day (t-statistic=4.97) higher during FOMC cycle weeks 2, 4 and 6 than it is in odd weeks in which it averages -6.8 bps per day (t-statistic=-3.21). To illustrate these findings graphically, Internet appendix Figure 1 plots the 5-day cumulative returns over the FOMC cycle for the three series, providing striking evidence that the bi-weekly patterns in stock returns in FOMC cycle time is present around the world.

The fact that the bi-weekly FOMC return cycle extends beyond the US is not driven simply by movements in the dollar exchange rate. Using the trade-weighted dollar exchange rate from the Federal Reserve Economic Data (FRED) database, we find no tendency for the dollar to appreciate in even weeks in FOMC cycle time against a broad set of currencies.

e. Treasury bonds

We next study excess bond returns, focusing on US Treasury bonds to isolate the variation in asset prices that is not associated with (nominal) cash flow risk or the equity risk premium. The prediction for the dynamics of Treasury returns over the FOMC cycle is unclear. Poole, Rasche and Thornton (2002) find no reaction of long term yields to monetary policy shocks. Likewise, Faust and Wright (2008) report no significant predictable variation in the bond risk premium on FOMC days. In addition, the correlation between excess returns on stocks and bonds changes sign in the late 1990s (e.g., Campbell, Sunderam and Viceira, 2016), and is on average negative over the 1994-2015 period (-0.27 using 10-year bond returns). These pieces of evidence suggest that it is unlikely that any monetary policy information driving stock returns over the FOMC cycle would also drive bond returns in the same way. To verify this intuition, in Table 3, we regress daily excess bond returns on a FOMC (day 0) dummy. We find that the coefficient on the FOMC dummy is positive across bond maturities, but insignificant. Moreover, the coefficient is small, not exceeding 2.5 basis points at any given maturity. When we extend this analysis to the entire FOMC cycle over the 1994-2015 period (not shown), we find that the 10-year excess bond return is on average 2.3 bps per day in even weeks and 0.5 bps per day in odd weeks. Again these results are not significantly different. Together, these results are in line with the earlier the studies and extend their evidence to the entire FOMC cycle.

It is not well understood in the literature how the Fed can be a strong driver of the stock market yet not a significant driver of bond excess returns. One possibility is that the term premium component of bond excess returns moves differently from the expectations hypothesis component and from the equity risk premium (and thus from the cost of capital and from earnings). This could

happen if interest rate accommodation by the Fed (immediately or via guidance about the future) leads investors to reach for yield, moving funds from bonds to stocks.

f. Cross-section of stock portfolios

We have also explored the behavior of the cross-section of stocks over the FOMC cycle. The bi-weekly stock return pattern is even more pronounced for high-beta stocks than it is for the aggregate market. Using CRSP beta deciles or industry-sorted portfolios, we find that the security market line is upward sloped in even weeks and downward sloped in odd weeks of the FOMC cycle – a result that echoes Savor and Wilson’s (2014) findings for macro announcement and non-announcement days.

g. Economic significance: Trading strategies based on the FOMC cycle

From a portfolio perspective, our new fact has large implications. To show this, we consider various trading strategies that exploit the bi-weekly pattern of stock returns over the FOMC cycle. We focus on US data and calculate annual excess returns for a given strategy by compounding stock returns across days on which the strategy invests in stocks and subtract the compounded T-bill returns over those same days. We then tabulate the means, standard deviations, and Sharpe ratios based on annualized excess returns. Table 4 shows the results.

For reference, the first row in Table 4 shows the performance of a strategy which simply holds the stock market all the time. This strategy would have earned an average excess return of about 8.3 percent per year over the last 22 years, with an annual standard deviation of about 19 percent and a Sharpe ratio of 0.43. Strategy B seeks to exploit our new fact in the simplest possible way: the investor stays out of the stock market in the odd weeks in FOMC cycle time. This is an easily implementable strategy since FOMC calendars are announced well in advance of a given FOMC cycle and since it could be executed with low transactions costs using an existing ETF that covers the overall stock market. Strategy B would have had a Sharpe ratio of 0.88, twice that of Strategy A. This is achieved by adding about 3.5 percentage points of average annual excess return and reducing the standard deviation of annual excess returns by about a third. Below the results for Strategy B, we show results for holding stocks in a given even week only and staying out of the market in all other weeks. This shows that week 0, 2 and 4 each contribute substantially to the overall performance of Strategy B, whereas week 6 is less important because that are fewer data points for that week, due to the varying duration between FOMC meetings.

Given the slightly negative average excess returns in the odd weeks, one may wonder whether shorting the market in odd weeks would improve upon Strategy B. This turns out not to be the case. Strategy C in Table 4 holds the market only in odd weeks, and Strategy D is long the stock market in even weeks and short in odd weeks. While the negative return on Strategy C indicates that shorting could be beneficial, it also adds volatility. Thus, although Strategy D obtains a higher average excess return than Strategy B, its Sharpe ratio is worse than that of Strategy B. Therefore, among the simple strategies we have considered here, the most attractive is to simply stay out of the stock market in odd weeks in FOMC cycle time. Following this advice would have resulted in a Sharpe ratio of 0.88 over the last 22 years, twice that of the stock market.

3. The “Fed put” as a driver of the FOMC cycle in stock returns

Having documented our new fact, we now investigate whether the returns are causally driven by news from the Fed, and, if so, which economic mechanism explains the pattern.

High even-week stock returns, if they are in fact driven by the Fed, could represent a risk premium for news about monetary policy or the economy coming from the Fed in even weeks. Alternatively, the even-week returns could result from monetary policy being on average unexpectedly accommodating over this time period (1994-2015), with the market-moving news from the Fed coming out in even weeks. In section 3.a, we provide evidence consistent with an unexpectedly accommodating monetary policy. Specifically, we test whether the Fed acted according to a “Greenspan put,” or more generally a “Fed put,” policy. These terms refer to a view among some market participants that the Fed, since the aftermath of the 1987 stock market crash, has reacted to poor stock market realizations with accommodating monetary policy. If a Fed put has indeed driven the high even-week returns, this policy needs to have been at least partly a surprise to the market. We test and confirm predictions of the joint hypothesis that news from the Fed comes out mainly in even weeks and that this news has had an unexpected Fed put nature. In addition to establishing direct evidence of a Fed put, these tests help to establish causality by making it more difficult to argue that the FOMC cycle in stock returns is not driven by the Fed. To further argue causality from the Fed, in section 3.b we show that the FOMC calendar varies across years. This feature reduces the chance that the FOMC cycle happens to systematically coincide with other news events. We consider several possible alternative sources of news but find

no evidence that these events line up with even weeks in FOMC cycle time. Furthermore, none of these possible alternatives can explain the Fed put evidence in stock returns and target changes.

a. The Fed put in stock returns and in federal funds target changes

If the Fed has provided unexpected monetary policy accommodation following poor stock market returns (through current policy actions or through communication about future actions), and if this news has become public mainly in even weeks in FOMC cycle time, then we would expect the following:

Prediction 1. The stock market should mean-revert following low stock market returns, and this mean-reversion should only be observed in even weeks.

Prediction 2. Following low stock market returns, the Fed should lower the federal funds target rate.

a.1 Testing Prediction 1

Figure 3 Panel A provides graphic evidence for a put pattern in stock returns in even weeks, consistent with prediction 1. We sort daily data for all 5736 observations covering 1994-2015 into five buckets based on the 5-day excess stock return over day $t-5$ to $t-1$. The quintile buckets are defined without conditioning on FOMC cycle time. The x-axis in Figure 3 Panel A is the average past 5-day excess return by quintile. For each of the five quintiles, we calculate the average excess stock return for day t separately for even-week days and odd-week days and graph these averages on the y-axis. The relation between the past 5-day excess returns and the day t return for even-week days strikingly resembles the payoff on a put option with the lagged stock return as the underlying asset. Following 5-day excess returns in the lowest quintile, the average excess returns are 30 basis points on even-week days and close to zero on odd-week days, consistent with mean-reversion only being present in even weeks. Figure 3 Panel B shows that the even-week mean-reversion pattern is very similar for weeks 0, 2 and 4 (it is more erratic for week 6 due to the lower number of observations). To assess the statistical significance of the Fed put, in Table 5 Panel A columns (1) to (5), we repeat our regression from column (2) of Table 1 Panel A for each of the five buckets of data defined based on quintiles of the excess stock return over day $t-5$ to $t-1$. Consistent with Figure 3, the even-week dummies are large and significant in the lowest quintile.

An implication to Table 5 is that the Fed must be processing stock market information fairly quickly and, within a 5-day period, expressing intent to accommodate (we will get to possible communication channels below). It is, however, far from clear what look-back period the Fed uses to assess whether a low stock return warrants accommodation. Therefore, in column (6) and (7) of Table 5 Panel A, we rerun the dummy variable regression on more restricted sets of observations. In column (6), we focus on observations where both the past 5-day (i.e., one week since we omit weekends) excess return and the past one-month excess return have been in their respective lowest quintiles. In column (7), we further restrict the sample to observations that have also been in the lowest quintile based on the past three months' excess return.⁷ The more restrictive the sample we use, the more likely it is that the Fed – if following a put policy – would consider the particular day to warrant accommodation. Consistent with this intuition, the coefficients on the dummy variables increase substantially going from column (1) to column (6) and from column (6) to column (7).

The large coefficients in column (7) suggest that a large fraction of the realized equity premium must have been earned on a small number of days. In Table 5 Panel B, we decompose the log compound stock market return for 1994-2015. The total log compound stock return across all 5736 days in the 1994-2015 period was 1.91, meaning that \$1 would have grown to $\exp(1.91)=\$6.75$ over this sample. Column 2 shows that of this log return, 2.54 was earned in even weeks, with -0.62 being earned over the period in odd weeks. Even weeks that followed returns over the past week in the lowest quintile constitute less than 10 percent of all days (531 of 5736 days) but account for 1.57 of the total log return (note that these days fall not just on day 0 but are dispersed across weeks 0, 2, 4 and 6). Had it not been for the returns on these 531 days, \$1 invested over the 1994-2015 would have only grown to \$1.40 rather than \$6.75. Overall, these results document a strong mean-reversion on even-week days following low prior stock returns with dramatic impact on the overall stock market valuation. Even with this very simple approach to isolate potential accommodation days, the magnitudes suggest that the Fed put explains the majority of realized stock returns over our sample period.

a.2 Testing Prediction 2

⁷ To ensure comparable look-back period lengths for all days we define 1 month as 22 weekdays and 3 months as 65 weekdays.

If the even-week mean-reversion is due to the Fed put, low stock returns should predict reductions in the federal funds target with a similar put-shaped pattern. Table 6 shows how the federal funds target has changed across future FOMC cycles as a function of the realized excess return between meetings. We focus on the 1994-2008 period (120 FOMC announcement days) since the zero lower bound has been binding for most of the 2009-2015 period. We define the inter-meeting excess return as the total excess return from, and including, day +1 of the last FOMC cycle (call it cycle N-1) to, and including, day -2 of the current FOMC cycle (call it cycle N). We focus on intermeeting returns here given that post-1994 the Fed has rarely moved the target in between meetings. To be consistent with Table 5, we calculate quintiles of these intermeeting excess returns.⁸

In Table 6, column (1), we regress the change in the federal funds target at the current FOMC meeting in cycle N (relative to its value after the last FOMC meeting in cycle N-1) on the dummy variable for the intermeeting excess returns being in the lowest quintile. Columns (2)-(8) repeat the same estimation but with the dependent variable calculated as the cumulative forward changes of the target rate from just after the FOMC announcement at cycle N-1 up to the FOMC announcement at cycle N+7 (i.e., approximately one year later). We find that the cumulative target change is negative and statistically significant after 2 cycles. For example, the interpretation of the result in the final column is that the quintile 1 (lowest) stock performance in an intermeeting period correlates with a subsequent 1.20 (120 basis points) reduction in the target rate during the following year.

For consistency with the earlier results, in Table 6 we have focused on the quintile 1 stock performance. Figure 4 strongly motivates this focus and extends our understanding of the Fed put. We graph the average cumulative target changes from day 0 of cycle N-1 to day 0 of cycle N+7 against average the intermeeting excess returns leading up to day 0 of cycle N; averages are calculated for each of the five quintiles of the intermeeting excess return. Consistent with the magnitude in Table 6, the average federal funds target reduction exceeds one percentage point following an FOMC cycle during which the intermeeting excess stock return was in the lowest quintile. In line with Figure 3, the relationship between the intermeeting return and the future target rate change resembles a put option (in this case the payoff from writing a put).

⁸ To be precise, we construct these buckets using the full 1994-2015 period and 176 FOMC dates to be consistent with our prior tables, but then only focus on the 1994-2008 period.

To document that the above target changes came as a surprise to the market, we show next that the Fed put in the federal fund target is present even after controlling for market expectations about the target change. We measure expectations using federal funds futures. Since the payoff of federal funds futures contracts is based on the average effective fed funds rate in a calendar month, we switch from an FOMC-cycle frequency to a calendar-month frequency. We calculate the realized excess stock return over the last two calendar months (months m and $m-1$) to match the typical FOMC cycle length of about 1.5 month as best possible. We then measure actual, expected, and unexpected changes in the target from before this two-month stock return was observed and to a later month. Specifically, we define the following:⁹

$$\begin{aligned} \text{Actual target change} &= (\text{Avg. realized daily federal funds target during month } m+X) \\ &\quad - (\text{Federal funds target at end of month } m-2) \end{aligned}$$

$$\begin{aligned} \text{Expected target change} &= (\text{Federal funds futures rate for month } m+X \text{ as of end of month } m-2) \\ &\quad - (\text{Federal funds target at end of month } m-2) \end{aligned}$$

$$\text{Unexpected target change} = (\text{Actual target change}) - (\text{Expected target change})$$

In Table 7, we regress actual target changes (Panel A) and unexpected target changes (Panel B) on a dummy variable for the excess return over months m and $m-1$ being in the lowest quintile. The cumulative changes are statistically significant by month $m+1$ and grow to about -70 bps by month $m+5$. Focusing on the contract for month $m+5$, the left panel of Figure 5 juxtaposes actual and expected changes in the federal funds target by quintile of the two-month excess stock returns for month m and $m-1$. The right panel of Figure 5 shows that following low average excess stock returns in months $m-1$ and m there was on average a large unexpected reduction in the target by month $m+5$, relative to what had been expected about that month's target prior to seeing the low excess stock return.

A natural question that arises is why the Fed would respond to severe stock market downturns by persistently easing policy over a sequence of meetings. In Cieslak and Vissing-Jorgensen (2016), we establish the role of the stock market as a powerful predictor of Fed policy,

⁹ The largest value of X we can consider is $X=5$ because reliable data (no prolonged periods of stale prices) are available out to the federal funds futures contract 8 months ahead. As of the end of month $m-2$ the contract for month $m+5$ is the 8th contract.

over and above commonly observed macro indicators. We document furthermore that the stock market explains a significant part of variation in Fed's Greenbook forecasts of real GDP and unemployment and argue that its predictive power for the Fed funds target works mainly via the impact on these expectations.

a.3 Fed put vs. risk premium interpretation

The above evidence on the Fed put suggests that the cycle in stock returns to a large extent is a reflection of an unexpectedly accommodating monetary policy over our sample period. While the bi-weekly pattern may also to some extent reflect a risk premium for monetary policy news, it is unlikely that the risk premium component is the dominant one. First, while the FOMC announcements are associated with high average returns in international stock markets, recent work by Brusa, Savor and Wilson (2015) finds no evidence for high excess returns around important monetary policy dates of other major central banks (European Central Bank, Bank of England and Bank of Japan). This suggests that there may not be a large risk premium for monetary policy news in general. One interpretation is that the Fed has been more aggressive -- or more surprising in its aggressiveness -- in accommodating downturns than other central banks, with other central banks following the Fed. Second, prior to our paper, no one appears to have been aware of the bi-weekly return cycle. Related, there is no systematic spike in realized stock return volatility in even weeks. This makes it unlikely that the Fed itself causes large amounts of risk with an associated risk premium.¹⁰ It seems more plausible that a trickle of systematically good news from the Fed in even weeks explains the positive even-week returns. Our task for the remainder of the paper is then to explain why this trickle of information happens in even weeks, tying it to the internal functioning of the Fed.

b. Ruling out that the FOMC calendar lines up with the calendar for reserve maintenance periods, macroeconomic data releases, or corporate earnings releases

Since 1981, the FOMC has had 8 scheduled meetings per year. The schedule of meetings for a particular year is announced ahead of time, generally in the summer prior to the calendar year. Figure 6 shows a histogram of the day of the year on which FOMC meetings took place over the 1994-2015 period. For each of the 8 meetings, there is a quite wide dispersion across years in what

¹⁰ We do find a bi-weekly pattern in FOMC time in implied volatility but this may be somewhat mechanical since implied volatility is known to move inversely with realized stock returns.

day of the year the meeting takes place. The dispersion is the largest for the third meeting of the year for which the difference between the first and last day of the year on which this meeting took place is 27 days. The change in the FOMC schedule from year to year makes it less likely that the FOMC calendar systematically lines up with other important economic calendars.

We now consider the possibility that the high even-week returns line up with alternative calendars and sources of news. We first document that the FOMC calendar is not aligned with the calendar for reserve maintenance periods. Banks have to hold an average amount of reserves over a two-week period called a *reserve maintenance period*.¹¹ If banks are more risk averse toward the end of the reserve maintenance period and if reserve maintenance periods ended in even weeks in FOMC cycle time, this could potentially explain the bi-weekly stock returns cycle. However, reserve maintenance periods are bi-weekly in calendar time with no exceptions around holidays and are thus about as likely to end in even weeks in FOMC cycle time as they are to end in odd weeks. Likewise, since reserve maintenance periods end on a Wednesday and FOMC meetings typically end on a Tuesday or a Wednesday, the irregularity of the FOMC calendar implies that it is about equally likely that an FOMC meeting occurs in the second week of a reserve maintenance period as in the first week of a reserve maintenance period starting week. Table 8 column (1) presents our baseline regression from Table 1. In column (2), we rerun our main regression for the excess return on the stock market including day of the reserve maintenance period dummies (10 dummies total) and find almost identical results for the coefficient and significance of the dummies for FOMC week 0 or FOMC week 2, 4, or 6.

We next explore macroeconomic news calendars. We use all US macroeconomic data releases in Bloomberg for the November 1996-December 2015 period. The start of the sample in November 1996 is dictated by the availability of Bloomberg data. In total, we have 19,167 non-Fed macro releases. The number of releases per day ranges from 1 to 26 with an average of 3.3. There are over 100 different types of macro data releases, with 91 types having at least 50 releases over the sample period. Since not all macroeconomic data releases are equally important for asset prices, we exploit a relevance variable provided by Bloomberg. For each type of macro release, Bloomberg calculates a relevance measure based on how many Bloomberg users have set up “alerts.” The relevance variable is a number between 0 and 1. The most followed macro releases

¹¹ Banks also often hold excess reserves, historically for transactions purposes (to avoid overdrafts) and recently because of reserves earning interest (in order to make banks willing to hold the large amounts of reserves used to finance the Fed’s purchases of bonds under quantitative easing).

are initial jobless claims, the change in nonfarm payrolls and GDP growth. These are about as popular as the FOMC announcements. To calculate a relevance-weighted count of macroeconomic data released on a given day, we simply sum the relevance variable for each date. Internet appendix Figure 2 shows the average number of macroeconomic data releases both un-weighted and weighted by relevance. Both exhibit a clear weekly pattern in FOMC cycle time, not a bi-weekly pattern as we observe for stock returns. Moreover, Table 8 column (3) adds to our baseline specification a control for the relevance-weighted number of macroeconomic data releases. This has almost no effect on the coefficient or significance of the dummies for FOMC week 0 or FOMC week 2, 4, or 6. We have also not found any substantial effect of controlling for the most important macroeconomic releases separately.

Furthermore, in column (4) we control for day of the month and day of the week fixed effects and fixed effects for the last day of the month, quarter or year. This has little effect on the coefficients of the even week dummies and ensures that the even week effects are not driven, e.g., by any confounding calendar seasonalities that occur on particular days of the month or week.

Finally, we confirm that corporate earnings announcements do not explain our bi-weekly return pattern in FOMC cycle time. For each day in the 1994-2015 sample, we compute the total number of quarterly earnings per share announcements by US firms in the IBES database as well as the fraction of positive surprises relative to the consensus analyst expectation. The average number of earnings announcements per day is 84 with a standard deviation of 106. Column (5) of Table 8 shows that controlling for these variables has little impact on the FOMC cycle dummies.

4. What happens at the Fed in even weeks?

In this section, we study the timing of federal funds target changes and of the board meetings at the Board of Governors in order to argue that key Fed policy discussions take place in even weeks in FOMC cycle time. As a background to our results, prior work suggests that news driving investors' updates of monetary policy expectations does not predominantly come out at the time of the FOMC statement. Kuttner (2001) uses market prices on federal funds futures contracts to decompose target rate changes into an expected and a surprise component. Using Kuttner's data for 1994-June 2008 we verify that the surprise component tends to be small. For example, on the 25 occasions when the FOMC increased the federal funds rate target by 25 bps, the market expectation on average was only off by 2 bps from the realized change (this is the average absolute

value of the surprise).¹² Therefore, vast majority of news relevant for forming expectations about monetary policy comes out in the period between FOMC meetings. Our added value is to show *when* during the intermeeting period Fed news comes out. We now turn to the evidence tying the bi-weekly cycle to the Fed.

a. Federal funds target changes before 1994 tend to be bi-weekly in FOMC cycle time

Since 1994 the Fed has predominantly changed the federal funds target at scheduled FOMC meetings, with only 7 out of 61 changes over the 1994-2015 period taking place in between meetings. This differs from the period prior to 1994 when it was more common to change the target in between meetings than at the meetings. The Federal Reserve provides a series of the federal funds target rates going back to September 27, 1982.¹³ From September 1982 to 1993, only 31 of 93 target rate changes happened at one of the eight scheduled meetings per year, whereas 62 (about two thirds) took place between meetings. Prior to 1994, the FOMC did not make an announcement after the target had been changed, and the market instead had to infer target changes from open market operations. The timing of intermeeting target rate changes provides evidence on when decision making tends to happen within the Fed, with the pre-1994 period being more informative due to the larger number of intermeeting target rate changes.

Figure 7 shows the probability of a federal funds target change on any of days t to $t+4$ over the FOMC cycle. The left graph focuses on the pre-1994 period and shows four clear peaks in the probability of rate changes. The peaks appear a few days delayed relative to the peaks in the average excess stock returns over the FOMC cycle. It is possible that Thornton's approach (described in footnote 13) dates those changes after they were already known by the market.¹⁴

¹² Kuttner's data are available at <http://econ.williams.edu/people/knk1/research>. We do not update Kuttner's data since the federal funds target has been a constant range from 0 to 25 bps from December 16, 2008 to Dec 16, 2015, i.e. for most of the period following Kuttner's sample period.

¹³ The series of target rate values provided by the Federal Reserve in the FRED database is constructed by Thornton (2005) based on a variety of Fed sources. Thornton (2005) uses information from transcripts of FOMC meetings, Blue Books, the Report of Open Market Operations and Money Market Conditions and data on open market operations obtained from the Open Market Desk at the Federal Reserve Bank of New York. In order to capture the timing of when the market knew of target rate changes, Thornton assumes that target changes decided at a given meeting were implemented on the first business day following the meeting unless this day is a reserve settlement day. If the next business day is settlement Wednesday, Thornton assumes the new target is implemented on the Thursday following the settlement day unless documentary evidence suggests otherwise. We count all target changes that are dated on the meeting date or on one of the two following dates as having been decided at the meeting and count all other target changes as intermeeting changes.

¹⁴ Indeed, regressions of excess stock market returns on Thornton's target changes in the pre-1994 period suggest that stock returns on day t are as negatively related to target changes on date $t+2$ or $t+3$ as they are to the target

Table 9 Panel A tabulates the timing of the seven intermeeting target changes in the 1994-2015 period showing that six of these took place in even weeks in FOMC cycle time. Overall, the evidence on the timing of intermeeting changes suggests that information aggregation and policy decision making within the Fed tends to be bi-weekly in FOMC cycle time.

Table 9 Panel B confirms the role of the stock market as a predictor of Fed policy in the 1994-2015 sample. For each intermeeting rate change we calculate the cumulative excess stock returns since (and not including) the most recent day 0, as well as cumulative excess stock returns since day 0 of the prior cycle, the second prior cycle etc. Out of the seven intermeeting moves, only one (April 18, 1994) was a hike. The six intermeeting rate reductions all follow a period of poor stock market performance, with stock market returns over the past several FOMC cycles being in the lowest quintile.¹⁵

b. Board of Governors discount rate meetings: Information processing and decision making within the Fed still tends to be bi-weekly in FOMC cycle time

The most direct evidence that information processing and decision making within the Fed still tends to be bi-weekly in FOMC cycle time in the 1994-2015 period comes from the timing of a little-known set of meetings, called the Board of Governors board meetings or the discount rate meetings. This subsection describes these meetings and then provides narrative evidence on their importance along with statistical evidence. These meetings are called the “board meetings” in Chairman Bernanke’s and Chair Yellen’s calendars (which we obtained via a Freedom of Information Act (FOIA) request) so we will refer to them as such going forward.¹⁶ In contrast to the FOMC meetings, transcripts of the board meetings are not available. Minutes of the board meetings, called the Discount Rate Minutes, are posted on the Federal Reserve Board web page starting from May 2001.¹⁷ We obtained the dates of discount rate meetings back to 1994 via a FOIA request. Under the Federal Reserve Act, Section 14, as amended in 1935, the board of each of the regional Federal Reserve Banks (the “Reserve Banks” in what follows) have to set their

change on date t . This may suggest that many of the target changes became known to the market before the date Thornton assumed they did.

¹⁵ Leading up to the rate hike in April 1994, the stock market dropped by about 6% from the prior day 0. The losses took place in late March and early April, a period in which bond yields increased sharply in expectation of Fed tightening. Thus, the poor stock returns likely did not cause a tightening, rather the expectation of a tightening may have caused the poor stock returns in this episode.

¹⁶ There are occasional board meetings which are not discount rate meetings. We exclude those from our analysis.

¹⁷ See <http://www.federalreserve.gov/monetarypolicy/discountrate.htm>.

discount rate at least every two weeks, subject to approval of the Board of Governors.^{18,19} The charter for each Reserve Bank lays out when the board of directors and executive committee of the Reserve Bank meet to fulfill their obligation to report discount rate recommendations to the Board of Governors. For example, a charter might say “second and fourth Thursday of the month,” but these schedules differ across Reserve Banks. Ahead of a Governors’ board meeting, the Reserve Banks submit their requests. There is always a Governor’s board meeting to review the regional preferences on one of the days just prior to each scheduled FOMC meeting. Following that, it takes two weeks for the Board of Governors to receive a full set of updated recommendations of the Reserve Banks over monetary policy.

b.1 Narrative evidence that board meetings are an important venue for monetary policy deliberations

With the exception of the recent financial crisis, discount window borrowing in our period is small, typically less than \$1B. Therefore, the importance of discount rate requests is not so much about the discount facility itself. Rather, the Reserve Banks use their discount rate recommendations as a way to express their policy views regarding the federal funds rate target. Former Fed Governor Larry Meyer states:

“While the Reserve Bank presidents are not part of the pre-meeting discussions at the Board, they have their own devices for influencing the policy discussion in between meetings. They do this specifically through requests to change the discount rate.” (Meyer (2004), Kindle Location 1067)

Jinushi and Kuttner (2008) use data for 1990-June 2008 and find that the average change in the discount rate requested by regional feds has strong predictive power for the change in the federal funds target rate.

The board meetings involve not only discussions of Reserve Bank discount rate requests and regional economic conditions but also updates on the state of the economy by board staff, as well as exchange of views among participants. Bernanke (2015) mentions the economic updates and the fact that the board meetings are one of the few occasions where the full Board of Governors meets:

¹⁸ The discount rate is the interest rate charged to commercial banks and other depository institutions on loans they receive from their regional Federal Reserve Bank’s lending facility--the discount window. Since 2003, the discount rate has been called the primary credit rate.

¹⁹ The Federal Reserve Act is available at <http://www.federalreserve.gov/aboutthefed/section14.htm>.

“When I joined, the full Board met infrequently; much of the substantive work was done by committees. We did convene every other Monday morning for a staff briefing on economic, financial, and international developments.” (Bernanke (2015), Kindle Locations 1051-1052).

Meyer (2004) describes that, similar to the FOMC meetings, the board meetings are “highly structured events,” where governors and the Fed Chair have a chance to see each other and where “discussions circle the table in go-arounds.” Meyer (2004) also describes the pre-FOMC board meeting the point of a genuine exchange of ideas among participants and of consensus seeking in preparation for the FOMC meeting:

“Unlike the FOMC meeting the next day, the discussions at the Monday Board meeting did not consist of prepackaged presentations. They were a much truer give-and-take, a serious exchange of ideas, with each of us questioning one another along the way. I often used the pre-FOMC Monday Board meetings as an opportunity to engage the Chairman in a discussion of the outlook and monetary policy, as I had previously done in the individual meetings. While we may not have always explicitly voiced our support of his policy recommendation at the end of the individual meetings, and later, at the end of the pre-FOMC Monday Board meetings, there was, in my view, an implicit commitment to support the Chairman the next day. Of course, if you were not prepared to support the Chairman at the FOMC meeting the next day, you had the obligation to tell him so at the Monday Board meeting.” (Meyer (2004), Kindle Locations 1055-1061)

In the early years of our 1994-2015 sample, the board meetings were more frequent with around 40 annual meetings. This number declines gradually to around 20 annual board meetings. However, even in the period with close to weekly meetings, the bi-weekly cycle of getting a full set of fresh inputs from the Regional Banks would imply that monetary policy discussions happen bi-weekly. This presumption has been confirmed by a former senior Fed official who in an email exchange with us stated that although meetings used to take place weekly:

“Every other one included a type 3 discussion [i.e., as she or he explained, predictions of how forecasts of the economy map into policy choices] with regard to discount window requests.”

The importance of the governors’ board meetings is related to the fact that the Government in the Sunshine Act of 1976 is closely followed by the Fed. While the Fed is not legally required to comply with this act, it does so in practice.²⁰ The act implies that FOMC members may (under the Fed’s choice to comply with the act) not meet to discuss policy without advance notice that a

²⁰ The Fed’s view of its relation to this act is at https://www.federalreserve.gov/monetarypolicy/files/FOMC_SunshineActPolicy.pdf

meeting will take place. Apart from the FOMC meetings, the board meetings are the only other meeting for which such notice is given (the notices are available a few days before the board meetings on the Fed's web page).

The fact that the board meetings have no transcripts and a much smaller number of people attending is likely to facilitate a more open debate between the board members thus increasing the importance of these meetings. Greenspan has openly expressed worry about the impact of transcripts. Arguing against release of FOMC transcripts (which became practice from 1994, though only with a five year delay), he stated:

"... release of videotape, audiotape, or a literal transcript would have a chilling effect on the free flow of ideas and the ability to bring confidential information to the deliberations" (FOMC transcript, October 5, 1993 conference call).

"I fear in such a situation the public record would be a sterile set of bland pronouncements scarcely capturing the necessary debates which are required of monetary policymaking. A tendency would arise for one-on-one premeeting discussions, with public meetings merely announcing already agreed-upon positions or for each participant to enter the meeting with a final position not subject to the views of others." (Quoted in Meade and Stasavage (2008), pg. 704)

Following the decision to publish the transcripts, the deterioration in the quality of free discussion during the FOMC meeting has been noticed by a number of FOMC members.²¹

These arguments in support the role of board meetings in policy deliberations have recently been summarized by former Fed governor Kevin Warsh (2015):

"In my experience, there is no attempt by FOMC members to avoid the transcripts per se, but policy deliberations happen on a rather continuous basis. Given the large number of FOMC participants and the even larger number of staff in attendance at meetings, some discussions inevitably happen more routinely in small groups. The Government in the Sunshine Act-- a law designed to ensure the public's right to know of policy discussions-- is diligently followed. But, hallway discussions by two or three members of the Committee are not uncommon. Moreover, the board of governors (as distinct from the FOMC) typically meets bi-weekly to discuss, among other things, the state of the economy and the establishment of so-called discount rates. While distinct from the FOMC's policy decision, these discussions by the board of governors are not totally unrelated to FOMC policy discussions."

²¹ See comments of Governor Thomas Hoenig in the FOMC transcript of February 1, 1995 (<http://www.federalreserve.gov/monetarypolicy/files/FOMC19950201meeting.pdf>, pg. 20) and of Philadelphia Fed President Edward Boehne in the FOMC transcript, July 1, 1998 (<https://www.federalreserve.gov/monetarypolicy/files/FOMC19980701meeting.pdf>, pg. 153). Chairman Bernanke states in his 2015 book: "Unfortunately for the quality and spontaneity of the discussion (although good for transparency), the FOMC, in response to demands by Representative Henry González, then-head of the House Financial Services Committee, had agreed in 1994 to release full meeting transcripts after five years. Since then, most participants had taken to reading prepared statements." (*Kindle Locations 938-940*)

Highlighting the importance of the board meetings, all intermeeting target changes post 1994 were preceded by a board meeting taking place either on the day of the intermeeting move or the day before (see Table 9 Panel A).

b.2 Testing the link between the board meetings and the bi-weekly stock return pattern

In this section, we document that the high average excess stock returns in even weeks are driven mainly by even week days that follow board meetings. This result is due to both there being more board meetings going into even weeks and, conditional on a board meeting taking place, average excess stock returns being higher in even weeks.

We want to test whether the stock market excess return in even weeks is driven by news coming out following the board meetings. We decompose Figure 1 Panel A into the contributions from observations that do, or do not, follow within five days of a board meeting. Figure 8 shows that the bi-weekly stock return pattern is driven mainly by the subset of observations in even weeks that follow board meetings.²² These days (even week days t for which there was a board meeting on one of days $t-5, \dots, t-1$) account for 32% of all days in the 1994-2015 period (dropping weekends). The likely interpretation for this pattern is that information is created at or around the time of board meetings and gradually makes its way into the market over the following 5-day period.

Table 10 assesses the statistical significance of our claim that high even week stock returns are driven mostly by even week days that follow board meetings. Table 10 column (1) repeats our regression from Table 1 column (2). Table 10 column (2) is the regression equivalent of Figure 8. We include interaction terms of even weeks with a dummy for whether any of days $t-5$ to $t-1$ had a board meeting. This results in larger, and with the exception of week 6, more significant coefficients. The regression in column (2) also includes a term interacting even weeks with a dummy for days $t-5$ to $t-1$ not having a board meeting and a term interacting odd weeks with a dummy for whether any of days $t-5$ to $t-1$ had a board meeting (the omitted category is thus odd weeks that do not follow a board meeting). These two interaction terms are economically and statistically insignificant suggesting that there is no excess stock return for even weeks that do not follow a board meeting or excess stock return for odd weeks that do follow a board meeting.

²² Week 6 returns are high even for observations that do not follow board meetings. However, there are few week 6 observations (38 data points) and of those only about $\frac{1}{4}$ do not follow a board meeting.

Instead, the market appears to earn a positive average excess return only on even-week days that follow board meetings. We interpret this as showing that even-week board meetings are central to monetary policy decision making, most likely because the Board of Governors will have a full set of economic updates and recommendations of the Reserve Banks every two weeks following the pre-FOMC board meeting.

5. Possible channels for how information gets from the Federal Reserve to asset markets

Summarizing up to this point, we have documented a new fact that the equity premium is earned in even weeks in FOMC cycle time and have tied this in several ways to the Fed. We provided evidence from stock returns and target rate changes that lines up with a Fed put mechanism. We also showed that the FOMC calendar is irregular across years and does not line up with the calendar for reserve maintenance periods, macroeconomic data releases, or corporate earnings releases. Furthermore, we reported evidence that information processing for monetary policy decisions happens bi-weekly in FOMC time. In particular, the timing of fed funds target changes before 1994 suggests that information aggregation and processing tended to happen bi-weekly in FOMC cycle time before 1994, and the importance of Board of Governors board meetings post-1994 suggests that this is still the case.

While these facts make it highly likely that the bi-weekly cycle in stock returns over the FOMC cycle is in fact driven by news coming from the Fed, we have not provided a channel for precisely how news gets from the Fed to asset markets. In this section we consider several possibilities. We argue that signaling via open market operations is not the channel. We then describe how (with the exception of week four in FOMC cycle time) the high return weeks do not systematically line up with official information releases from the Federal Reserve or the frequency of speeches by Fed officials. This leads us to a discussion of intentional or unintentional informal communication from the Fed lined up with its decision making process.

a. Open market operations

In February 1994, the FOMC started announcing its fed funds rate decision right after the meeting. Before February 1994, the Fed did not announce policy changes, and the market instead inferred changes to the target fed funds rate from open market operations. Might the Fed have continued to communicate with the market via open market operations in the post-1994 period? We have

spoken with senior Federal Reserve officials who inform us that no such signaling via OMOs takes place.

b. Public information releases and public speeches by Federal Reserve officials

Another obvious communications channel is public information releases and public speeches by Fed officials. The main public releases from the Fed are as follows:

FOMC statement: This summarizes the outcome of the FOMC meeting and is released publicly just after the FOMC meeting has ended, typically around 2.15pm. As shown by Lucca and Moench (2015) the return in week 0 in FOMC cycle time is earned prior to the FOMC statement. The statement release thus cannot be viewed as the direct explanation for the high average excess stock returns in week 0, and has no bearing on the other weeks in FOMC cycle time. For reference, Internet appendix Figure 3 shows a daily version of Figure 1, Panel A.

Beigebook: This summarizes economic conditions across the 12 Reserve Bank districts. It is prepared by the Reserve Banks and is made public two weeks *prior* to each scheduled FOMC meeting.

Minutes of FOMC meetings: These are released once per FOMC cycle. Before December 2004, FOMC minutes were released on average 47 days after the meeting (i.e., after the next FOMC meeting). Since December 2004, FOMC minutes have been released on average 21 days after the meeting.²³

Minutes of Board of Governors discount rate meetings (board meetings): Since May 2001, minutes for all discount rate meetings in a given FOMC cycle are released together, around four weeks after the FOMC meeting. Before this, we have the minute release dates only for the 1994 and 1995 minutes which were released in bundles, with two releases in 1994, two in 1995 and one in 1996.

²³ To reconstruct the historical minutes release dates we follow the minutes publication rules discussed in the 2005 Federal Reserve Bulletin (Dankner and Luecke, 2005). Historically, the publication rules were: From the beginning of 1994 through December 1996 – Friday following the next scheduled FOMC meeting; from 1997 through 2004 – Thursday after the next scheduled FOMC meeting; from 2005 onward – 21 days after the FOMC meeting. We further verify the dates implied by these rules as follows: From January 1997 to January 2004, we use the date on which Fed minutes were updated on the FRB website. From June 2002, we are able to cross-check those dates with Bloomberg economic calendar. On one occasion, the Bloomberg release date is one day after the date on the FRB website in which case we use the latter. For minutes released after January 2004, we use the official release date reported on the FRB website under “Transcripts and Other Historical Materials.”

Greenbook and Bluebook (now merged into the Tealbook) and FOMC transcripts: These are only released to the public with a five-year lag, with all information for eight FOMC cycles released once per year.²⁴ We are unable to determine the specific dates of the yearly releases but the five-year lag is intended to make the releases contain little news at the time of the release.

Internet appendix Figure 4, Panel A, illustrates the timing of public releases of Beigebooks, FOMC minutes, and discount rate meeting minutes. Beigebook releases and releases of discount rate minutes tend to take place in week 4 in FOMC cycle time and may thus, if sufficiently informative, help explain the high average excess stock returns in this week. Release of FOMC minutes do not line up with even weeks in FOMC cycle time after 2004. Before that time they fall just after the next FOMC meeting which is in week 0 in FOMC cycle time, but after the high week 0 returns are earned prior to the announcement.

In Table 11, we test whether Beigebook releases and releases of discount rate minutes do in fact help account for the high average excess returns in week 4. Table 11 column (1) is the specification from Table 1 column (2). Table 11 column (2) includes controls for public Fed releases related to monetary policy. None of the public release dummies are significant. Importantly, including the public release dummies has little effect on the coefficients and statistical significance of the even week dummies. One may worry that a public release is done after the end of trading or that the full effect on markets is not realized until the following day.²⁵ Adding the lagged value of the public release dummies (not shown for brevity) has little effect on results. The lagged dummies are insignificant and the even week dummy coefficients are largely unchanged.

Internet appendix Figure 4, Panel B, presents the timing of speeches by Fed officials. We collect dates of speeches from the web page of the Board of Governors of the Federal Reserve and the web pages of the Reserve Banks. Our sample includes 438 days when the Chair gave a public speech, 199 days for the Vice-Chair, 600 days for a governor, and 1,468 days for a president of a Reserve Bank.²⁶ There are few speeches around the FOMC meetings themselves since this period is part of the “blackout period” which runs from seven days before the start of the FOMC meeting

²⁴ The Green/Blue/Tealbooks are released internally within the Fed a few days before the FOMC meeting.

²⁵ Beige book and FOMC minutes were released at 2:00pm or earlier (each on a different date) throughout our sample, with the exception that before 1996, FOMC minutes were released at 4:30pm. We do not have a time of day information for the discount rate meeting minutes releases.

²⁶ If a speech takes place on Saturday or Sunday, we include it in the dummy variable on Monday following the weekend. There are 23 days with weekend speeches given by the Chair, 15 days for the Vice-Chair, 19 days for a governor and 46 days for a Reserve Bank president.

to the end of the day after the day on which the FOMC meeting ends. During this period, the Fed's self-imposed communications policy prohibits staff from communicating with the public about macroeconomic or financial developments or about monetary policy issues. The blackout policy was extended to the FOMC members themselves in 2011 but, based on the frequency of public speeches, it appears to have been informally adhered to prior to that.²⁷ The only peak in speech frequency which overlaps with an even week in FOMC cycle time is speeches by Reserve Bank presidents in week four in FOMC cycle time. This lines up with the release of Beigebooks. In Table 11 column (3) we test whether there is a stock market excess return associated with speeches by Federal Reserve officials. Since we do not have a time of day information for many of the speeches we include both a set of speech dummies and a set of lagged speech dummies. Only speeches by governors are associated with excess returns. Excess returns are on average about 9 basis points higher on days of governor speeches, significant at the 10 percent significance level. However, the importance of the even week dummies is essentially unchanged by the inclusion of the speech dummies. We have also analyzed whether speeches in even weeks are more important than speeches in odd weeks (omitted from the table for brevity). Even-week days with governor speeches are associated with 20 basis points excess returns (t-statistic=3.24) whereas odd-week days with governors speeches have 1 basis points excess returns (t-statistic=0.11). The fact that governors' speeches and especially even-week governors' speeches are associated with significant excess returns is supportive of the importance of the Board of Governors as the source of important market-moving information. However, since even-week dummies remain unaffected by inclusion of speech dummies (for all speeches as shown in Table 11 or only for even week speeches) or by public release dummies, these events are unlikely to be the main channel through which information gets from the Fed to financial markets in even weeks in FOMC cycle time.

c. Systematic informal communication with the media and the financial sector

In this subsection, we argue that the most important and likely channel through which information gets from the Fed to asset markets is informal communication with the media and private financial institutions. We start with a quote by Richard Fisher, then president of the Dallas Fed, in the November 2010 FOMC meeting transcript stating that the Fed has a leak problem:

²⁷ The policies on external communications for staff and FOMC members are available at http://www.federalreserve.gov/monetarypolicy/files/FOMC_ExtCommunicationStaff.pdf and http://www.federalreserve.gov/monetarypolicy/files/FOMC_ExtCommunicationParticipants.pdf.

*“On the second issue of people that have close relationships with market participants, I think of it as akin to insider trading. There are people who do profit. There is one former Governor who recently visited my Bank [...] who told the staff [...] that this individual—I’ll let you guess who it is—was, in essence, the 18th or 19th member, depending on how many we have, of the FOMC, and the equivalent of a voting member. He makes money off of us when he talks and sells. If we can’t solve this, then I think we should seriously look at some kind of firm legal strictures that are equivalent to the prosecution of insider trading. If people make money off inside knowledge about our decisions, it’s no different from people who make money off inside information trading securities. In fact, I think it’s a more grievous abuse.”*²⁸

Although documenting informal communication is a difficult task since we are constrained to leaks that have emerged in the public domain, we seek to make the case that informal communication is frequent and takes place systematically over the FOMC cycle, with more information disclosed in even weeks. First, we provide direct evidence of leaks of board of governor meeting discussions, occurring through the media and financial sector. Second, to reinforce the role of private financial institutions, we provide a list of Fed leaks of FOMC outcomes or related decision-making to financial institutions. Third, to further document the importance of even weeks for informal communication, we document the frequency of articles covering the Fed over the FOMC cycle by David Wessel, a well-known Fed reporter. Fourth, we provide evidence on the Fed’s motives for informal communication based on statements made by current and former Fed officials and market participants. Finally, we tie the pieces together with two empirical tests that support the importance of particular motives.

c.1 Evidence of Fed informal communication (leaks)

Table 12, Panel A lists eight examples of board meeting discussions emerging in the public domain through the media or Fed watcher newsletters²⁹. We include media articles or private Fed watcher newsletters as well as the comparable excerpts from the *Discount Rate Minutes*, describing the discussions at the board meeting. The similarity of article/newsletter content to discount rate minute content is highly suggestive that the writer had conversations with a Fed official. The first five items are leaks to the media. The remaining three are leaks appearing in Fed watcher newsletters. We do not have access to newsletters; thus we only can provide examples of leaks to newsletters that later appear in the media.

²⁸ According to media reports that followed the transcript release in January 2016, the former governor referred to in the quote is Larry Meyer who as of 2010 was with Macroeconomic Advisers. See, in particular, the Jan 15, 2016 *Wall Street Journal* article written by Josh Zumbrun. According to the article Meyer left the firm a few weeks before the transcript release.

²⁹ We use the word Fed watchers narrowly to mean for-profit macroeconomic forecasters, policy intelligence financial consultants, or Fed watchers at other financial firms.

As an example of the items in Table 12, Panel A, consider item 6, written on April 29, 2010. The private newsletter explicitly mentions conversations with Fed officials who revealed the views of FOMC participants from the pre-FOMC board meeting on April 26, 2010. Item 2 of Panel A similarly reflects the knowledge – in this case of the media – of the preferences of the Reserve Banks compiled for and discussed at the board meetings. Other examples are similar.

Prior to our 1994-2015 sample period, there is additional direct evidence of systematic leaks from the Fed to the Wall Street Journal. As part of Congressional “Gonzales hearings” in 1993, it became clear that from 1989 to May 1993 on 11 occasions, the essence of the FOMC directive to the open market operations desk was leaked the Wall Street Journal within one week of the meeting (Belongia and Kliesen (1994)), prior to its public release.³⁰ Lindsey (2003) provides a detailed discussion of how congressional dissatisfaction with these leaks led to the Fed’s concessions to release its fed funds target decision right after the FOMC meeting and to make transcripts of FOMC meetings available, albeit with a 5-year lag.³¹ Meyer (2004) provides a historical list of recent reporters involved in what he calls the *signal corps*:

“The use of reporters as part of the Fed’s signal corps is not official Board or FOMC doctrine. The public affairs staff and the Chairman like to pretend it doesn’t happen... John Berry, longtime reporter for The Washington Post and now at Bloomberg is the more widely recognized in this role. But The Wall Street Journal reporter covering the Fed – it was David Wessel, then Jake Schlesinger, and most recently Greg Ip during my term – was also a regular member of the signal corp.” (pg 98) [...] “I was surprised, then, one Monday before an FOMC meeting, to pass John Berry coming out of the Chairman’s office.” (pg 99)

Bernanke in his 2015 book lists his most used reporters as Jon Hilsenrath (*WSJ*), Greg Ip (*The Economist*), Krishna Guha (*FT*), Neil Irwin (*Washington Post*), John Berry (*Bloomberg*), Steve Liesman (*CNBC*), and Ed Andrews (*NYT*).

We can be more systematic in documenting informal communication around the time of board meetings, by looking into the timing of media articles on monetary policy. We collect the dates of news articles by David Wessel in the Wall Street Journal which contain any of the words

³⁰ The most famous articles in this series of leaks were two stories by David Wessel in May 1992 and May 1993 on the FOMC’s decision to switch to a “symmetric tilt” in 1992 and an “asymmetric tilt” toward tightening in 1993.

³¹ Woodward (1994) suggests that Greenspan is the likely source of the 1989-1993 leaks. Irrespective of whether he personally informed the WSJ, communication with the media would not have been something Greenspan invented. As far back as 1936, in his treatise on the Fed, Burgess (vice president of the New York Fed) writes of communication through the press: “There have frequently also been informal conversations with the representatives of the press reviewing the general factors having weight in the discount rate discussions.” (Burgess, 1936, page 222)

“FOMC”, “open market committee”, or “fed board”, obtained using Proquest searches. Among those in the signal corps, we focus on Wessel because his writing stays relatively focused on monetary policy. We drop commentaries, book reviews and duplicates. Our search renders 74 articles over the 1994-2015 period. The left graph in Figure 9 plots the probability of an article on day t . Many of the articles cover public releases from the Fed (primarily FOMC statements, FOMC minute releases), which is not our focus in this exercise to document informal communication. In the right graph of Figure 9 we therefore drop any article published the day after either of those two public events and plot the probability of any of days t to $t+4$ having an article. The figure displays a bi-weekly pattern in FOMC cycle time.

In Table 12, Panel B, we provide a list of Fed leaks of non-public FOMC meeting content, illustrating the access financial institutions have to confidential monetary policy information. The most well-known example (item 6 in this panel) is the October 3, 2012 leak to Medley Global Advisors (MGA), a policy intelligence firm.³² Regina Schleiger, the MGA analyst, had a copy of the FOMC minutes from the September 2012 FOMC meeting, which were due to be released the day after her article. In addition, she provides a step-by-step account of the policy debate among FOMC members ahead of the September 2012 FOMC meeting, information that goes beyond the content of the minutes. It is informative that the analyst wrote the newsletter without a concern for the legality. One possible interpretation of this is that leaks are commonplace and not prosecuted. Pozen (2013) makes this argument in the context of leaks from other parts of the US government. Second, the subsequent investigations of the MGA leak offers evidence of the systematic nature of informal communication between the Fed and the financial sector. After the leak emerged, Congress demanded the list of Fed employees with whom MGA had contacted. Chair Yellen has herself met with MGA on multiple occasions, but not during the leak period.³³ One current staff member at the Fed revealed to us that the list has many names and that one of that staff’s job assignments was regular conversations with policy forecasting or newsletter firms, including MGA.

Leaks to other financial institutions are equally revealing of the systematic nature of Fed leaking to the private sector. In Table 12, Panel B, the first item is the famous Geithner Leak, from the FOMC transcript of August 2007 detailing Geithner’s leak of changes to the discount facility

³² Their promotion material (website) reads: “Medley Global Advisors delivers accurate, unbiased intelligence on macroeconomic and political events by cultivating relationships with senior policymakers around the globe. Our network includes central banks, finance ministries, regulatory and intelligence agencies, and international finance and trade organizations.” Medley Global Advisors is a Financial Times company.

³³ Chair Yellen reported her schedule to Jon Hilsenrath of the WSJ as a part of a Freedom of Information Act request.

to Bank of America's CEO. In Item 2 PIMCO's Bill Gross discusses the content of the Greenbook live on CNBC on a day 0, before the FOMC announcement. Item 3 discusses how Larry Meyer, then the President of Macroeconomic Advisers, had the details of the August 2010 FOMC meeting weeks before the information was to emerge publicly.³⁴ Item 4 is a reference to a newsletter writer writing about the Fed's plans to do another Operation Twist in 2010, following a meeting with Bernanke. Item 5 recounts how a former Fed governor, and then a Fed intelligence executive, changed his view and predicted a surprise move by the Fed, after having watched Fourth of July Fireworks with Fed officials.

The words of FOMC participants themselves are also informative about the extent of leaks. In addition to the discussion of leaks in the November 2010 transcripts, the word leak appears in many FOMC transcripts since 1994 with different FOMC members expressing concerns about leaks. Those expressing concern include Lacker, Rosengren, McDonough, Jordan, Boehne, Moskow, and Bernanke. Bernanke reminds FOMC members on two occasions not to leak (FOMC transcripts of October 31, 2007 and transcript of FOMC conference call on February 7, 2009).³⁵

c.2 Evidence of Fed motives for systematic informal communication

We next turn to evidence on the Fed's motives for informal communication focusing on statements by the Fed officials themselves. We identify four main drivers of Fed informal communication.

The first is that information communication retains policy *flexibility*, i.e., the ability to change policy in response to new information. Flexibility is facilitated by informal communication because the Fed is averse to surprising the market and because it is difficult to make sufficiently clear state-dependent public statements. Ex-governor Stein has emphasized the Fed's aversion to surprising markets. In a recent paper, Stein and Sunderam (2015) assume that the Fed behaves as if it is averse to bond-market volatility implying a preference for the Fed to stick to pre-announced projections. A *Wall Street Journal* article (3/17/2015) quotes Stein's view on this issue: "To avoid unsettling markets, he [Stein] said, Fed officials have an incentive to stick to the path investors

³⁴ Perhaps it is not very surprising that the macroeconomic forecasting by Macroeconomic Advisers ranks 1st among private models in Bauer, Eisenbeis, Waggoner, and Zha (2006)'s analysis of forecast accuracy.

³⁵ To further document that informal communication with private parties is part of a systematic pattern, we submitted Freedom of Information Act requests for the schedules of Chairs Greenspan, Bernanke, Yellen, and all the sitting governors over the 1994-2013 period, as of 2013. The chairs complied, but with varying degrees of detail and redactions. Among governors, only Governor Tarullo provided his schedule. One other former Governor was willing to share his calendar but our FOIA request for this calendar was denied by the Fed. The redactions and lack of content in entries like "conference call" (with whom?) and the lack of governor calendars cause us to defer detailed analysis of the calendars to future work.

infer.” By using informal communication, the Fed can – without committing to a given policy decision -- steer the expectations of investors by engaging with the macro policy forecasting and newsletter firms who set market perception of monetary policy. While expectations can (and are) also steered by public communication, informal communication has the advantage that it can be more nuanced and detailed and directed to those better able to understand these nuances. The Fed’s concern that the market does not correctly process information in public statements was expressed vigorously by Greenspan. Arguing against the publication of an official statement after the FOMC meeting, Greenspan wrote in a letter of September 23, 1991, to Representative Stephen Neal:

“Earlier release of the Directive would [...] force the Committee itself to focus on the market impact of the announcement as well as on the ultimate economic impact of its actions. To avoid premature market reaction to mere contingencies, FOMC decisions could well lose their conditional character. Given the uncertainties in economic forecasts and in the links between monetary policy actions and economic outcomes, such an impairment of flexibility in the evolution of policy would be undesirable.”

The preference for informal communication to retain flexibility is closely related to the notion of gradualism in monetary policy, which is also driven by a desire to be able to react to information as it becomes available.³⁶ In his speech on May 24, 2004, Governor Bernanke explains:

“Because policymakers cannot be sure about the underlying structure of the economy or the effects that their actions will have on economic outcomes, and because new information about the economic situation arrives continually, the case for policymakers to move slowly and cautiously when changing rates seems intuitive. (...) Specifically, Brainard [1967] showed that when policymakers are unsure of the impact that their policy actions will have on the economy, it may be appropriate for them to adjust policy more cautiously and in smaller steps than they would if they had precise knowledge of the effects of their actions.”

Informal communication is more gradual than public communication in the sense that policy makers, faced with an uncertain environment, can make incremental policy changes outside of the discrete FOMC meetings schedule.

The second motive for informal communication is *explaining* Fed policy and the Fed’s decision making process. By explaining the weights of various economic inputs in Fed decision making as they change dynamically over time in between meetings, the Fed can use informal

³⁶ There is substantial empirical evidence that supports the notion of gradualism (or inertia) in the conduct of monetary policy during Greenspan and Bernanke’s tenures, see e.g., Coibion and Gorodnichenko (2012).

communication to reduce uncertainty about the policy rule and guide policy expectations. Blinder, Ehrmann, Fratzscher, de Haan and Jansen (2008) provide an excellent overview of the benefits of central bank communication, arguing that openness increases the efficiency of monetary policy, echoing the views by the original charter-writers as described in Burgess (1936) concerning the use of media (see our footnote 31 above) and official communications channels (i.e., bulletins, statements, and testimony). Communication from the Fed, however, has not always been transparent, as reflected in the quote in Blinder et al. (2008) of Greenspan taking pride in “mumbling with great incoherence.” Even so, Blinder, et al (2008) document a trend toward increased central bank transparency around the world over the last few decades, with the trend at the Fed starting in 1994. What appears to be different from the original intent of conveyance, however, is the use of informal rather than formal means of explaining Fed policy.

The third motive for informal communication is *learning* by the Fed from the private sector. The Fed benefits from comparing its assessment of the economy to that of the private sector. Given its aversion to Fed-induced market volatility, the Fed may also perceive a benefit from getting a sense of how the market would react to a given policy move. This could be either through learning how the macro models used by the private sector would forecast the market’s reaction to a particular move, or through direct feedback on its potential policy decisions. Item 4 in Table 12, Panel B is an example of such feedback on what came to be called the Maturity Extension Program (MEP). A Wall Street Journal article by Susan Pullman, 11/22/2011, quotes Blackrock CEO Laurence Fink explaining the Fed’s desire to learn from the private sector:

“Mr. Bernanke discusses only matters already public; a spokeswoman said. But hedge fund managers and Wall Street executives who meet regularly with him and other Fed officials -- both in his office and through advisory committees -- say they get valuable insights during the face-to-face talks. "It's like an inquisition; they have a topic;" said Laurence Fink; chief executive of investment-management giant BlackRock Inc. "By the questions they ask; by definition; you know what's on their mind."... There are central bank rules that bar officials from discussing confidential Fed actions not yet public. But gleaning clues about the thinking of Fed officials during private talks can be as valuable to investors making bets on the direction of the economy.”

Fink’s words clearly convey a quid pro quo relationship with financial institutions.

The fourth motive for Fed leaks is that leaking is an equilibrium outcome of *disagreement* among FOMC members. The transcript of the 9/15/2003 FOMC meeting contains a 69-page debate on the difficulty of drafting a policy statement that reflects the views of all members. Meyer

(2004), describing the situation inside the Fed at the time of the Clary leak (item 2 of Table 12, Panel A), refers to the positioning of reserve bank presidents and governors against Greenspan as the reason for the leak, calling it “political hardball inside the Fed” and “an uprising within the Committee [the FOMC].” Individual FOMC members may seek to drive the market’s perceptions of Fed’s thinking by communicating with the media and newsletter writers. One top official used the terminology of “setting the record straight” to describe this behavior. Leaks as an outcome of disagreement fit naturally with the Fed’s concern not to cause market volatility: If one FOMC member succeeded in representing his or her view as that of the Fed more broadly and markets reacted accordingly, the Fed would be compelled to act as the market (incorrectly) expected. To avoid this outcome, FOMC members have an incentive to all talk to the same members of the press and the same newsletter writers. Consistent with this, an investigation into the sources behind a particularly detailed WSJ article by Jon Hilsenrath on 9/28/2012 found that before publishing the article “its author had talked, in some cases multiple times, with every Reserve Bank president and most members of the Board of Governors. He had also spoken to a number of staff members.”³⁷ One former official stated that the pre-FOMC stock returns documented by Lucca and Moench (2015) were likely due to leaks intended to influence the public’s interpretation of the FOMC statement – by necessity such leaks would need to come before the statement itself to be useful.

The motives for informal communication by the Fed are surprisingly similar to the motives for leaks from other parts of the US government (particularly the White House) documented by Pozen (2013). Leaks due to internal disagreements are what Pozen (drawing on earlier work by Hess (1984)) calls “internecine leaks” and “counter-leaks”. Similarly, what we refer to as a Fed learning motive to obtain feedback on potential policy moves is denoted a “trial-balloon leak” by Pozen “meant to test the response of key constituencies”. As for flexibility, Pozen advances a theory of how executive branch interests are served by leakiness: “These interests include preserving ambiguity as to the origins of unattributed disclosures and therefore the communicative flexibility of top officials”.

c.3. Tests of the Fed’s informal communication framework

³⁷ See “Staff Summary of Review of Potential Breach of FOMC Policies Protecting Confidential FOMC Information,” available at <http://www.federalreserve.gov/foia/files/staff-summary-of-review-of-potential-breach-of-fomc-policies-20150323.pdf>

We finish this section by providing two tests of the Fed's motives for informal communication. First, if we are correct that the Fed still values flexibility, the Fed would be expected to make fewer changes to the target post-1994, because changes necessitate public statements. This is precisely what happened. The fraction of target changes that do not happen at the FOMC meeting drops discretely in 1994 from a mean of 66.7% for 1982:9-1993 to a mean of 11.5% for 1994-2015. This difference in means is significant at the 0.1% level and consistent with a continued desire for flexibility. To our knowledge, no other explanations have been put forward for the decreased use of intermeeting changes post-1994.

Second, if we are correct that the Lucca and Moench (2015) pre-FOMC effect is driven by leaks prior to the FOMC statement, then the pre-FOMC effect should not be present before 1994. However, as long as a similar amount of information is released in week 0 in its entirety, the total week 0 excess return on stocks should be similar before and after 1994. Only the timing should differ, with the post-1994 week 0 returns condensed prior to the announcement due to the information reaching the market via leaks, and pre-1994 week 0 returns spread out after the end of the FOMC meeting as the market gradually learns about any target change from the Fed's open market operations. In Table 13, we test this prediction. We show the average week 0 returns for the pre-and post-1994 period and the decomposition of these returns into the part earned before the end of the FOMC meeting and after the end of the FOMC meeting (we assume the meeting ended at 2 pm on days with an announcement at 2.15 pm – see the table note for additional detail). Overall week 0 returns are large and statistically significant in both periods, but are concentrated before end of the FOMC meeting (and thus before the announcement) on day 0 in the post-1994 period and after the end of the meeting on day 0 in the pre-1994 period. Aside from providing a test of our communications framework, the more gradual information dissemination after the FOMC meeting pre-1994 could help explain why the trough in week 1 in Figure 2, Panel B is not as sharp as the trough in week 1 in the post-1994 period in Figure 1, Panel A.

6. Policy discussion

If we are correct that systematic informal communication plays a central role in the Fed's communication, should one be concerned with that from a social welfare perspective?

Regarding flexibility and disagreement, at the heart of the issue is the extent to which the Fed is concerned with not being perceived as driving financial markets. A Fed less concerned with

moving the market would not lose flexibility by using public communication and would not need to resort to informal communication in response to disagreement. Stein and Sunderam (2015) argue that society would be better off with a Fed that cared less about surprising the market. If it is difficult to make state-contingent policy statements, greater efforts around conveyance via informative, nuanced formal statements would seem to be preferred over informal communication.

As for the motive of explaining policy, unless the Fed thinks the market cannot efficiently process information there is little reason for explanations to be private. In our view, the only motive for informal communication one may be able to defend is Fed learning from the private financial sector. However, informal communication also has costs: The Fed is giving an information advantage to some in the financial sector. Having this information is highly profitable. A former Fed official in an e-mail exchange with us put it like this:

“Talking to people poses a tradeoff between potentially conveying an information advantage to a subset of the public against refining the outside understanding of policy and improving the inside view of the economy.”

The optimal point on this tradeoff depends on how insider trading on Fed information affects inequality (given that those getting insider information are likely concentrated at the top of the wealth distribution) and the public’s confidence in financial markets and the Fed. However, even if some leaks necessitated by learning may be beneficial to society, increased sanctioning of other leaks would be welfare increasing.

7. Conclusion

We have documented a novel pattern in stock returns in the U.S. and around the world. Over the last 22 years, the equity premium has been earned entirely in even weeks in FOMC cycle time, with the equity premium in odd weeks not being statistically different from zero. This pattern is statistically robust and stable across the periods before and after the onset of the financial crisis. The FOMC calendar is irregular across years and does not appear to line up with calendars for reserve maintenance periods, macro releases or corporate earnings releases. We not only rule out a number of non-Fed-based explanations, but also provide evidence to rule in that the bi-weekly return cycle is in fact driven by the Fed. We emphasize a central role for the Fed put by documenting that stock returns mean-revert only in even-weeks and only following low past stock returns. Furthermore, we show that Fed policy deliberations tend to take place in even weeks.

Before 1994, when intermeeting target changes were frequent, they disproportionately took place in even weeks. After 1994, the bi-weekly stock return cycle is driven mainly by even week observations that follow board meetings (discount rate meetings) of the Board of Governors.

To establish the channel for how information gets from the Fed to asset markets, we show that the bi-weekly peaks in average excess stock returns over the FOMC cycle do not systematically line up with official information releases from the Fed or with the frequency of public speeches by Fed officials. Instead, we argue that systematic informal communication is an important channel. We provide direct evidence of how information from the meetings of the Board of Governors is obtained by the media, newsletters, and the financial sector around the time of those meetings, as well as examples of Fed leaks of the FOMC outcome and the FOMC minutes to financial institutions and newsletter writers. We also lay out a framework for the Fed's systematic informal communication emphasizing flexibility, explaining, learning, and disagreement. Only learning from the private financial sector could have benefits from a public policy perspective, but any such benefits from learning must be balanced against the risk that insider trading confers profits to a subset of connected financial institutions and individuals, and undermines the public's trust in financial markets and the Fed's credibility as an institution.

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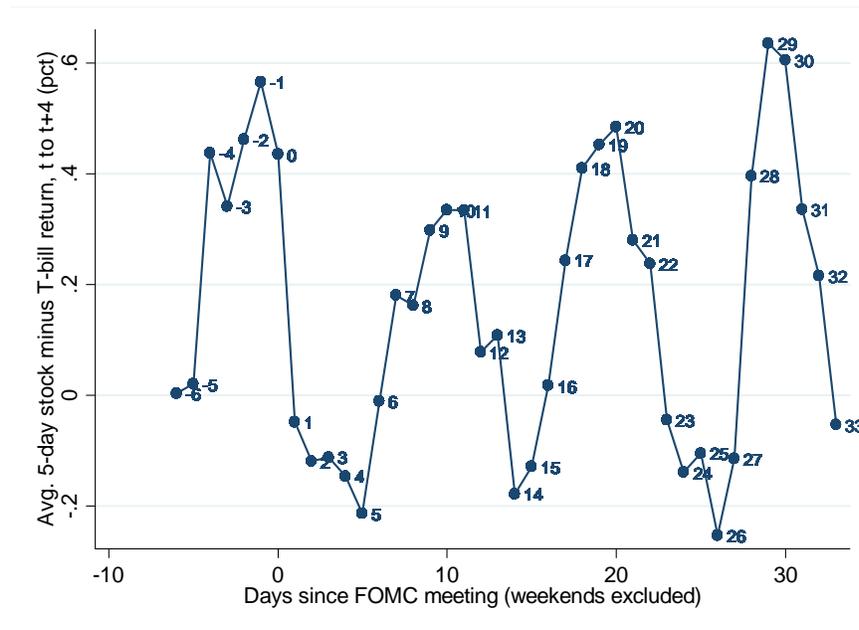
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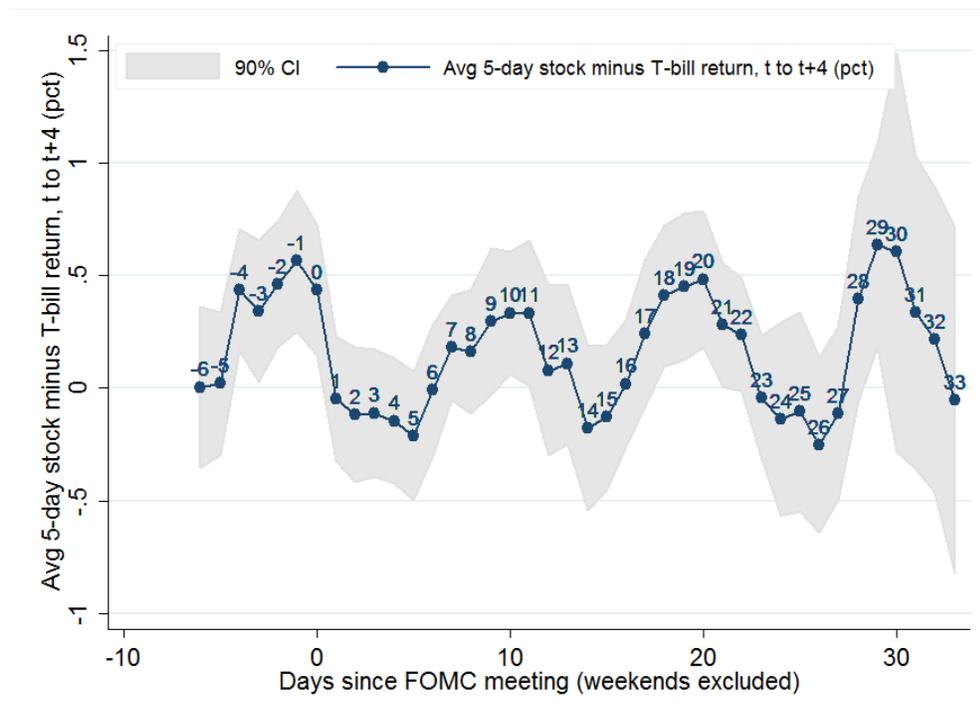
Figure 1. Stock returns over the FOMC cycle, 1994-2015

Panel A. Average 5-day stock return minus bill return over the FOMC cycle, percent



Note. Based on 176 FOMC cycles (8 scheduled FOMC meetings per year). The numbers along the line indicate the value on the horizontal axis. If a given day is day -6 or closer to the next meeting, the 5-day (forward) return for this day is not used in the right part of the graph, so points to the right do not use any data for days -2 and later.

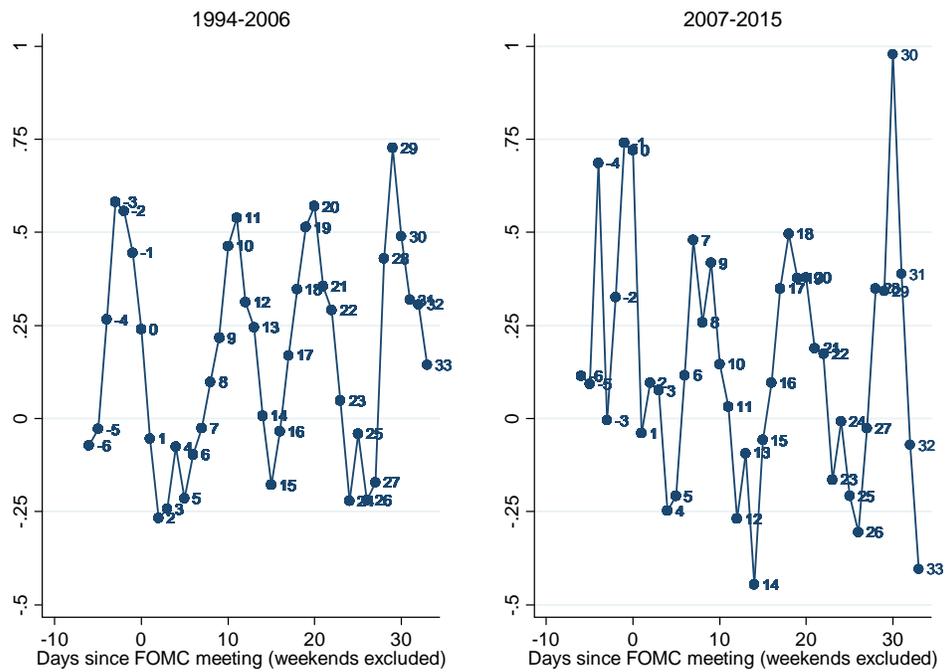
Panel B. Average 5-day stock return minus bill return over the FOMC cycle, percent, with 90 percent bootstrapped confidence band



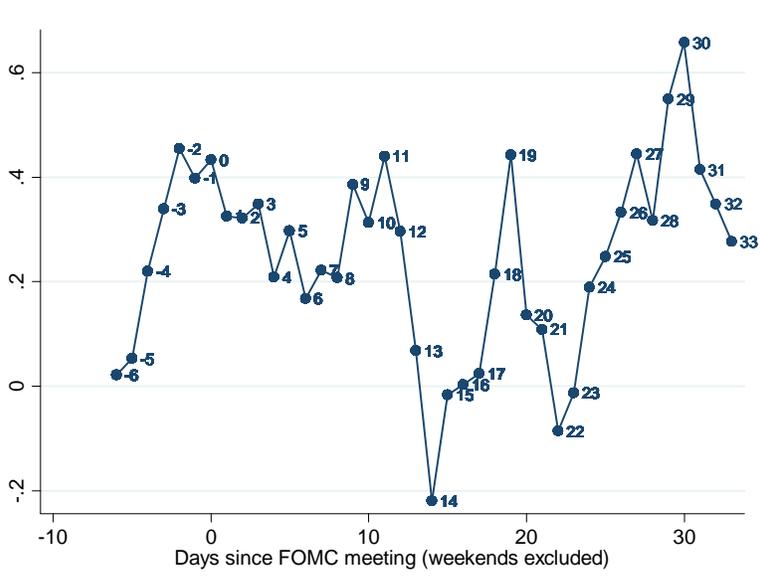
Note. The numbers along the line indicate the value on the horizontal axis.

Figure 2. Stock returns over the FOMC cycle, by time period

Panel A. Sub-periods of 1994 to 2015. Average 5-day excess return, t to $t+4$ (percent)



Panel B. 1982:9 to 1993. Average 5-day excess return, t to $t+4$ (percent)

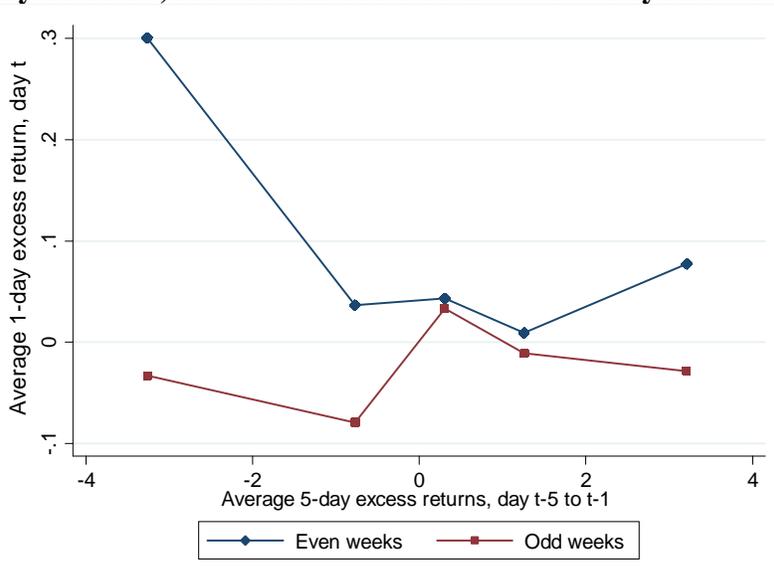


Note. The figure omits data from October 19, 1987 (Black Monday) on which the market fell by over 17 percent in one day.

Figure 3. Even week mean-reversion, 1994-2015

Daily data for all 5736 observations are sorted into five buckets based on quintiles of the x-variable (quintiles are defined without conditioning on FOMC cycle time). Within each bucket we calculate the average of the y-variable and the average of the x-variable and graph the y-average against the x-average.

Panel A. Average excess return on day t as a function of average 5-day excess return over day t-5 to t-1, even versus odd weeks in FOMC cycle time



Panel B. Average excess return on day t as a function of average 5-day excess return over day t-5 to t-1, shown for each week in FOMC cycle time

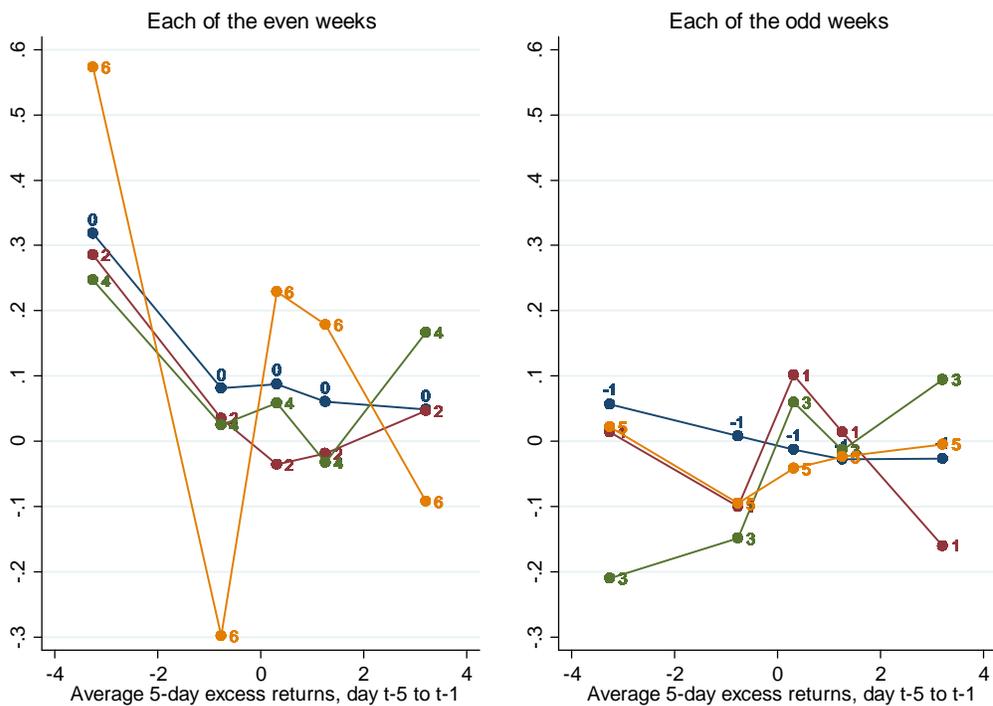


Figure 4. The Fed put: Accommodation following low intermeeting excess returns, 1994-2008

The intermeeting excess return is defined as the excess return from day 1 of cycle N-1 to day -2 of cycle N. We define 5 quintiles based on this variable. The average cumulative Federal funds target change from day 0 of cycle N-1 to day 0 of cycle N+7 (approximately a one-year period) is plotted as a function of the intermeeting excess return.

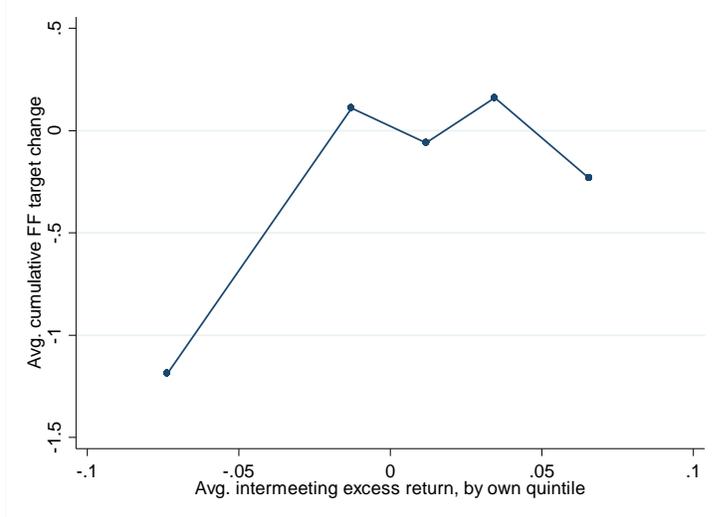


Figure 5. The Fed put, controlling for expectations from Federal funds futures, 1994-2008

Actual change: (Avg. realized daily Federal funds target during month m+5)-(Federal funds target at end of month m-2). Expected change: (Federal funds futures rate for month m+5 as of end of month m-2)-(Federal funds target at end of month m-2). Unexpected change: (Actual change)-(Expected change). For each of these three variables we calculate averages based on quintiles of the realized excess stock return over months m-1 and m.

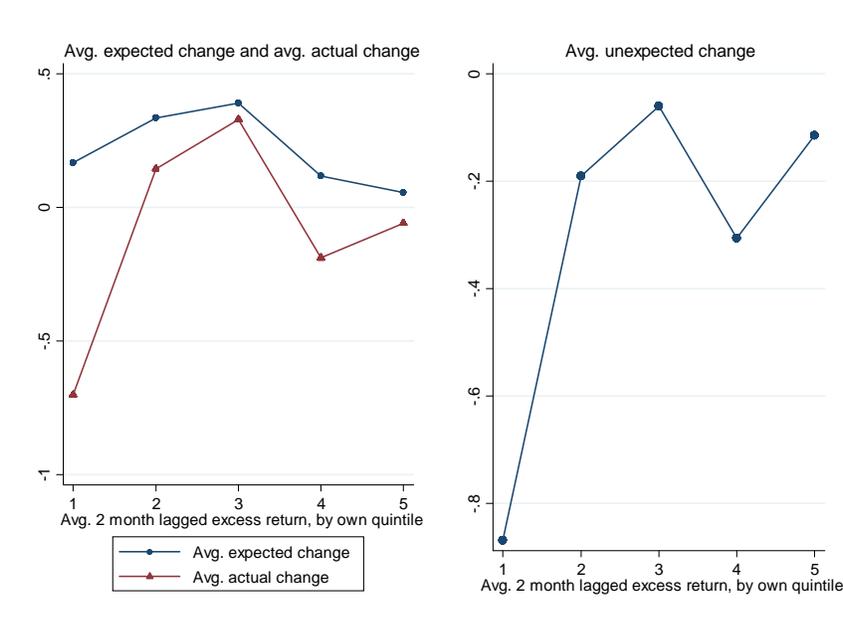
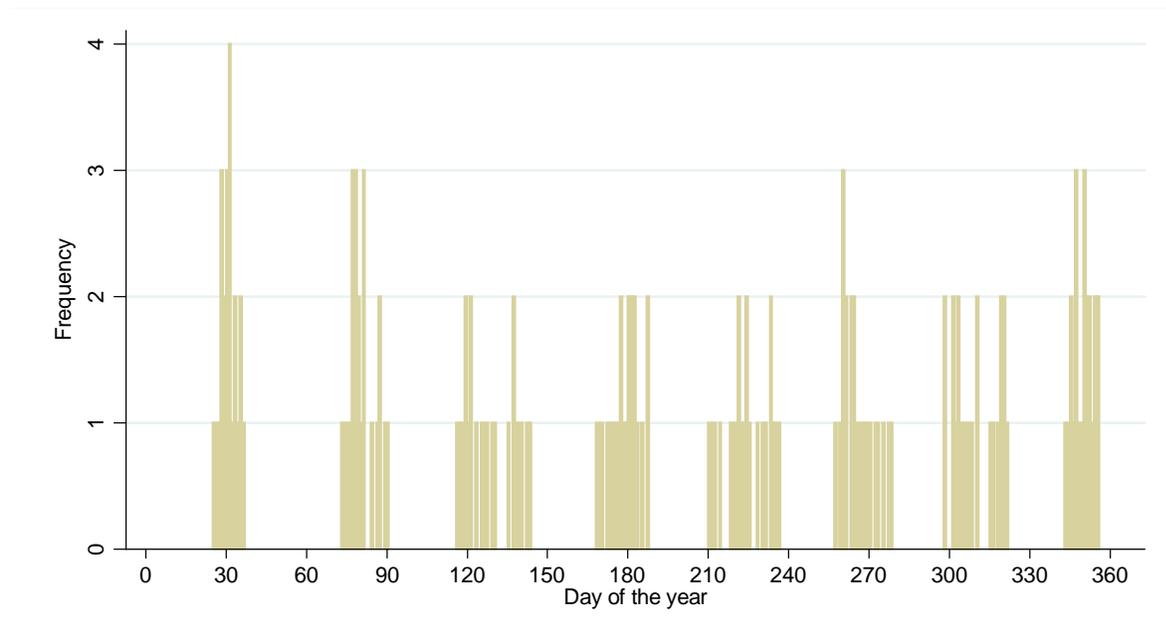


Figure 6. Timing of the eight FOMC meetings within the year: Histogram of the day of the year on which FOMC meetings took place, 1994-2015



Note. For 2-day meetings, we set the FOMC meeting day equal to the second day.

Figure 7. Probability of federal funds target change over the FOMC cycle

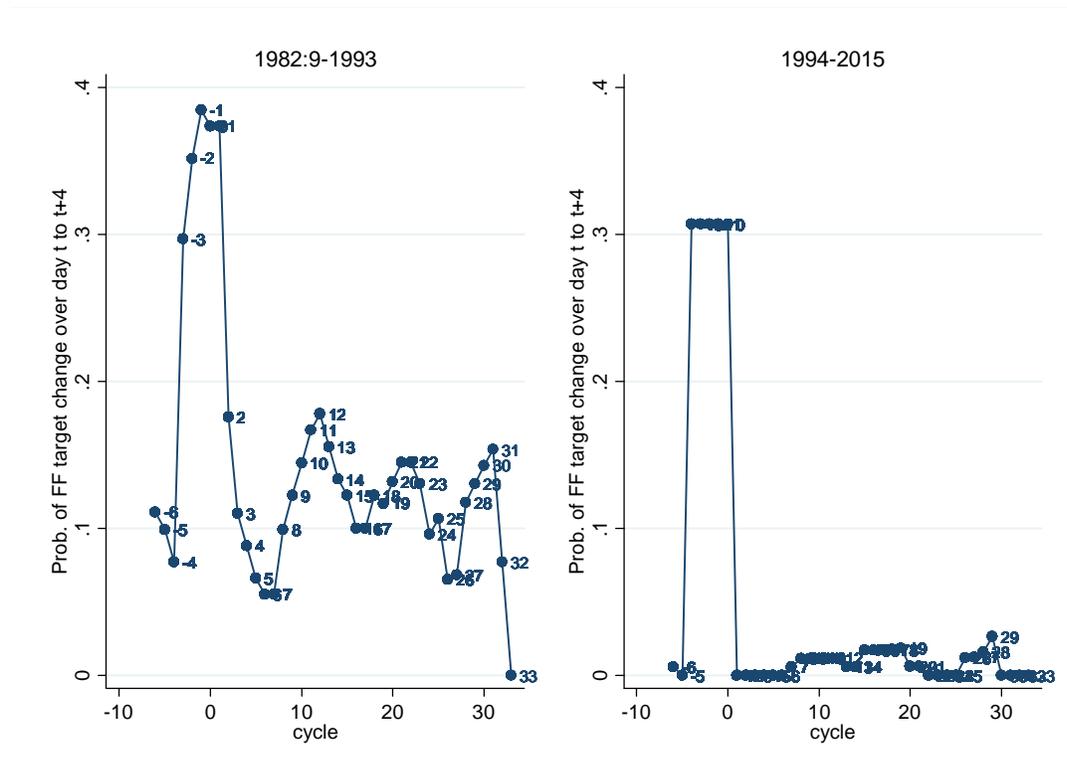
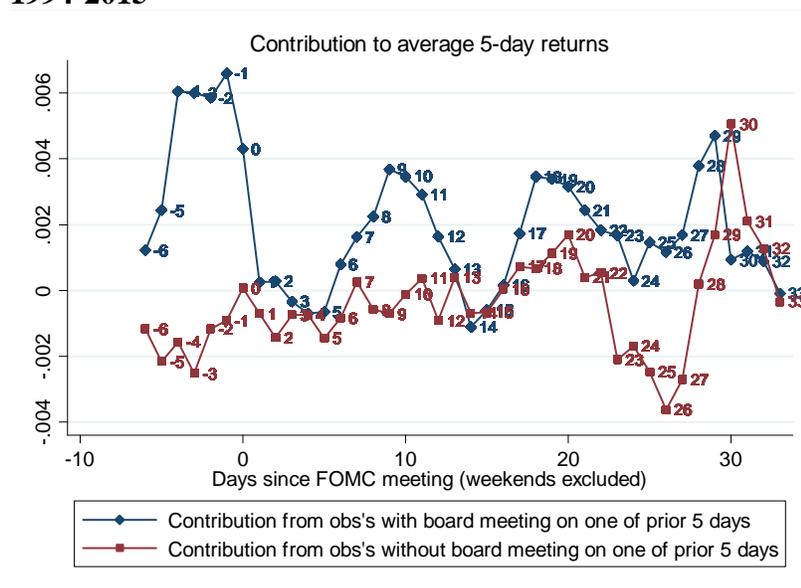


Figure 8. Observations that follow or do not follow a Board of Governors board meeting, 1994-2015



Note. The line denoted “Contribution from obs's with board meeting on one of prior 5 days” is the average of 5-day excess returns for days t to $t+4$ where excess returns are set to zero for days where none of the prior 5 days had a board meeting. The line denoted “Contribution from obs's without board meeting on one of prior 5 days” is the average of 5-day excess returns for days t to $t+4$ where excess returns are set to zero for days where one of the prior 5 days had a board meeting.

Figure 9. Wall Street Journal articles by David Wessel, 1994-2015

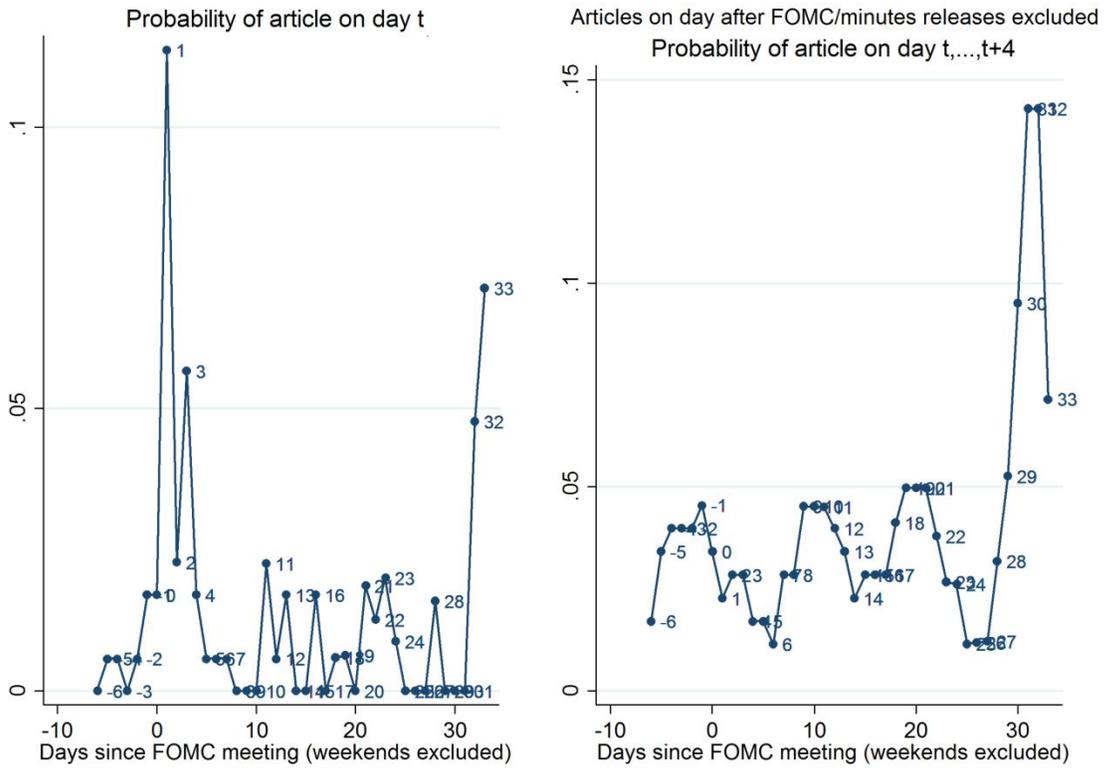


Table 1. Regressions of daily excess US stock returns on FOMC cycle dummies

The definition of weeks in FOMC cycle time are: Week -1: Days -6 to -2. Week 0: Days -1 to 3. Week 1: Days 4 to 8. Week 2: Days 9 to 13. Week 3: Days 14 to 18. Week 4: Days 19 to 23. Week 5: Days 24-28. Week 6: Days 29-33. t-statistics robust to heteroscedasticity are in parentheses. The left hand side variable is in percent, so (for example) 0.1 means 10 basis points per day. Holidays and these day are included with returns set to zero, but regression results are almost identical if holidays are instead dropped. In Panel B, results for 1982M9-1993 omit data from October 19, 1987 (Black Monday) on which the market fell by over 17 percent in one day. ***/**/* indicates significance at the 1/5/10 percent level.

Panel A. Main sample: 1994-2015

Dependent variable: Excess return on stocks over T-bills		
	(1)	(2)
Dummy=1 in Week 0	0.138*** (3.00)	0.138*** (3.00)
Dummy=1 in Week 2, 4, 6	0.106*** (3.03)	
Dummy=1 in Week 2		0.083* (1.88)
Dummy=1 in Week 4		0.117** (2.37)
Dummy=1 in Week 6		0.201** (2.21)
Constant	-0.024 (-1.17)	-0.024 (-1.17)
<i>N (days)</i>	5736	5736

Panel B. 1982-1993, 1994-2006, 2007-2015

Dependent variable: Excess return on stocks over T-bills						
	(1)	(2)	(3)	(4)	(5)	(6)
	1982M9-1993	1994-2006	2007-2015	1982M9-1993	1994-2006	2007-2015
Dummy=1 in Week 0	0.075* (1.78)	0.104** (2.13)	0.188** (2.14)	0.075* (1.78)	0.104** (2.13)	0.188** (2.14)
Dummy=1 in Week 2, 4, 6	0.087** (2.48)	0.093** (2.28)	0.123** (2.01)			
Dummy=1 in Week 2				0.072 (1.63)	0.059 (1.11)	0.118 (0.06)
Dummy=1 in Week 4				0.087* (1.71)	0.116** (2.02)	0.120 (1.40)
Dummy=1 in Week 6				0.171** (2.37)	0.185* (1.92)	0.233 (1.07)
Constant	0.004 (0.19)	-0.015 (-0.63)	-0.037 (-1.02)	0.004 (0.19)	-0.015 (-0.63)	-0.037 (-1.02)
<i>N (days)</i>	2936	3387	2349	2936	3378	2349

Table 2. International stock returns over the FOMC cycle, 1994-2015

	DMxUS		EM		WI	
	(1)	(2)	(3)	(4)	(5)	(6)
Dummy=1 in week 0	0.140*** (3.29)	0.140*** (3.28)	0.184*** (3.95)	0.184*** (3.95)	0.124*** (3.33)	0.124*** (3.33)
Dummy=1 in week 2 4 6	0.089*** (2.91)		0.172*** (4.97)		0.092*** (3.34)	
Dummy=1 in week 2		0.078** (2.10)		0.190*** (4.39)		0.082** (2.40)
Dummy=1 in week 4		0.078* (1.80)		0.136*** (2.80)		0.091** (2.35)
Dummy=1 week 6		0.245*** (2.92)		0.282*** (3.56)		0.181** (2.58)
Constant	-0.033* (-1.76)	-0.033* (-1.76)	-0.068*** (-3.21)	-0.068*** (-3.21)	-0.026 (-1.52)	-0.026 (-1.52)
N (days)	5735	5735	5735	5735	5735	5735

Note: t-statistics robust to heteroscedasticity are in parentheses. ***/**/* indicates significance at the 1/5/10 percent level. The dependent variable is a daily simple return to various MSCI equity indices, expressed in percent. To account for time zone differences, we use returns realized on day t+1 relative to the US calendar. MSCI indices are obtained from Bloomberg. WI is the world index including developed and emerging markets (Bloomberg ticker MXWD); DMxUS is the developed market index excluding US (ticker MXWOU); EM is the emerging markets index (ticker MXEF). Returns are in USD.

Table 3. Bond excess returns on scheduled FOMC announcement days, 1994-2015

	FOMC day dummy	(t-stat)	Constant	(t-stat)	N (days)
Equity	0.317	(3.52)	0.021	(1.32)	5736
1Y bond	0.004	(1.00)	0.003	(3.58)	5736
2Y bond	0.005	(0.54)	0.005	(3.30)	5736
5Y bond	0.022	(0.82)	0.010	(2.65)	5736
7Y bond	0.019	(0.49)	0.013	(2.51)	5736
10Y bond	0.025	(0.56)	0.012	(1.91)	5736
20Y bond	0.015	(0.24)	0.020	(2.16)	5736
30Y bond	0.022	(0.28)	0.017	(1.51)	5736

Note: The table presents regressions of daily stock and Treasury bond excess returns (in excess of 1-month T-bill rate) on an FOMC day dummy and a constant. T-statistics adjusted for heteroscedasticity are in parentheses. Excess returns are reported in percent. Daily returns on Treasury bonds are obtained from CRSP fixed-term Treasury indices files. ***/**/* indicates significance at the 1/5/10 percent level.

Table 4. Profitability of various trading strategies, 1994-2015

Trading strategy:	Average annual excess return	Standard deviation of annual excess return	Sharpe ratio for annual returns
Standard buy and hold strategy			
A. Hold stocks all the time	8.26	19.12	0.43
Alternating FOMC week strategies for the overall stock market			
B. Hold stocks in weeks 0, 2, 4, 6 only	11.77	13.33	0.88
Hold stocks in week 0 only	4.73	8.63	0.55
Hold stocks in week 2 only	2.33	6.50	0.36
Hold stocks in week 4 only	3.31	6.43	0.52
Hold stocks in week 6 only	1.01	1.57	0.64
C. Hold stocks in weeks -1, 1, 3, 5 only	-3.00	14.55	-0.21
D. Long stocks in weeks 0, 2, 4, 6 and short stocks in weeks -1, 1, 3, 5 (strategy B minus strategy C)	14.78	21.12	0.70

Table 5. Even-week mean-reversion, 1994-2015**Panel A. Main regression, by quintile of excess return over various look-back periods**

Regressions of excess stock returns on even week dummies for various categories of observations based on lagged excess stock returns							
	Quintile (last week)=1 (low)	Quintile (last week)=2	Quintile (last week)=3	Quintile (last week)=4	Quintile (last week)=5 (high)	Quintile(last week)=1 and Quintile(last month)=1	Quintile(last week)=1 and Quintile(last month)=1 and Quintile(last 3 months)=1
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dummy=1 in Week 0	0.354** (2.305)	0.157* (1.720)	0.0539 (0.635)	0.0732 (0.803)	0.0769 (0.878)	0.609** (2.284)	1.049** (2.141)
Dummy=1 in Week 2	0.321** (2.057)	0.112 (1.409)	-0.0671 (-0.877)	-0.00765 (-0.113)	0.0753 (0.806)	0.546** (2.131)	0.667* (1.711)
Dummy=1 in Week 4	0.282* (1.898)	0.101 (0.988)	0.0251 (0.231)	-0.0202 (-0.285)	0.195* (1.839)	0.533** (2.117)	0.712* (1.837)
Dummy=1 in Week 6	0.608*** (3.159)	-0.222 (-0.948)	0.196 (1.181)	0.191 (1.330)	-0.0633 (-0.299)	0.893*** (3.081)	1.404*** (3.728)
Constant	-0.0355 (-0.541)	-0.0759* (-1.842)	0.0334 (0.968)	-0.0128 (-0.373)	-0.0285 (-0.657)	-0.0786 (-0.735)	-0.104 (-0.649)
<i>N</i> (days)	1148	1147	1147	1147	1147	598	354

Note: t-statistics robust to heteroscedasticity are in parentheses. ***/**/* indicates significance at the 1/5/10 percent level.

Panel B. Decomposition of log stock returns

	Sum of $\ln(1+r_m)$ for various categories of observations based on lagged excess stock returns					
	All days		Even week days		Odd week days	
	(1)	(2)	(3)	(4)	(5)	(6)
Overall total	1.91	(<i>n</i> =5736)	2.54	(<i>n</i> =2669)	-0.62	
Quintile(last week)=1 (low)	1.32	(<i>n</i> =1148)	1.57	(<i>n</i> =531)	-0.24	
Quintile(last week)=2	-0.20	(<i>n</i> =1148)	0.22	(<i>n</i> =541)	-0.43	
Quintile(last week)=3	0.50	(<i>n</i> =1147)	0.26	(<i>n</i> =543)	0.24	
Quintile(last week)=4	0.04	(<i>n</i> =1146)	0.08	(<i>n</i> =546)	-0.03	
Quintile(last week)=5 (high)	0.25	(<i>n</i> =1147)	0.41	(<i>n</i> =508)	-0.16	
	1.91	(<i>n</i> =5736)	2.54	(<i>n</i> =2669)	-0.62	
Quintile(last week)=1 and Quintile(last month)=1	1.10	(<i>n</i> =598)	1.38	(<i>n</i> =280)	-0.28	
Quintile(last week)=1 and Quintile(last month)=1 and Quintile(last 3 months)=1	0.89	(<i>n</i> =354)	1.12	(<i>n</i> =161)	-0.23	

Table 6. Impulse response of Federal funds target to an intermeeting excess return in the lowest quintile, 1994-2008

Daily data for all 176 day zeros are sorted into five buckets based on quintiles of the excess return from day 1 of cycle N-1 to day -2 of cycle N (we denote this return by the “intermeeting excess return”). We then focus on data for 1994-2008 and document how an excess return in the lowest quintile affects the Federal funds target over cycle N and the next 7 cycles.

	Dependent variable: (Federal funds target on day 0 of cycle N+X) -(Federal fund target on day 0 of cycle N-1)							
	X=0	X=1	X=2	X=3	X=4	X=5	X=6	X=7
Dummy for intermeeting excess return being in quintile 1	-0.149	-0.424**	-0.585***	-0.791***	-0.926***	-1.004***	-1.123**	-1.198**
	[-1.65]	[-2.87]	[-3.56]	[-3.99]	[-3.79]	[-3.54]	[-3.28]	[-3.06]
Constant	0.0109	0.0489	0.0584	0.072	0.0693	0.0489	0.038	0.0109
	[0.41]	[0.87]	[0.58]	[0.49]	[0.36]	[0.20]	[0.13]	[0.03]
Observations (FOMC cycles)	120	120	120	120	120	120	120	120

Note: Newey-West t-statistics allowing for autocorrelation up to X lags.

***/**/* indicates significance at the 1/5/10 percent level.

Table 7. The Fed put, controlling for expectations from Federal funds futures, 1994-2008

Panel A. Actual target changes

	Dependent variable: (Average realized daily Federal funds target during month m+X)- (Federal funds target at end of month m-2)					
	X=0	X=1	X=2	X=3	X=4	X=5
Dummy for excess return over months m and $m-1$ being in quintile 1	-0.115*	-0.254**	-0.445***	-0.596***	-0.703***	-0.762***
	[-1.82]	[-2.17]	[-2.65]	[-3.02]	[-3.31]	[-3.40]
Constant	0.0103	0.0259	0.0524	0.0671	0.0696	0.0607
	[0.46]	[0.63]	[0.88]	[0.80]	[0.62]	[0.42]
Observations (months)	178	178	178	178	178	178

Panel B. Unexpected target changes

	Dependent variable: (Average realized daily Federal funds target during month m+X)- (Federal funds futures for month m+X as of end of month m-2)					
	X=0	X=1	X=2	X=3	X=4	X=5
Dummy for excess return over months m and $m-1$ being in quintile 1	-0.0513	-0.175**	-0.347***	-0.502***	-0.617***	-0.698***
	[-1.32]	[-2.24]	[-2.91]	[-3.60]	[-4.14]	[-4.37]
Constant	-0.0454***	-0.0583***	-0.0694**	-0.0893**	-0.129**	-0.170*
	[-4.76]	[-3.28]	[-2.51]	[-2.07]	[-1.98]	[-1.90]
Observations (months)	178	178	178	178	178	178

Note: Newey-West t-statistics allowing for autocorrelation up to X lags.

***/**/* indicates significance at the 1/5/10 percent level.

Table 8. Regressions of daily excess stock returns on FOMC cycle dummies with controls for non-Fed news, 1994-2015

	Dependent variable: Excess return on stocks				
	(1)	(2)	(3)	(4)	(5)
Dummy=1 in Week 0	0.138*** (3.00)	0.139*** (3.01)	0.134*** (2.90)	0.131*** (2.80)	0.138*** (2.99)
Dummy=1 in Week 2, 4, 6	0.106*** (3.03)	0.107*** (3.05)	0.105*** (3.00)	0.0949*** (2.72)	0.106*** (3.04)
Number of macro releases, relevance weighted			0.013* (1.81)		
Number of corp. earning Announcements (10^{-4})					0.622 (0.38)
Fraction of positive earnings surprises					-0.012 (-0.14)
Dummies for day of week/month, end of month/quarter/year				Yes	
Dummies for day in the reserve maintenance period		Yes			
Constant	-0.0238 (-1.17)	-0.222 (-0.85)	-0.049** (-2.07)	0.068 (0.73)	-0.026 (-0.55)
N (days)	5736	5736	5736	5736	5736

Note: t-statistics robust to heteroscedasticity in parenthesis. The left hand side variables is in percent, so (for example) 0.1 means 10 basis points per day. ***/**/* indicates significance at the 1/5/10 percent level. Earning announcements are from IBES. Macro announcements are from Bloomberg Economic Calendar, and exclude FOMC-related news.

Table 9. The seven intermeeting Federal funds target changes from 1994-2015

Panel A. Dates of the intermeeting target changes

Date of intermeeting change in Federal funds target	Federal funds target change	Date in cycle	Date of prior board meeting	FOMC conference call
10/8/2008	-0.5	16	1 day before	1 day before
1/22/2008	-0.75	-6 (30 of last cycle)	1 day before	1 day before
9/17/2001	-0.5	19	Same day	Same day
4/18/2001	-0.5	21	Same day, 2 days before	Same day
1/3/2001	-0.5	11	1 day before	Same day
10/15/1998	-0.25	12	1 day before	Same day
4/18/1994	0.25	19	Same day	Same day

Panel B. Stock returns leading up to the intermeeting target changes

Date of intermeeting change in Federal funds target	Cumulative excess stock return (pct) since day 0 of:					Quintile of cumulative excess stock return (1=lowest) since day 0 of:				
	Cycle N (this cycle)	Cycle N-1	Cycle N-2	Cycle N-3	Cycle N-4	Cycle N (this cycle)	Cycle N-1	Cycle N-2	Cycle N-3	Cycle N-4
10/8/2008	-18.2	-21.4	-25.0	-28.2	-21.6	1	1	1	1	1
1/22/2008	-13.9	-14.6	-10.8	-10.0	-12.7	1	1	1	1	1
9/17/2001	-11.6	-14.8	-16.7	-10.6	-24.6	1	1	1	1	1
4/18/2001	5.3	-11.2	-7.1	-12.1	-16.6	5	1	1	1	1
1/3/2001	1.5	-4.0	-8.9	-11.8	-8.6	4	1	1	1	1
10/15/1998	-1.7	-6.1	-11.1	-9.4	-8.6	1	1	1	1	1
4/18/1994	-6.3	-7.8	-4.1	-3.9	-1.7	1	1	1	1	2

Table 10. The importance of board meeting weeks: Even week effects driven by even weeks that follow Board meetings, 1994-2015

	Dependent variable: Daily excess return on stocks	
	(1) Baseline from Table 1	(2)
Dummy=1 in Week 0	0.138*** (3.00)	
Dummy=1 in Week 2	0.083* (1.88)	
Dummy=1 in Week 4	0.117** (2.37)	
Dummy=1 in Week 6	0.201** (2.21)	
(Dummy=1 in Week 0)*(Dummy=1 if t-5 to t-1 had board meeting)		0.177*** (3.52)
(Dummy=1 in Week 2)*(Dummy=1 if t-5 to t-1 had board meeting)		0.182*** (3.13)
(Dummy=1 in Week 4)*(Dummy=1 if t-5 to t-1 had board meeting)		0.156** (2.41)
(Dummy=1 in Week 6)*(Dummy=1 if t-5 to t-1 had board meeting)		0.166 (1.47)
(Dummy=1 in Week 0,2,4,6)*(Dummy=1 if t-5 to t-1 had no board meeting)		0.037 (0.71)
(Dummy=1 in Week -1,1,3,5)*(Dummy=1 if t-5 to t-1 had board meeting)		0.032 (0.79)
Constant	-0.024 (-1.17)	-0.038 (-1.34)
<i>N (days)</i>	5736	5736

Note. t-statistics robust to heteroscedasticity in parenthesis. The left hand side variables is in percent, so (for example) 0.1 means 10 basis points per day. ***/**/* indicates significance at the 1/5/10 percent level.

Table 11. Regressions of daily excess stock returns on FOMC cycle dummies with controls for public Fed releases and speeches, 1994-2015

	(1)	(2)	(3)
Dummy=1 in Week 0	0.138*** (3.00)	0.146*** (3.09)	0.135*** (2.91)
Dummy=1 in Week 2	0.083* (1.88)	0.082* (1.85)	0.083* (1.89)
Dummy=1 in Week 4	0.117** (2.37)	0.120** (2.35)	0.118** (2.38)
Dummy=1 in Week 6	0.201** (2.21)	0.185** (2.01)	0.204** (2.22)
<u>Controls for public Fed monetary policy releases:</u>			
Dummy for Beige book release on day t		0.083 (0.87)	
Dummy for FOMC minutes release on day t		-0.092 (-1.01)	
Dummy for discount rate meeting minutes release on day t		-0.121 (-1.16)	
<u>Controls for speeches by Fed officials:</u>			
Dummy for Governor speech on day t			0.087* (1.71)
Dummy for Vice Chair speech on day t			-0.053 (-0.52)
Dummy for Chair speech on day t			0.002 (0.03)
Dummy for President speech on day t			-0.045 (-1.18)
Dummy for Governor speech on day t-1			-0.005 (-0.11)
Dummy for Vice Chair speech on day t-1			0.027 (0.28)
Dummy for Chair speech on day t-1			-0.051 (-0.80)
Dummy for President speech on day t-1			0.011 (0.29)
Constant	-0.024 (-1.17)	-0.022 (-1.07)	-0.019 (-0.77)
<i>N (days)</i>	5736	5736	5736

Table 12. Examples of Fed leaks

Panel A. Fed leaks to media and newsletter writers of information from Fed board meetings

Below are examples of news columns or newsletters content (column 1) parallel with information discussed in Federal Reserve Board of Governors Board Meetings (column 2). *Discount Rate Minutes* are posted on the Fed's website with a lag. Discount rate refers to the votes by the Federal Reserve Bank Presidents regarding their preference for the discount rate (now called primary rate), generally taken as a broader signal of their preference for monetary policy. Other matters in addition to votes are discussed at the meetings, as these examples convey. Not all *Discount Rate Minutes* contain additional content other than the votes. We found these examples either because of the articles moving the market (and thus making further news) or by reading relevant newspapers around the dates when the *Minutes* contained a discussion of the Board's discussion topics.

	Media or Newsletter content in the public domain	Private discussions at the Fed Board Meeting
1	<p>Wessel, David. <i>Wall Street Journal</i>, June 19, 1995</p> <p>"In speeches and interviews; the outspoken Mr. Blinder has made it clear he is increasingly worried.... Two other Fed governors; fellow Clinton appointee Janet Yellen and Bush appointment Lawrence Lindsey; are said to be ready to cut interest rates; too. All three supported the round of interest-rate increases that ended four-and-a-half months ago."</p>	<p><i>Discount Rate Minutes</i>, June 19, 1995</p> <p>"Vice Chairman Blinder believed that the requests for a reduction in the discount rate had merit...Governor Lindsey stated ..., in his view, this outlook for a relatively weak economy called for a reduction in the overall structure of interest rates. Governor Yellen believed that the inflation risk had moderated and that economic conditions warranted a monetary easing action."</p>
2	<p>Clary, Isabelle. <i>Reuters</i>, September 17, 1996</p> <p>"Eight of the 12 district banks in the Federal Reserve System have requested a hike in the discount rate amid mounting evidence the pace of economic expansion is likely to remain brisk in the second half of 1996, a senior Fed official said Tuesday. "Eight (Fed) banks have requested a discount rate hike and (of those) three have requested a 50-basis-point (one-half percentage point) discount rate hike," the source told Reuters."... The source said the requests for a discount rate hike have been submitted by banks in Fed districts that are experiencing rapid growth and tight labour markets or that have a "hawkish" anti-inflation tradition. The three district banks calling for a half-point discount rate hike are in Minneapolis, Richmond, Va., and San Francisco, according to the source. The source said the August employment report -- though its strength may have been exaggerated by special factors -- "gave the hawks fresh ammunition and raised questions about how far the (non-inflationary growth threshold) experiment can go." The source added that some of the Fed governors known for their moderate views on monetary policy -- such as Laurence Meyer -- were sympathetic to the bank presidents' concern that the economy may be overheating. The votes favouring a higher discount rate were taken at various regional Fed board meetings in recent weeks. Bank board meetings are held on regular dates, but the schedules differ from bank to bank."</p>	<p><i>Discount Rate Minutes</i>, September 16, 1996</p> <p>"Requests by eight Reserve Banks to increase the discount rate; requests by four Reserve Banks to maintain existing rates."..."Subject to review and determination by the Board of Governors, the directors of the Federal Reserve Banks of Boston, Richmond, and St. Louis had voted on September 12 to establish a basic discount rate of 5-1/2 percent (an increase from 5 percent)".</p> <p><i>Greenbook</i>, September 18, 1996</p> <p>"The decision at the August FOMC meeting to keep reserve conditions unchanged had little impact on financial market prices. However, interest rates have been volatile over the intermeeting period, responding sharply at times on the release of data suggesting greater or lesser growth and inflationary pressure.</p> <p>Reports of the attitudes of Federal Reserve officials also precipitated significant market moves on occasion, with a reported leak of discount rate proposals causing rates to rise yesterday."</p>
3	<p>Wessel, David. <i>Wall Street Journal</i>, March 17, 1997</p> <p>"In short; Fed officials privately say the risks of the economy growing too fast and setting off an unwelcome round of price and wage increases outweigh the risks of an imminent recession. ... Certainly; no one will be shocked if he opts to lift rates at the March 25 meeting of the Fed's policy committee."</p>	<p><i>Discount Rate Minutes</i>, March 17, 1997</p> <p>"At today's meeting, Chairman Greenspan observed that, based on data now available, an equally strong case could be made for increasing the federal funds rate ... He noted that the Board could tighten policy as a preemptive move against the potential for increased inflationary pressures."</p>
4	<p>Berry, John. <i>Washington Post</i>, March 30, 1999</p> <p>"Federal Reserve officials aren't likely to make any change in short-term interest rates at a policymaking session this</p>	<p><i>Discount Rate Minutes</i>, March 29, 1999</p> <p>"At today's meeting, Chairman Greenspan observed that, based on data now available, an equally strong case could be</p>

	<p>morning, according to comments from several of the officials and analysts who watch them... A small minority of the 18 Fed officials scheduled to attend the meeting probably favor raising rates ..."</p>	<p>made for increasing the federal funds rate ... He noted that the Board could tighten policy as a preemptive move against the potential for increased inflationary pressures."</p>
5	<p>Wessel, David. <i>Wall Street Journal</i>, December 18, 2000 "But Fed insiders say there is discussion of doing more; although not yet any firm consensus. Both private and Fed staff forecasts have been marked down in the past several months; and there is some concern inside the Fed that the U.S. economy's momentum is slowing more rapidly than desired. Incoming data is mixed; but a slew of companies have reported surprisingly abrupt drops in sales and orders; and consumer confidence has fallen sharply. Fed officials welcome a slowdown; but differ on how much of a slowdown -- and how much of an increase in unemployment -- is desirable...Members of the Federal Reserve Board in Washington are scheduled to meet with staff economists for an important review of the outlook today."</p>	<p><i>Discount Rate Minutes</i>, December 18, 2000 "Reserve Bank directors recommending a reduction in the discount rate generally reported that many national economic indicators were softening. Some noted that growth in the real Gross Domestic Product had slowed in response to tightening financial conditions, with noticeable weakness in retail sales and manufacturing. Others cited decreased retail sales, in combination with slower growth in employment, as signaling that the expansion was slowing by more than was needed to maintain growth at a sustainable pace... Reserve Bank directors in favor of maintaining existing rates acknowledged that there were signs of an economic slowdown... In light of these considerations, they favored no change in existing rates at this time, but recognized that if economic conditions continued to soften, there might be a need to lower rates in the near term. "</p>
	<p>Note the market effect in the follow-up article: Ip, Greg. <i>Wall Street Journal</i>, December 19, 2000 "Hopes that the Fed could be poised to reverse its 19-month anti-inflation stance sent blue chips soaring yesterday; ...The Fed has either raised rates or maintained a bias to higher rates at each of its meetings since May of last year.... But an article in The Wall Street Journal yesterday said Fed officials were contemplating a more-aggressive response...."</p>	
6	<p>Newsletter of Paul Markowski, <i>MES Advisors</i>, April 29, 2010 Reported by Cooke, Kristina , Pedro da Costa and Emily Flitter. <i>Reuters</i>, September 30, 2010</p>	<p><i>Discount Rate Minutes</i>, April 26, 2010</p>
	<p>"I had two interesting phone conversations with senior Fed officials --one last night and another this morning. What I heard was that going into the meeting the staff were split 50:50 as to the recommendation on rates; there were 6 members who favored some change in the asset sales issue and 3-4 who favored changing (the Fed's commitment to keep rates low for an extended period), with another 1-3 suggesting putting the change off to the next meeting."</p>	<p>"Requests by nine Reserve Banks to maintain the existing rate; requests by three Reserve Banks to increase the primary credit rate."</p>
7	<p>Newsletter of Jan Hatzius, <i>Goldman Sachs</i>, August 9, 2010</p>	<p><i>Discount Rate Minutes</i>, August 6, 2010</p>
8	<p>Newsletter of Laurence Meyer, <i>Macroeconomic Advisers</i>, August 18, 2010 Reported by Pullman, Susan. <i>Wall Street Journal</i>, November 22, 2011</p>	
	<p>"On Aug. 18; 2010; former Fed governor Laurence Meyer; who runs a research service predicting and analyzing Fed actions; told clients in a note the central bank's "bazooka is loaded" to buy bonds to stimulate the economy. The note described how the Fed's "doves;" members inclined to ease monetary policy; had said the Fed couldn't "sit on its hands;" according to Mr. Meyer's account. ...Jan Hatzius; chief economist at Goldman Sachs; was also ahead of the pack; telling clients on Aug. 9 [2010] that he believed another round of bond buying by the Fed was coming. Mr. Hatzius is a regular guest of Mr. Bernanke and he meets privately with Mr. Dudley -- his former boss at Goldman -- according to calendar records."</p>	<p>"Federal Reserve Bank directors noted that recent economic conditions were indicative of a slower pace of recovery in output and employment than had been anticipated. While some directors said that growth in certain sectors, including manufacturing, had been slightly higher than expected, others commented that consumer spending had softened somewhat... Overall, directors anticipated only modest near-term economic expansion. With inflation subdued and inflation expectations stable, most directors recommended that the current accommodative stance of monetary policy be maintained."</p>

Panel B. Fed leaks to newsletter writers and financial institutions of the FOMC outcome or the FOMC minute contents

Below are examples of private news leaks, found by searching the words leak and Federal Reserve in Factiva.

1	<p>Leak to Bank of America of FOMC meeting outcome prior to FOMC meeting <i>FOMC Transcript</i> August 16, 2007</p> <p>“MR. LACKER. Vice Chairman Geithner, did you say that [the banks] are unaware of what we’re considering or what we might be doing with the discount rate? VICE CHAIRMAN GEITHNER. Yes. MR. LACKER. Vice Chairman Geithner, I spoke with Ken Lewis, President and CEO of Bank of America, this afternoon, and he said that he appreciated what Tim Geithner was arranging by way of changes in the discount facility. So my information is different from that.”</p>
2	<p>Leak to PIMCO of Greenbook content (and thus likely FOMC outcome) prior to FOMC meeting Interview of Bill Gross, PIMCO, on <i>CNBC</i>. Reported by Taibbi, Matt, <i>The Rolling Stone</i>. October 8, 2010</p> <p>“A hilarious example of this cozy insiderism popped up just a few weeks ago, when PIMCO bond fund chief Bill Gross let it slip on a live CNBC interview that he was getting inside info from the Fed. The interview is with former Goldman analyst and (now) CNBC anchor Erin Burnett, as well as... Steve Liesman... Gross at one point says this: ‘What is important going into November is the staff forecast for economic growth for the next 12-18 months. Our understanding is that the Fed is about to downgrade their forecast from 3% down to 2%. Which in turn would suggest that unemployment won’t be coming down... and so that would be the trigger to my way of thinking for Quantitative Easing in November.’ The admission is so untoward that the ex-Goldmanite Burnett immediately races to clean up the problem, saying to Liesman, who is also on the panel, ‘We don’t have that forecast yet, right, Steve?’ At which point [Liesman] replies, ‘We won’t get that for 3 weeks, Erin. That’s when it comes out with the minutes of this meeting.’”</p>
3	<p>Leak to Fed watcher of FOMC minutes prior to public release Newsletter, Laurence Meyer, Founder & Senior Managing Director, <i>Macroeconomic Advisers</i> Reported by Cooke, Kristina, Pedro da Costa and Emily Flitter. <i>Reuters</i>, September 30, 2010</p> <p>“On August 19, just nine days after the U.S. central bank surprised financial markets by deciding to buy more bonds to support a flagging economy, former Fed governor Larry Meyer sent a note to clients of his consulting firm with a breakdown of the policy-setting meeting. The minutes from that same gathering of the powerful Federal Open Market Committee, or FOMC, are made available to the public -- but only after a three-week lag. So Meyer’s clients were provided with a glimpse into what the Fed was thinking well ahead of other investors.”</p> <p>[Later in the article, concerning former Fed employees and outsiders:]</p> <p>“Fed board staffers who retire even get to keep their pass for the central bank’s building, which boasts fitness facilities, a barber and a dining room... they are not restricted to where they can go once inside the building.”</p>
4	<p>Leak to Fed watcher (former governor) of FOMC outcome prior to FOMC meeting Calls by Nancy Lazar to clients, <i>International Strategy & Investment</i>, August 15, 2011 Reported by Pullman, Susan. <i>Wall Street Journal</i>, November 22, 2011.</p> <p>“Hours after an Aug. 15 meeting with Federal Reserve Chairman Ben Bernanke in his office, Nancy Lazar made a hasty call to investor clients: The Fed was dusting off an obscure 1960s-era strategy known as Operation Twist...Ms. Lazar is among a group of well-connected investors and analysts with access to top Federal Reserve officials who give them a chance at early clues to the central bank’s next policy moves; according to interviews and hundreds of pages of documents obtained by The Wall Street Journal through open records searches.”</p>
5	<p>Leak to Fed watcher (former governor) of FOMC debate prior to release of FOMC minutes Advice to clients, Wayne Angell, <i>Bear, Stearns & Co.</i> Reported by Wessel, David. <i>Wall Street Journal</i>, July 7, 1995</p> <p>"One Fed watcher who called it right -- barely -- was former Fed governor Wayne Angell; now an economist at Bear; Stearns & Co. Mr. Angell had been among those confidently predicting that the Fed would hold rates steady at this week's meeting. But on Wednesday -- after joining current Fed officials and others the night before to watch Fourth of July fireworks from the roof of the Fed's building in Washington -- Mr. Angell abruptly announced that he had changed his view and anticipated a one-quarter-point cut. Mr. Angell said he changed his mind while riding a bike on Tuesday before going to the fireworks."</p>
6	<p>Leak to Fed watcher (policy intelligence firm) of FOMC debate prior to release of FOMC minutes Newsletter to clients, Regina Schleiger, <i>Medley Global Advisors</i>, October 3, 2012 (Full text at https://www.propublica.org/documents/item/1372212-fed-dec-bound.html)</p>

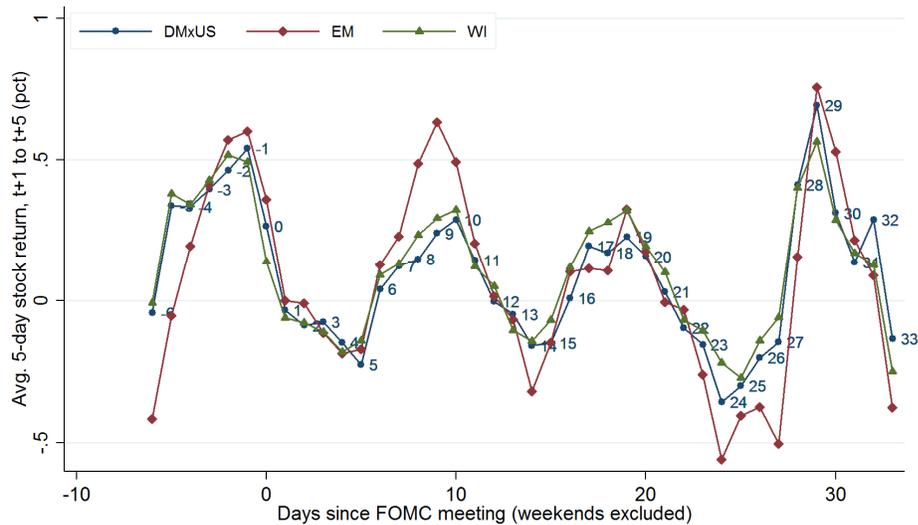
Table 13. The impact of changing incentives for private communication on return patterns before and after 1994

Sample	Excess returns	
	1982:9-1993	1994-2015
(1) Avg. excess return from open on day -1 to close on day 3	0.447** (2.01)	0.605*** (3.46)
(2) Avg. excess return from open on day -1 to end of FOMC meeting on day 0	0.0621 (0.43)	0.509*** (5.17)
(3) Avg. excess return from end of FOMC meeting on day 0 to close on day 3	0.390** (2.00)	0.0963 (0.66)
N	91	176

Note: We construct the intra-day stock returns from the S&P 500 futures (after 2000 we use the prices of E-mini futures) in order to break up the day 0 return into the parts earned before the meeting and including and after the meeting. We define return from the open on day -1 to the end of the FOMC meeting on day 0 (row (2)) as the return from open on day -1 to 2pm (as in Lucca and Moench (2011)), unless the Fed's announcement time (in post-1993 sample) deviated from the regular time of 2:15pm EST. Such deviations happened twice in 1994, once in 1996, in which cases we compute the returns earned up to five minutes before the announcement time (as reported by Bloomberg). Between Apr 2011 and Dec 2012, the Fed made six announcement at 12:30pm, in which case we compute returns earned up to 12:25pm. Since March 2013 through the end of our sample, the Fed announcement has taken place at 2:00pm, in which case we compute returns up to 13:55pm. Returns in row (3) are then computed from the end of meeting cut-off time to the close on day 3. The regular trading hours for the S&P 500 futures are between 9:30am and 4.15pm EST (the exchange time of CME where futures contracts are traded is CST). We do not have intra-day returns on T-bills so to construct excess returns we assume that T-bill return is earned evenly throughout the day on day 0.

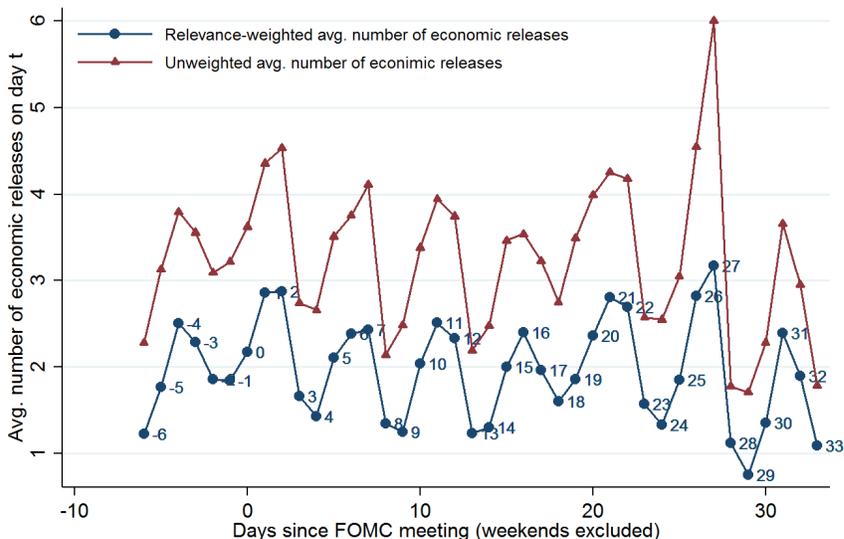
Internet appendix for “Stock Returns over the FOMC Cycle”

Appendix Figure 1. International stock returns over the FOMC cycle, percent, 1994-2015



Note: To account for time zone differences, we use returns realized on day t+1 relative to the US calendar. MSCI indices are obtained from Bloomberg. WI is the world index including developed and emerging markets (Bloomberg ticker MXWD); DMxUS is the developed market index excluding US (ticker MXWOU); EM is the emerging markets index (ticker MXEF). Returns are in USD.

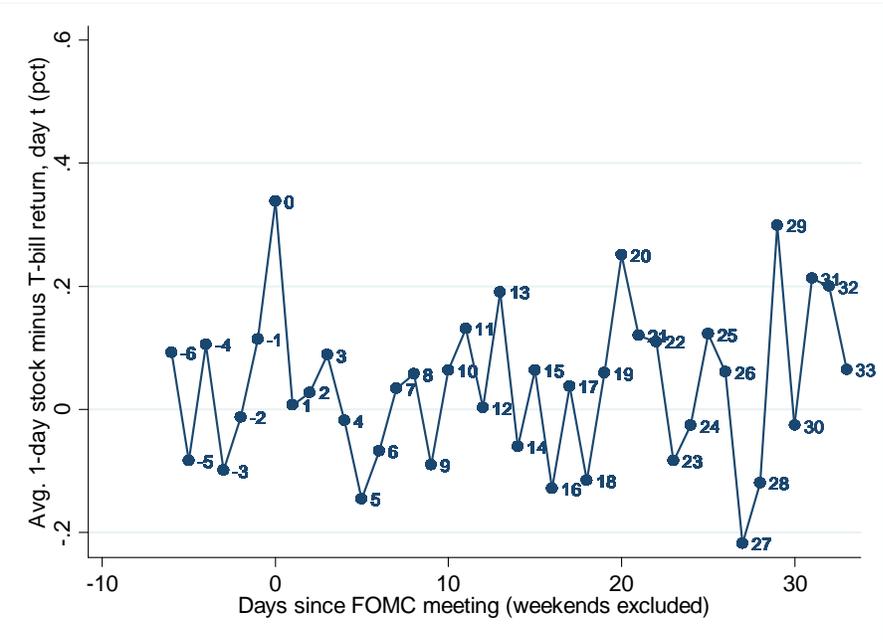
Appendix Figure 2. Number of macroeconomic data releases per day in FOMC cycle time, Bloomberg data, 1996:11-2015:12



Note: The plot does not include Fed-related public news, i.e., FOMC statements, minutes, Beige book releases are excluded.

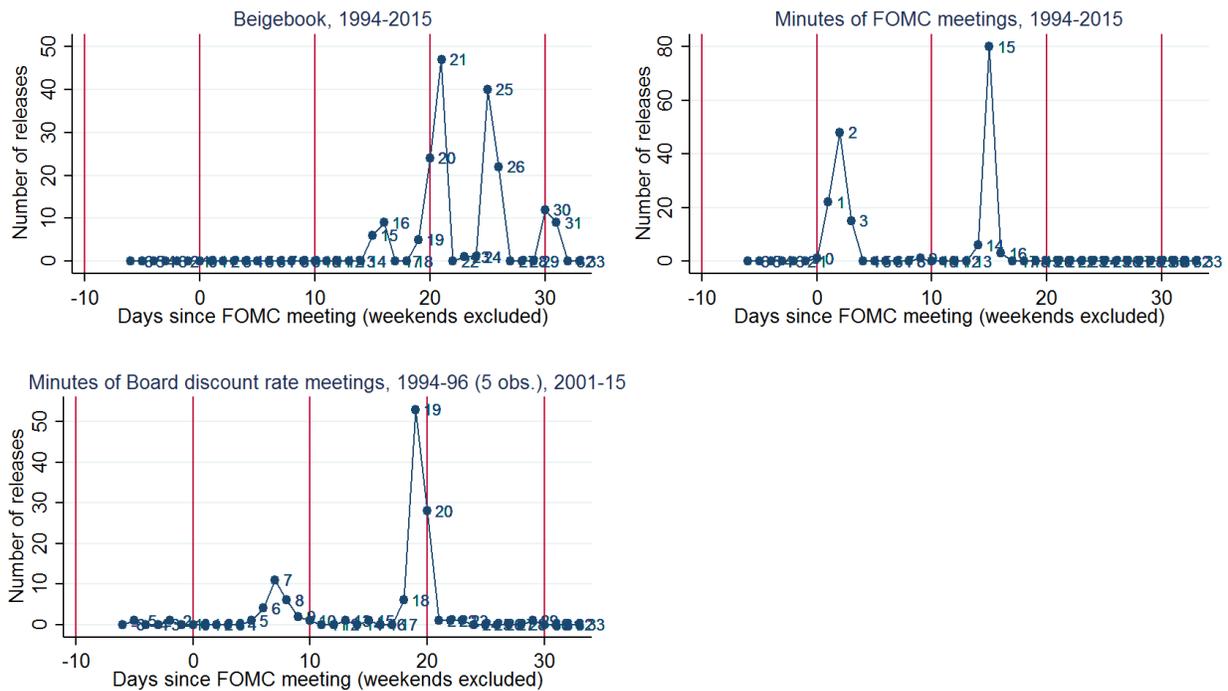
Appendix Figure 3. Stock returns over the FOMC cycle, 1994-2015.

Average 1-day stock return minus bill return over the FOMC cycle, percent

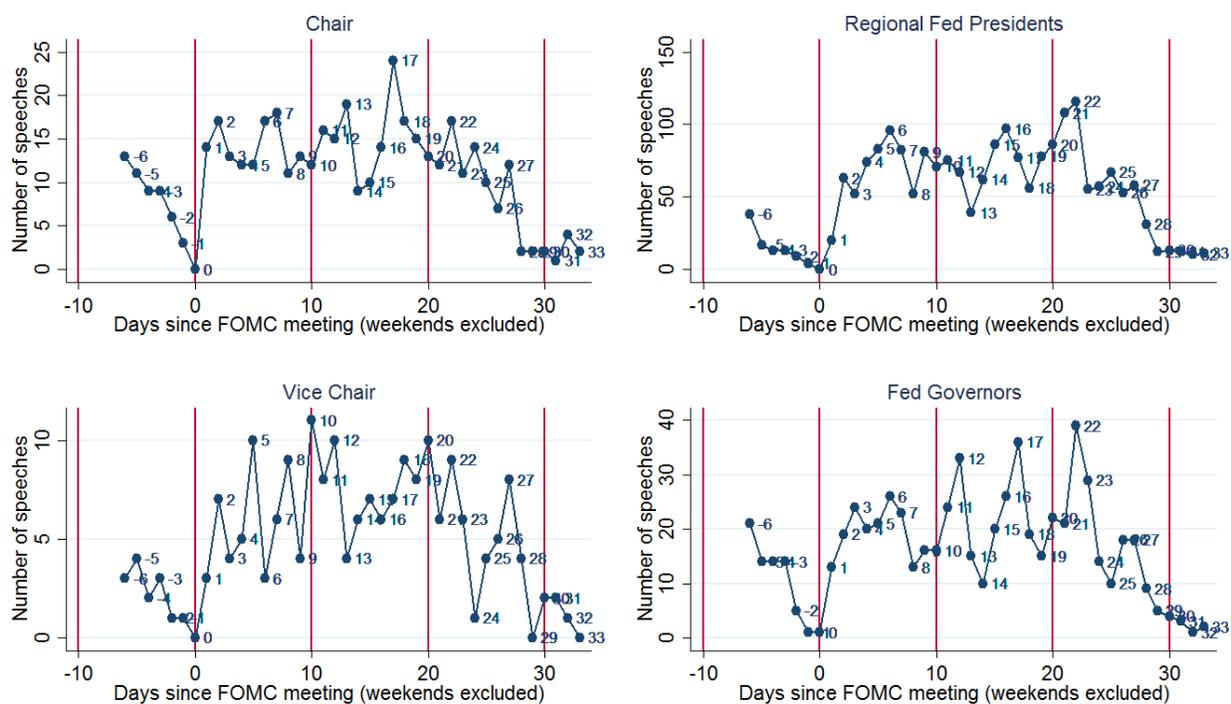


Appendix Figure 4. Public releases and speeches over the FOMC cycle, 1994-2015

Panel A. Public releases



Panel B. Public speeches and interviews by Federal Reserve officials over the FOMC cycle



Note: The figure displays the total number of speeches (3,407) and testimonies (94) given by Fed officials at each point of the FOMC cycle during the period 1994:01-2015:12. The dates of speeches have been collected from the Federal Reserve Board website and from the websites of the regional Feds.