Stock Returns over the FOMC Cycle

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Abstract: We document that since 1994 the US equity premium follows an alternating weekly pattern measured in FOMC cycle time, i.e. in time since the last Federal Open Market Committee meeting. The *equity premium is earned entirely in weeks 0, 2, 4 and 6 in FOMC cycle time* (with week 0 starting the day before a scheduled FOMC announcement day). We show that this pattern is likely to reflect a risk premium for news (about monetary policy or the macro economy) coming from the Federal Reserve: (1) The FOMC calendar is quite irregular and changes across sub-periods over which our finding is robust. (2) Even weeks in FOMC cycle time do not line up with other macro releases. (3) Volatility in the fed funds futures market and the federal funds market (but not to the same extent in other markets) peaks during even weeks in FOMC cycle time. (4) Information processing/decision making within the Fed tends to happen bi-weekly in FOMC cycle time: Before 1994, when changes to the Fed funds target in between meetings were common, they disproportionately took place during even weeks in FOMC cycle time. In addition, after 2001 Board of Governors discount rate meetings (at which the board aggregates policy requests from regional federal reserve banks and receives staff briefings) tend to take place bi-weekly in FOMC cycle time. As for how the information gets from the Federal Reserve to the market, we rule out the Federal Reserve signaling policy via open market operations post-1994. Furthermore, the high return weeks do not systematically line up with official information releases from the Federal Reserve or with the frequency of speeches by Fed officials. We end with a discussion of quiet policy communications and unintended information flows.

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1. Introduction

This paper documents a striking new fact about U.S. stock returns. Over the last 20 years, the average excess return on stocks over Treasury bills follows a bi-weekly pattern over the Federal Open Market Committee meeting cycle. The equity premium over this 20-year period was earned entirely in weeks 0, 2, 4 and 6 in FOMC cycle time, with week 0 starting the day before a scheduled FOMC announcement day.

The fact that stocks do well in week 0 in FOMC cycle time has recently been documented by Lucca and Moench (2013), who show that post-1994 stock returns have averaged about ½ percent over the 2pm to 2pm period prior to FOMC announcements. The bi-weekly pattern in stock returns over the FOMC cycle is a novel finding and appears surprisingly robust. Average excess returns are statistically significantly higher in even weeks than in odd weeks in FOMC cycle time. Furthermore, the pattern is robust across three sub-periods of this 20-year sample and is also present in stock markets outside the United States.

Having established this fact, we present evidence that the pattern likely reflects a risk premium for news (about monetary policy or about the macro economy) coming from the Federal Reserve. First, we document that while the FOMC has eight scheduled meetings per year, the timing of these meetings across days of the year is quite irregular, and it changes across the three sub-periods over which our finding is robust. Second, using Bloomberg macroeconomic data releases weighted by Bloomberg user attention paid to these releases, we document that our "even week" effect in FOMC cycle time does not line up with other macro news. Third, we show that volatility in the fed funds futures market peaks in even weeks in FOMC cycle time, suggesting that news about monetary policy is coming out during these weeks. Volatility patterns for both stocks and 10-year Treasuries do not show similar bi-weekly volatility patterns indicating that what drives our main fact is not that much more news comes out during even weeks in FOMC cycle time but that the type of news that comes out changes. Fourth, we provide evidence that information aggregation and decision making within the Federal Reserve tends to happen bi-weekly in FOMC cycle time. Prior to 1994, this can be inferred from the timing of changes to the federal funds target rate, which was frequently changed between meetings. Over the 1981-1994 period, the frequency of target changes shows distinct peaks in even weeks in FOMC cycle time. In the post-1994 period intermeeting target changes are rare. However, it is still the case that information aggregation and policy

discussions within the Fed occur bi-weekly in FOMC cycle time. Under the Federal Reserve Act of 1913, the regional reserve banks must set their discount rate at least every two weeks and the Board of Governors discount rate meetings disproportionately happen bi-weekly in FOMC cycle time. At these meetings, the Board of Governors decide on requests for changes to the discount rate (since 2003 the primary credit rate) made by the 12 regional federal reserve banks. The Board furthermore receives updates from the Federal Reserve staff on the economic and financial developments. We discuss existing work showing that information about regional Federal Reserve policy views and information received in board briefings is highly relevant for predicting the outcome of the subsequent FOMC meeting and for forecasting macroeconomic variables. This implies that this information is relevant for asset prices.

While these various approaches help to document that the stock return patterns are a causal outcome of information coming from the Fed they do not provide evidence on how information gets from the Federal Reserve to asset markets. We consider various possible mechanisms. 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 the Board's discount rate meetings) but find that with the exception of week four in FOMC cycle time, public releases do not line up with the periods of high average returns in FOMC cycle time. Furthermore, with the exception of week four in FOMC cycle time, there are not disproportionately many speeches by Federal Reserve officials in even weeks on FOMC cycle time. We discuss the possibility that the bi-weekly stock return pattern over the FOMC cycle could be driven by more subtle communication or by unintentional communication from the Fed.

Our findings suggest that there is a large risk premium either associated with macro news revealed by the Fed as part of its policy making process or for monetary policy news directly. It remains an open question which of these explanations drives the impact of Fed news on asset prices. Much more insight is also needed into how information gets from the Fed to asset markets.

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

a. Main result

Figure 1, Panel A, shows the main result of the paper, the pattern of U.S. stock returns over the FOMC cycle. Date 0 on the horizontal axis is the day of a scheduled FOMC meeting. For two-day meetings, date 0 refers to the second day. The graph omits weekends and sets return to zero on holidays. Therefore, 10 days on the horizontal axis represents 2 calendar weeks after an FOMC meeting, 20 days represents 4 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.[2] 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 calendar time. On average over the last 20 years, corresponding to 160 scheduled FOMC meetings, the average excess return has been 0.57 percent in week zero in FOMC cycle time (which we define as day -1 to 3), 0.30 percent in week two in FOMC cycle time (defined as days 9 to 13), 0.42 percent in week four in FOMC cycle time (defined as days 19 to 23), and 0.61 percent in week six in FOMC cycle time (defined as days 29 to 33). In sharp contrast to the high average excess returns in even weeks in FOMC cycle time, the average returns in odd weeks have been dismal, with an average excess return around zero in week minus one (days -6 to -2), -0.17 percent in week 1 (days 4 to 8), -0.17 percent in week 3 (days 14 to 18), and -0.12 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.[3] While it is known from Lucca and Moench (2013) 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 previously been documented.

Economically, the peaks and troughs are not all equally important. The distance between FOMC meetings varies from meeting to meeting (as we analyze below) so one does not always get to, e.g., day 30 in FOMC cycle time before a new meeting takes place. We have constructed the graph such that if a given day is day -6 or closer

[2] For ease of replicating the result, we use stock returns and T-bill returns from Ken French's website.
[3] 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.

to the next meeting, the 5-day return starting on this day is not used. Therefore, points in the right part of the graph do not use any data for days -2 and later. Figure 1, Panel B, shows the number of data points that are available for each day in FOMC cycle time. While most FOMC cycles include week 0, 2 and 4, the number of data points drop off quickly past this. 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.[4]

b. Beta-sorted portfolios over the FOMC cycle

The bi-weekly pattern in excess stock returns over the FOMC cycle is even stronger if one focuses on high-beta stocks. We use 10 beta-sorted portfolios provided by CRSP and use an equal-weighted average of returns across beta deciles 1, 2 and 3 as our return for high-beta stocks. Similarly, we define medium-beta stocks by averaging across deciles 4, 5, 6 and 7 and define low-beta stocks by averaging across deciles 8, 9 and 10. Figure 2 illustrates 5-day average excess returns over the FOMC cycle for each of the three beta groups. The average excess return for high-beta stocks has been 0.76 percent in week zero, 0.54 percent in week two, 0.52 percent in week four, and 1.13 percent in week six, all measured in FOMC cycle time. Comparing the three beta groups, high-beta stocks have outperformed low-beta stocks during the even weeks but have tended to underperform during the odd weeks. In that sense, the well-documented poor performance of the CAPM for beta-sorted portfolios is (over the 1994-2013 period) due to the poor performance in odd FOMC cycle weeks, whereas the excess returns line up more closely with the CAPM in even weeks.

c. 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 excess return on the stock market on dummies for FOMC cycle weeks. We do this in Table 1, Panel A, column (1) and (2). 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 return in

[4] There are 3 days over the last 20 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.

weeks 2, 4, and 6 in FOMC cycle time 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 13.6 basis points (bps) higher on days that fall in week 0 in FOMC cycle time and 10.1 bps higher on days that fall in week 2, 4, or 6 compared to days that fall in an odd week in FOMC cycle time. Both dummies are significant at the one percent level. In column (2), 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.

One may also be interested in whether the average excess return is significantly positive in a given week in FOMC cycle time. We assess this question in column (3) of Table 1 Panel A. The average excess return has been 11.5 bps per day in week 0, and 7.9 bps per day in weeks 2, 4, and 6, with both values significant at the one percent level. By contrast, the average excess return has been an insignificant -2.1 bps in odd weeks in FOMC cycle time indicating that over the last 20 years there has been no equity premium in odd weeks. In column (4), we include separate dummies for week 2, 4 and 6 to assess the equity premium in each of the even weeks. The equity premium is significantly positive at the 10 percent level in week 4 and 6 whereas the p-value for week 2 is around 14 percent. To illustrate the statistical significance of the equity premium graphically, we supplement the regression approach with a bootstrap approach in which for each day in FOMC cycle time we regress the 5-day excess return on a constant using bootstrapped standard errors. For each bootstrap sample, we save the regression coefficient on the constant and then construct 90 percent confidence intervals to test whether the 5-day excess return on this day in FOMC cycle time is statistically different from zero. Figure 1, Panel C, shows the resulting confidence bands which (not surprisingly) are consistent with the results from column (4) of Table 1.

Overall, the statistical significance of the bi-weekly pattern in average excess returns is thus fairly strong in that the average excess returns in each of the four even weeks in FOMC cycle time are significantly higher than the average excess return in odd weeks at the 10 percent level or better. When comparing week 0 to odd weeks and week 2, 4, and 6 (jointly) to odd weeks, the significance level increases to 1 percent.

Table 1, Panel B, assesses the statistical significance of the patterns for the three groups of beta-sorted stock portfolios. Column (1) shows that high-beta stocks have done statistically significantly better at the 1

percent level in week 0 and in weeks 2, 4 and 6 combined, relative to their performance in odd weeks. This is also the case for medium and low-beta stocks, but with smaller regression coefficients on the even-week dummies for stocks with lower beta. Therefore, as shown in column (7), the performance of the CAPM is poor in odd weeks where high-beta stocks significantly underperform low-beta stocks (the intercept is negative and significant at the 10 percent level), whereas the CAPM does better in even weeks (the excess return on high over low beta stocks is significantly higher in even than odds weeks).

d. Sub-sample robustness

To further assess the robustness of our new fact, we break the 20-year sample period into three roughly equal sub-periods, 1994-2000, 2001-2007 and 2008-2013 and calculate average 5-day excess returns in FOMC cycle time for each sub-period. The result is displayed in Figure 3, which shows that the bi-weekly pattern is surprisingly robust across sub-periods of the 1994-2013 sample, with each of the three sub-periods showing four peaks in average excess returns at roughly the same bi-weekly frequency. By contrast, our fact does not hold up prior to 1994 as illustrated by the figure for 1981-1993. In this earlier period, there are peaks in average excess stock returns for week 0 and 6 in FOMC cycle time but no peaks for weeks 2 and 4.

e. International stock returns over the FOMC cycle

We also study whether our return regularity arises with a similar strength in other stock markets outside the U.S. Table 2 presents the results for regressions of daily returns for various MSCI equity indices onto dummies for FOMC cycle weeks during the 1994-2013 sample. The first three columns contain the results for (1) the world index (WI) composed of stocks in the developed and emerging markets, (2) the developed market index excluding the U.S. (DMxUS), and (3) the global emerging market index (EM). Columns (4) though (9) report regressions for individual country returns (Canada, U.K., Germany, France, Switzerland and Japan). Since stock markets around the world operate in different time zones, we provide two sets of results. In panel A, we match the FOMC cycle on a given date with the international returns earned on the same date. In panel B, we lag the FOMC cycle date by one business day relative to returns earned in other time zones. This is motivated by the fact that many of the important stock exchanges open several hours before the US market. As one example, the stock exchanges in

Tokyo and New York have non-overlapping trading hours, and thus, globally-relevant news coming out of the US on day t is likely to be incorporated into stock prices in Tokyo only on day t+1.

The results in Table 2 indicate that the FOMC cycle pattern of returns does emerge in other markets as well. The returns earned in even weeks of the FOMC cycle are in many instances statistically significant and positive, especially when the time-zone adjustment in panel B is taken into account. None of the international stock markets earn a positive return outside the FOMC cycle weeks 0, 2, 4, and 6. Interestingly, our fact holds particularly strongly for the emerging market stocks, which earn a return that is on average 19 bps per day (t-stat=3.77) higher in week 0 and 18 bps per day (t-stat=4.75) higher during FOMC cycle weeks 2, 4 and 6 than it is in odd FOMC cycle weeks where it averages -6.5 bps per day (t-stat=-2.84). The results are weaker, but still significant, for the developed market stocks. Outside the U.S., the stock market returns in developed countries are on average 15 bps per day higher in week 0 (t-stat=3.29) and 8.8 bps (t-stat=2.66) higher in weeks 2, 4 and 6 than in odd weeks. To illustrate these findings graphically, Figure 4 superimposes the 5-day cumulative US returns over the FOMC cycle with the world index returns as well as developed non-US and emerging market returns, confirming that the bi-weekly patterns in stock returns in FOMC cycle time is present around the world.

f. 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 the equity premium 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 annual excess returns. Table 3 shows the results.

For reference, the first row in Table 3 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 8.5 percent per year over the last 20 years, with an annual standard deviation of about 20 percent and a Sharpe ratio around 0.4. Strategy B seeks to exploit our new fact in the simplest possible way. In this strategy, the investor simply 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 implemented with very low transactions costs using an existing ETF that covers the overall stock market. Strategy B would have a Sharpe ratio of 0.8, twice that of Strategy A. This is achieved by adding about 3 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, as shown earlier in Figure 1 Panel B. Given the slightly negative average excess returns in the odd weeks documented above one may wonder whether shorting the market in odd weeks would improve upon Strategy B. This is not the case. Strategy C in Table 3 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. Therefore, while Strategy D obtains a high average excess return, it has a sufficiently high standard deviation that its Sharpe ratio is worse than that of Strategy B.

Turning to strategies involving beta-sorted portfolios, Strategy E goes long high-beta stocks (the average of the three highest beta deciles as noted above) in even weeks. It has a higher average annual excess return than Strategy B, but also a higher standard deviation and thus about the same Sharpe ratio. Strategy F goes long high-beta stocks in even weeks and shorts high-beta stocks in odd weeks to exploit the slightly negative average excess return for high-beta stocks in odd weeks. Again this does not improve upon the Sharpe ratio 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 0.8 over the last 20 years, twice that of the stock market.

3. Evidence that the new fact is driven by news coming from the Federal Reserve

This section presents evidence that the bi-weekly stock return pattern in FOMC cycle time is likely to be driven by news coming from the Federal Reserve, over and above the FOMC announcement itself. The stock return pattern shows that there is a high risk-premium for such news. This risk premium must be a risk premium either for monetary policy news or for macroeconomic news unavailable to the markets but available to the Federal

Reserve for monetary policy deliberations. In this section, we present a series of arguments going from general to specific for why news from the Federal Reserve is likely to drive our main fact. Our goals are to rule in that our fact is driven by news from the Fed, to rule out other sources of information, and to begin to pin down what information gets from the Federal Reserve to asset markets, moving in section 4 to the possible mechanisms.

a. The FOMC calendar is unique and even weeks in FOMC cycle time do not line up with macroeconomic data 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. For example, the schedule of meetings for 2013 was announced in May of 2012. Figure 5, Panel A, shows a histogram of the day of the year on which FOMC meetings took place over the 1994-2013 period. Meetings tend to be held around the middle and end of each quarter, but for each of the 8 meetings, there is a quite wide dispersion across years in what day of the year the meeting takes place on. 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.

Within our 20-year sample, the scheduling principles appear to have changed over time. Figure 5, Panel B, reports that the typical timing of each of the eight meetings varies across the three sub-periods we studied in Figure 3.

The fact that the FOMC calendar changes from year to year and that the typical calendar changes across the three sub-periods is the first argument that our main finding is related to news coming from the Federal Reserve. This statement relies on the assumption that other macroeconomic data does not arrive at a bi-weekly frequency in FOMC cycle time. To show this, we use all US macroeconomic data releases in Bloomberg for the November 1996-2013 period. The start of the sample in November 1996 is dictated by the availability of Bloomberg data. In total, we have 16,396 non-Fed macro releases. The number of releases per day ranges from 0 to 21 with an average of 3.7. 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 measure of how many

Bloomberg users have set up “alerts”. The relevance variable is a number between 0 and 1. The most followed macro releases are initial jobless claims, the change in nonfarm payrolls, GDP growth and consumer confidence. These are about as popular as the FOMC announcements (on day zero in FOMC cycle time) which rank just after initial jobless claims and the change in nonfarm payrolls. To calculate a relevance-weighted count of macroeconomic data released on a given day, we simply sum the relevance variable for each date. Figure 6 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 saw for stock returns. Moreover, Table 4 shows that when we control for macroeconomic releases, our regression results remain largely unchanged. Column (1) presents our baseline regression from Table 1. Column (2) adds 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.

b. It is well-documented that news about monetary policy mainly comes out between FOMC meetings, not at the FOMC announcement

A large prior literature exists which seeks to measure monetary policy news. A common approach is that of Kuttner (2001), who uses market prices in fed funds futures contracts at a given date to measure the expected value of the average federal funds rate over the remainder of the month. The difference in this forecast of the federal funds rate and the current federal funds target is an estimate of how the market expects the Fed to change the target. Comparing actual changes in the federal funds rate to the change that the market expected as of the day before the FOMC announcement, one can measure how much of the announced change in the federal funds target, if any, was expected and how much comes as a surprise to the market. The magnitudes of Kuttner surprises indicate that the majority of the policy rate changes undertaken by the Fed were anticipated as of the day prior to the FOMC announcement.

In Table 5, we use Kuttner's data for 1994-June 2008 to quantify how much monetary policy news comes out on the FOMC announcement day and how much comes out in the inter-meetings period.[5] Actual changes are largely expected. On the 25 occasions when the FOMC increased the federal funds rate target by 25 bps, the market on average expected a change of 25 bps. Furthermore, the market expectation on average was only off by 2 bps from the realized change (see the last column of the table showing the average absolute value of the surprise). Even for target changes of 50 bps, the market's expectation error averaged only 9 bps. Therefore, the vast majority of news about monetary policy comes out before the FOMC announcement and in particular, in between the last and the current meeting.

To illustrate this graphically, Figure 7 plots the actual changes in the federal funds target against the expected changes and includes the 45-degree line for reference. Points on the 45-degree line correspond to no surprises. The data for most FOMC announcement days plot remarkably close to the 45-degree line. A regression of the actual change in the federal funds target on the expected value of this change results in a coefficient of 1.02 with a t-statistic of 41 and an R-squared value of 0.94 (for clarity the graph does not include the regression line). This does not, of course, show that monetary policy news comes out at a bi-weekly frequency in FOMC cycle time (we will get to that below), but it provides a summary of the well-appreciated fact that the news component of the FOMC announcement (Kuttner surprise) tends to be small compared to the size of the federal funds target change. Below, we extend this analysis to provide evidence that monetary policy news is likely to come out bi-weekly in FOMC cycle time.

c. Volatility in the federal funds and federal fund futures market peaks bi-weekly in FOMC cycle time

If the pattern of stock returns over the FOMC cycle is driven by news coming from the Fed about monetary policy, or about the macro economy but reflected in monetary policy decisions, we should see high volatility in markets directly tied to monetary policy at the same times over the FOMC cycle when we observe high average excess returns on stocks. To capture market expectations about monetary policy, we consider the first federal

[5] Kuttner's data are available 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 since December 16, 2008, i.e. for most of the period following Kuttner's sample period.

funds futures contract which is based on the average effective federal funds rate for the current calendar month. The next FOMC meeting may not fall in the current calendar month and news about monetary policy may be about not only the current meeting but also the next one (or later). Therefore, we also consider the second and third federal fund futures contracts, corresponding to the calendar month following the current month and the calendar month two months from the current calendar month. For each day in FOMC cycle time, we calculate the yield change for a given futures contract as the change from day t-1 to t. We then calculate the standard deviation of all available yield changes for that day in FOMC cycle time (so for day 0, for example, we calculate the standard deviation across 160 observations of daily yield changes from day -1 to 0). We then average these standard deviations across day t up to t+4 in FOMC cycle time, since we are interested in which risks may drive the risk premium observed in the 5-day excess returns on stocks on those same days. Figure 8, Panel A, shows the result. There are clear peaks in fed funds futures yield volatility in the even weeks in FOMC cycle time with volatility roughly twice as high in even as in odd weeks.

Changes in expected monetary policy may be reflected not only in futures contracts but also in the daily effective federal funds rate. This would be the case if financial institutions adjusted their demand for federal funds as they got news about the future federal funds rate, and if the Fed's open markets desk did not fully adjust its open markets operations to keep the effective funds rate equal to the current target rate. Figure 8, Panel B, shows the volatility of the effective federal funds rate over the FOMC cycle and is constructed in the same way as Panel A, based on daily yield changes and 5-day averages of standard deviations. While there seems to be a downward trend in effective federal funds rate volatility over the FOMC cycle, we again see four clear peaks in volatility in even weeks. To ensure that these volatility peaks do in fact reflect news about monetary policy, we use our earlier regression framework to control for known determinants of volatility in the effective federal funds rate. The two main determinants documented in the literature are the reserve maintenance period and high payment flow days.

Reserve maintenance periods in the US are two weeks long. Over a given reserve maintenance period banks have to hold an average amount of reserves which (since 1998) is known at the start of the reserve maintenance period and calculated based on an earlier computation period. Banks also often hold excess reserves, historically for transactions purposes (to avoid overdrafts) and recently because of reserve bearing 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). It is known that effective federal funds rate volatility tends to be higher on the last day of the reserve maintenance period (Hamilton (1996)). However, this is a priori unlikely to drive the bi-weekly volatility pattern in the effective federal funds rate over the FOMC cycle because reserve maintenance periods are bi-weekly in calendar time with no exceptions around holidays, and thus do not line up with the FOMC cycle. While 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 the Wednesday of/the Wednesday after an FOMC meeting is the end of a reserve maintenance period as it is that it is the middle of a reserve maintenance period. Figure 9 illustrates this by showing the probability that a given day in FOMC cycle time is the end of a reserve maintenance period. This probability has a weekly pattern, not a bi-weekly one. In column (3) of Table 4, 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 or significance of the dummies for FOMC week 0 or FOMC week 2, 4, or 6.

The other known determinant of volatility in the effective federal funds rate is high payment flows, i.e. large payments between banks to facilitate large amounts of transactions for their customers (households and firms). Judson and Klee (2009) state: "Payment flows tend to be elevated at month-start, mid-month, the twenty-fifth of the month, month-end, and on days after holidays, owing in part to corporate tax due dates, principal and interest payments on securities, and pent-up flows after a long weekend." … "On such days, DIs [depository institutions] likely face greater uncertainty about their end-of-day balances and thus have a greater incentive to hold excess balances as a precaution against overdrafts." Following Bartolini, Gudell, Hilton and Schwarz (2005), we define high payment flow days as the first and last business days of each month, the first business day after the fourteenth of each month, and the first day after each Monday holiday. Following Judson and Klee (2009), we also include the 25^{th} of the month as a high payment flow day which is a principal and interest payment date for Fannie Mae. There is some overlap between high payment flow days and even weeks in FOMC time. Figure 10 presents a histogram of days of the month on which the FOMC meetings take place, showing a spike at the end of the month. However, FOMC meetings are widely dispersed across days of the month leaving plenty of variation

to isolate the impact of high payment flow days from that of being in an even week in FOMC cycle time. In column (4) of Table 4, we find that the coefficient and significance of the dummies for FOMC week 0 or FOMC week 2, 4, or 6 are largely unaffected by including a dummy variable for high payment flow days.

Our results regarding the reserve maintenance period and high payment flow days make it unlikely that the bi-weekly pattern in volatility of effective funds rates in FOMC cycle time, and our main fact about stock returns over the FOMC cycle are driven by factors related to banks' reserve management. Instead, the most straightforward interpretation of the bi-weekly cyclicality of both stock excess returns and volatility in the fed funds market in FOMC cycle time is that monetary policy news (or macro news as reflected in monetary policy) comes out disproportionately in even weeks in FOMC cycle time, and that such news has a high risk premium in the stock market. To support the argument that news originate from monetary policy we show that, in general, volatility in assets markets is not elevated in even weeks in FOMC cycle time. Figure 11, Panel A shows the volatility of daily yield changes in the 10-year Treasury yield over the FOMC cycle. The graph is constructed in the same way as Figure 8, by first calculating the standard deviation of daily yield changes for each day in FOMC cycle time and then averaging this standard deviations over days t to t+4 in FOMC cycle time. Figure 11, Panel B shows the volatility of the excess return on the stock market over the FOMC cycle, constructed in the same way, except that excess returns are used instead of daily yield changes. While there is a peak in volatility in week 0 in FOMC cycle time for both 10-year Treasuries and stocks, later peaks do not systematically line up with even weeks in FOMC cycle time. For example, the volatility in the 10-year Treasury yield peaks around day 13 of the FOMC cycle which corresponds to an odd week while the second and third peaks in stock market volatility are earlier than the average stock return peaks in Figure 1, Panel A. These volatility patterns indicate that it is not so much the total volatility that moves over the FOMC cycle as the amount of volatility coming from news that drive federal fund futures and effective federal funds rates. Monetary policy news (or macro news being revealed via monetary policy news) is the obvious candidate.[6]

[6] As an additional robustness check, we also confirmed that the frequency of corporate announcements does not have a bi-weekly pattern in FOMC cycle time. We use corporate earnings announcements from IBES. For each day in the 1994-2013 sample, we compute the total number of quarterly EPS announcements by the US firms in the IBES database as well as the fraction of positive surprises, i.e. earnings announcements that exceed the consensus analysts' expectation. The average

d. 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 of 60 changes over the 1994-2013 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 1982. From September 1982 to 1993, only 32 of 94 target rate changes happened at one of the eight scheduled meetings per year, whereas 62 (about two thirds) took place between meetings.[7] The small number of inter-meeting target rate changes post-1994 makes it infeasible to use inter-meeting target rate change over the post-1994 period to determine when policy news came out during that period. However, for the 1981-1993 period, the timing of inter-meeting target rate changes provide evidence on when decision making tended to happen during that period. If the underlying timing of information collection, information aggregation, and policy discussions over the FOMC cycle has been similar in the post-1994 period, and if policy news in the post-1994 period comes out as part of this process, then any bi-weekly pattern in pre-1994 target rate changes over the FOMC cycle would make it more likely that the stock return cycle we have documented in the post-1994 period is in fact related to policy news coming from the Fed or to macro news revealed by policy changes.

Figure 12 shows the probability of an inter-meeting federal funds target change over the FOMC cycle for the 1982:09-1993:12 period. The left graph shows the probability (as estimated by the empirical frequency) that a target rate change happened on day t in FOMC cycle time.[8] The right graph uses 5-day windows as our earlier figures and shows the probability that a target rate change took place on any of days t to t+4 in FOMC cycle time. There are four clear peaks in the right graph showing that in the 1982-1993 period decision making within the Fed

number of earnings announcements per day is 84 with a standard deviation of 104. Column (5) of Table 4 shows that controlling for these variables has little impact on our results.

[7] Prior to 1994 the FOMC did not make an announcement after a meeting at which the target had been changed and the market instead had to infer target changes from open market operations. The series of target rate values provided by the Federal Reserve in the FRED database is constructed by Thornton (2005) based on information from transcripts of FOMC meetings, Blue Books, the Report of Open Market Operations and Money Market Conditions and data on open market operations that Thornton obtains 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 code all other target changes as inter-meeting changes.

[8] The left graph is similar to Figure 2 of Piazzesi (2005).

disproportionately took place during the weeks (in FOMC cycle time) that post-1994 are high-return weeks. This evidence suggests that information aggregation and policy decision making within the Fed is bi-weekly in FOMC cycle time.

e. 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 post-1994 period comes from studying the timing of a little known set of minutes from what is called the Board of Governors discount rate meetings (these meetings are called Fed Board meetings in Bernanke's schedule, which we have obtained via FOIA request). In this section, we document that these meetings tend to take place bi-weekly in FOMC cycle time, and that they serve as an occasion not only for the board to make decision regarding the discount rate and discuss policy views of the regional Federal Reserve banks, but also for the Board of Governors to receive updates from Federal Reserve staff on economic and financial conditions.

We start this discussion with background on the discount rate procedure and the Board of Governors discount rate meetings. 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. Under the Federal Reserve Act of 1913, Section 14, the boards of each of the regional Federal Reserve banks ("regional feds" in what follows) have to set their discount rate (now primary credit rate) at least every two weeks, subject to approval of the Board of Governors.[9] 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 made by regional feds to the Board of Governors is not so much the discount facility itself, but instead that regional feds use their discount rate recommendations as a way to express their policy views regarding the federal funds target. In his book, former governor Larry Meyer states: "While the Reserve Bank presidents are not part of the pre-meeting discussions at

[9] The Federal Reserve Act is available at http://www.federalreserve.gov/aboutthefed/section14.htm

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), pg. 54).

The regional feds each have a 9-member board of directors, which include three classes of representatives from the community, including financial institutions.[10] Each regional board has an executive committee which is a subset of board members that is allowed to make decisions on its behalf. The charter for each regional fed lays out when their board meetings and executive committee meetings occur. Appendix Table 1 lists these schedules. For example, the St. Louis Fed board meets eight times per year while its executive committee meets on alternate Thursdays following the board meeting. Because the timing of meetings differs across regional feds, it takes two weeks for the Board of Governors to receive updated requests from all the regional feds. Consistent with this, the Federal Reserve charter lays out that the Board of Governors must consider the regional requests every two weeks. Meetings of the Board of Governors to consider the regional requests are referred to as Board of Governors discount rate meetings. Minutes of these meetings, called the Discount Rate Minutes are posted on the Federal Reserve's web page starting from May 2001. Appendix A contains two examples of these minutes.

Figure 13 presents data from May 2001 to 2013 showing that Board of Governors discount rate meetings disproportionately take place bi-weekly in FOMC cycle time. There is always a discount rate meeting within a few days of a scheduled FOMC meeting. Since regional input is an important part of the monetary policy decision making process prior to the FOMC meeting, it makes sense to align the discount rate meeting into the Board of Governors pre-FOMC meeting.[11] Following that, it would take two weeks to have a full set of new views from the regional feds at which point a new meeting may be useful. Consistent with that, Figure 13 shows that subsequent meetings (which do not always happen) tend to occur bi-weekly in FOMC cycle time. The cycle of discount rate meetings is shifted a few days left (earlier) relative to the cycle in the average excess stock returns in Figure 1, Panel A. One interpretation is that information from the decision making process surrounding the discount rate meeting takes a couple of days to make its way into asset markets. There is one potentially important caveat to the

[10] Class A board members represent the financial institutions in the region. Class B and C directors represent the public.
[11] Again, a quote from Larry Meyer's book helps put the pieces together: "The influence of the discount rate requests are perhaps reinforced by the fact that the pre-FOMC Board discussions of monetary policy come at the time the Board reviews the Reserve Bank requests for discount rate changes" (Meyer, (2004), pg. 52).

finding in Figure 13 that the timing of discount rate meetings tend to line up with high average excess returns on stocks in FOMC cycle time. Before 2001, discount rate meetings tended to take place at a weekly frequency in FOMC cycle time, as opposed to a bi-weekly frequency. We determined this based on discount rate minutes for 1994:01-2001:05 obtained from the Fed via a FOIA request. It is possible that some of the weekly meetings were "formalities." This would be consistent with the Fed subsequently changing to a bi-weekly meeting frequency in FOMC cycle time but this remains an open question.

Although these Fed Board meetings are referred to as discount rate meetings, the meetings themselves are a point of aggregating, analyzing, and discussing a lot more information than the discount rate requests made by the regional feds. From Chairman Bernanke's daily schedule, the Board meetings on the days for which there is a discount rate meeting minute typically last two hours. There are no transcripts of the discount rate meetings of the Board of Governors. The minutes are brief but give a sense of which types of economic data are discussed. Axilrod (2009) describes a dispute between board members as follows: "The dispute—which was, to me, about as dramatic as things get at the Fed—broke out at a usual weekly board meeting on Monday, February 24, 1986, a day when the staff made its weekly presentation about the latest economic and financial developments. Following the presentation, the board met in a more limited session to consider discount-rate proposals from Reserve Banks." This clarifies that board meetings on days of discount rate meetings involve not only discussions of regional fed discount rate requests and economic conditions but also updates of the Board of Governors by the board staff. We do not have direct information about which Fed staff provide updates, but the most likely would be (i) updates on national economic conditions and forecasting from Fed staff economists in charge of the Greenbook (now Tealbook), (ii) updates on trading operations and market conditions from the Open Markets Desk, and (iii) updates on bank conditions from bank supervision economists in the Fed system.

Before discussing potential channels through which the information may get from the Fed to asset markets, we give a quick summary of the many papers in the literature documenting that information about the regional feds policy views and economic updates from Federal Reserve staff would be relevant for asset prices. Using data for 1974-1993, Tootell (2000) shows that the FOMC vote of a regional bank president is strongly correlated with the most recent discount rate recommendation of that president's regional fed board. 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 at the subsequent FOMC meeting (or the subsequent intermeeting date at which the FOMC target was changed). Equally important, they show that the average discount rate change request has predictive power for one- and two-month ahead changes in the federal fund target rate, even controlling for the change implied by prices of federal funds futures. Romer and Romer (2000) compare the quality of inflation forecasts prepared by the Fed staff (for the Greenbook) and by the private sector. They find that the Fed staff possesses a significant information advantage. Having access to inflation forecasts by the staff and by the private sector, an econometrician would put essentially no weight on the latter. Cieslak and Povala (2014) show that similar conclusions pertain to the Fed staff forecasts of future output and the future path of the federal funds rate. Peek, Rosengren and Tootell (1999, 2003) document that the bank supervision duties of the Fed lead to valuable information; in particular, confidential bank information (CAMEL ratings) could be used to improve upon both private sector and Greenbook forecasts of inflation and unemployment rates. This literature thus suggest that the types of information that becomes available to policy makers in the context of discount rate meetings would be highly relevant for market participants both because of the information's impact on subsequent policy decisions and because of the information's usefulness for understanding the state of the economy.

In addition to the fact that the discount rate meetings tend to take place bi-weekly in FOMC cycle time and thus line up with the patterns we have documented for stocks and federal funds markets, there is one more important argument for why these meetings would be a forum for key policy discussions. Unlike the FOMC meetings, meetings of the Board of Governors involve a smaller set of people than the FOMC meetings (the chairman, vice-chairman and governors) and are not transcripted. They may thus be a better forum for open policy debate between board members.

4. Possible mechanisms for how information gets from the Federal Reserve to asset markets

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 timing of decision making processes within the Fed: The FOMC calendar is irregular, it changes across sub-periods over which our finding is robust and even weeks in FOMC cycle time do

not line up with other macro releases. Kuttner monetary policy surprises show that news about monetary policy mainly comes out between FOMC meetings, not at the FOMC announcement. Volatility patterns for federal funds futures and the effective fed funds rate over the FOMC cycle line up with average excess stock return patterns over the FOMC cycle. Finally, we reported evidence that information processing for monetary policy decisions happen in bi-weekly FOMC time. In particular, the timing of fed funds target changes before 1994 suggest that information aggregation and processing tended to happen bi-weekly in FOMC cycle time before 1994, and the timing of Board of Governors discount rate meetings post-2001 suggest that this is still the case.

While these facts make it highly likely that the stock return FOMC cycle is in fact driven by news coming from the Fed, we have not provided a mechanism 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 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 happens.

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: The FOMC statement 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 (2013) 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 in FOMC cycle time, and has no bearing on the other weeks in FOMC cycle time.
- Beigebook: The Beigebook summarizes economic conditions across the 12 regional fed districts. It is prepared by the regional feds, and is made public 2 weeks *prior* to each scheduled FOMC meeting.
- Minutes of FOMC meetings: Before December 2004, minutes of a given FOMC meeting 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.
- Minutes of Board of Governors discount rate meetings: Minutes for all discount rate meetings in a given inter-meeting period (in FOMC cycle time) are released 8 times per year, around 4 weeks after the FOMC meeting.
- Green/Blue/Teal books and FOMC transcripts: The Greenbook and Bluebook (now merged into the Teal book) are the Fed Board staff reports on economic and financial developments and monetary policy alternatives (staff from Research and Statistics and Monetary Affairs, respectively). Together with the FOMC transcripts, the Green/Blue/Teal books are only released to the public with a five-year lag while the Green/Blue/Teal books are released internally within the Fed a few days before the FOMC meeting.

Figure 14, Panel A, illustrates the timing of public releases of Beigebooks, FOMC minutes and discount rate 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. However, within week 0 the high excess stock returns are earned mainly on day 0 (prior to 2pm as documented by Lucca and Moench (2013)) so releases of FOMC minutes do not help explain the high average excess stock returns in week 0 in FOMC cycle time. For reference, Appendix Figure 1 shows a daily version of Figure 1, Panel A.

Figure 15 presents the timing of speeches by regional fed presidents, Fed governors, the Fed chairman and the Fed vice-chairman. There are few speeches around the FOMC meetings themselves since this period is part of a "blackout period" which runs from seven days before the start of the FOMC meeting 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.[12] The only peak in speech frequency which overlaps with an even week in FOMC cycle time is speeches by regional Fed presidents in week four in FOMC cycle time. This lines up with the release of beige books (which as noted cover regional economic conditions).

Public releases (Beigebooks and discount rate minutes) and speeches (by regional fed presidents) thus may help explain the high average excess stock return in week 4 in FOMC cycle time but do not help explain the high average excess returns in weeks 0, 2 and 6 in FOMC cycle time.

c. **"Subtle" communication and unintended communication by the Fed**

We established that Board meetings at the Board of Governors tend to occur bi-weekly in FOMC cycle time and that at these meetings the Board of Governors receives a host of updates on both the economic outlook and policy opinions. We start this section considering whether the Fed might view it as advantageous to get this information to the public from an optimal policy perspective. There is a long literature on the optimal amount of central bank communication. Blinder, Ehrmann, Fratzscher, de Haan and Jansen (2008) provide an excellent overview. While communication practices vary widely across central banks, there are clear trends toward more timely and more open communication. This is motivated by the usefulness of communication for guiding market expectations about interest rates and inflation and for reducing uncertainty about the policy rule. Greenspan is noted for his objections to full public disclosure and a preference for having flexibility in terms of policy and disclosure. In Greenspan's view, public disclosure is sometimes undesirable due to the risk of overreaction of market prices and the risk that the Fed's decision making would be less conditional due to the market's inability to fully understand contingencies in policy statements. In Chairman Greenspan's words, from a letter of September 23, 1991, to

[12] The policy on external communications is available at http://www.federalreserve.gov/monetarypolicy/files/FOMC_ExtCommunicationStaff.pdf

Representative Stephen Neal in response to congressional pressure for immediate disclosure of target rate changes and the directive given by the FOMC to the open markets desk (our emphasis added):

> *"The immediate disclosure of all changes in our operating targets would take a valuable policy instrument away from us* ***by reducing our flexibility to implement decisions quietly*** *at times to achieve a desired effect while minimizing possible financial market disruptions.* ***With an obligation to announce all changes as they occurred, the distinction between making changes either quite publicly or more subtly, as conditions warrant, would evaporate;*** *all moves would be accompanied by announcement effects. If markets always accurately assessed the implications of such announcements, incorporating them into the structure of prices, then market efficiency might be enhanced by making our open market objectives public immediately. However,* ***prices can, and do, overreact to particular announcements.*** *….]*
>
> *The immediate release of the Directive also would be ill-advised. […] early release could provoke overreactions in financial markets to contingencies or reserve pressure alternatives mentioned in a Directive that may not occur, or that may be superseded by intermeeting developments and adjustments. […] 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."*

Greenspan's changes in policy were "subtly" communicated to the market, as opposed to not being communicated at all. Prior to February 1994, the Fed did not release statements after its scheduled meetings. It instead preferred to let the market infer policy changes from open market operations and from any "subtle" communication by the Fed. As part of Congressional hearings in 1993, known as the Gonzalez hearings, it became clear that from 1989 to May 1993 on 11 occasions, the essence of the FOMC directive to the open markets desk was made available to the Wall Street Journal within one week of the meeting (Belongia and Kliesen (1994)). This was much earlier than the public release of the directive following the subsequent scheduled FOMC meeting.[13] Lindsey (2003) provides a detailed discussion of how Congressional dissatisfaction with this subtle communication lead to the Fed conceeding to release its fed funds target decision right after the FOMC meeting and to make transcripts of FOMC meetings available with a 5-year lag. The interesting connection for us is that the change in disclosure in 1994 lines up with the Fed's change from making quite frequent intermeeting changes to the target to making almost no intermeeting changes after 1994. A speculative interpretation could be that the Fed has had a continued preference for "making changes either quite publicly or more subtly, as

[13] The most famous are 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.

conditions warrant" and given that target changes are now immediately public therefore has reduced its use of intermeeting changes of the fed funds target. What is less speculative is that the economic outlook information and policy positions of Fed officials that get updated in the Fed Board meetings are on occasion still subtly communicated to the public via the Wall Street Journal and others.

Appendix B, Part 1 list twelve *samples* of "subtle" information coming from the Fed. For example, item number 7 is a David Wessel article (parts reproduced below, our emphasis added) that according to an article the next day in the Wall Street Journal "sent blue chips soaring" (see item 8):

> *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.*
>
> Wessel, David. Wall Street Journal, December 18, 2000.

The "meet[ing] with staff economists… today" refers to the Board of Governors discount rate meeting on that day. Except for the first item, all of the news articles in Appendix B part 1 concern information coming out aligned with the discount rate meetings. We found this sample of articles by reading each discount rate meeting minute and cross referencing text of articles from prominent news sources on the discount rate meeting day and the few days subsequent to the meeting. It would not be a surprise to any Fed watcher to suggest that the Fed has selected reporter outlets for distributing information. If the Fed favors a somewhat continuous monetary policy with subtle communication, the mechanism could be reporting that comes out of the Board meetings.

Beyond intentional releases of information, we have anecdotes that suggest that private parties on occasion obtain insights from the information aggregation process inside the Fed. At the extreme is the indictment of Robert Rough (Appendix B, item 13), a New York Fed director convicted for profiting from inside information on the regional fed discount rate votes and on the information coming back to the N.Y. Fed from Board of Governors discount rate meetings concerning discount rate policy. This example is unique in that it generated a criminal inquiry. Information flows that at least some would consider undesirable do, however, seem to happen quite frequently. Larry Meyer's book (2004) points to the fact that the Greenbook is rather "leaky," and thus there

has been a resistance to include the update from the trading desk in the written copy. Figure 14, Panel B, shows the timing of Greenbook releases internally within the Fed. If leaks from the Greenbook took place over the subsequent couple of days that would line up with the high average excess stock returns in week 0 even FOMC cycle time (which as shown my Lucca and Moench (2013) happen before the FOMC announcement). Furthermore, Appendix B, Part 2 presents six examples of other leaks. We highlight a few, the first being the famous Geithner Leak, from the FOMC transcript of August 2007 (item 12). President Lacker questions Geither about the leaking of information which Geithner then denies. President Lacker then says, "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." Two other articles are worth a quick note. A Reuters report by Cooke, da Costa and Flitter (2010) (item 15) discusses how Larry Meyer, the former Fed regional President whose book we cite repeatedly, and other former employees have access to the Fed Board facilities. The article describes how Larry Meyer, who provides macroeconomic/ monetary policy updates to private sector clients for an annual subscription price of $75,000, had the details of the August 2010 FOMC meeting weeks before the information was to emerge publicly. (A couple of weeks later, the WSJ has even more details (item 10).) Article item 14 is a similar story from 1995. A regular Fed watcher changed his view and predicted a surprise move by the Fed, after having watched Fourth of July Fireworks with Fed officials on the roof of the Fed's building in Washington.

Overall, it is possible that the bi-weekly patterns in average excess stock returns and fed funds futures volatility result from both subtle intentional and unintentional communication coming from the Fed. The precise mechanism remains a central issue for understanding the economics behind our newly documented asset return patterns and an avenue that we (and hopefully others) will explore.

5. Why such a high risk premium for Fed news post-1994?

We have documented that average excess stock returns follow a bi-weekly pattern in FOMC cycle time over the last 20 years, but not prior to that, and that the underlying driver of the pattern is likely to be news coming from the Fed. Thus, either there is a risk premium for macro news revealed by the Fed which is larger post-1994 or a risk premium for monetary policy news that is larger in the post-1994 period.

We cite several papers above showing that the Fed has proprietary information about the state of the economy. Fed staff forecast of economic variables are more precise than those of the private sector and the Fed obtains proprietary information from bank supervision which is useful for predicting inflation and unemployment. Furthermore, since it knows the size of its open market operations the Fed may learn about demand shocks in the federal funds market faster or more precisely than other market participants. These demand shocks stem from transactions flow in household and firm's accounts at banks which could be very informative about the state of the economy. However, it is unclear why the Fed information advantage would have increased since 1994.

Are there instead good arguments for why the risk premium for monetary policy news could be larger in the post-1994 period? A possible argument would be the increased importance of levered intermediaries in asset markets. For example, the hedge fund sector has grown in importance and now has assets of about $2.6 trillion (Financial Stability Oversight Council (2014)). A leveraged intermediary would be particular worried about monetary policy news given that the institution's funding cost is tightly linked to the federal funds rate. Two pieces of evidence indicate that institutions are particularly concerned about the news that comes out bi-weekly in FOMC cycle time.

First, we have obtained data for net stock buying by individuals for a large US exchange over a sub-period of our 1994-2013 sample. Individuals' net buying peaks *before* even weeks in FOMC cycle time. Rather than indicating good market timing ability of individuals this is more likely to be driven by institutions wanting to reduce exposure prior to monetary policy news.[14]

Second, evidence from Treasury auctions indicates that primary dealers bid more aggressively to obtain Treasuries just prior to the high-return weeks, possibly because they would like more Treasury collateral which has lower haircuts in repo contracts and thus decreases the risk of margin calls. Figure 16 illustrates primary dealer oversubscription in Treasury auctions for notes and bonds based on data obtained from the Treasury Direct website. For each date t in the sample, we compute 5-day moving sums of the amount tendered by primary dealers and the amount offered by the Treasury, respectively, between t and t+4. The figure reports the ratio of the 5-day total amount tendered to the 5-day total amount offered, averaged over each day in the FOMC cycle. We

[14] We are waiting for legal clearance to show this graph and therefore do not include it in the current draft.

merge the FOMC cycle date onto the Treasury issue date (rather than the auction date), which is when the auction is settled and transfer of funds takes place. The sample covers the period 1994:01-2008:06, i.e. we exclude the crisis and its aftermath due to the difficultly in disentangling the supply and demand shocks for Treasuries. The cycle of oversubscription is shifted left by a couple of days relative to the stock return cycle, suggesting that primary dealers actively try to avoid the risk generated by news coming from the Fed in even weeks in FOMC cycle time. We view this evidence as only suggestive. Determining why the risk premium for Fed news is higher post-1994 remains a central question for future work.

6. Conclusion

We have documented a novel pattern in stock returns in the U.S. and around the world. Over the last 20 years, the equity premium has been earned entirely in even weeks in FOMC cycle time, with the equity premium in odd weeks being close to zero or negative. This pattern is statistically robust and stable across sub-samples of this 20-year period. Several pieces of evidence link the pattern to information coming from the Federal Reserve. The FOMC calendar is irregular, it changes across sub-periods over which our finding is robust and even weeks in FOMC cycle time do not line up with other macro releases. Kuttner monetary policy surprises on scheduled FOMC announcement days are typically small, implying that news about monetary policy mainly comes out between FOMC meetings, not at the FOMC announcement. Volatility of fed funds futures and the effective fed funds rate over the FOMC cycle line up with average excess stock return patterns over the FOMC cycle. The timing of fed funds target changes before 1994 suggest that information aggregation and processing tended to happen bi-weekly in FOMC cycle time, and the timing of Board of Governors discount rate meetings post-2001 suggest that this is still the case.

Our findings suggest that either there is a large risk premium associated with macro news revealed by the Fed as part of its policy making process or there is a large risk premium for monetary policy news. It remains an open question which of these explanations drives the impact of Fed news on asset prices. Much more insight is also needed into how information gets from the Fed to asset markets given that the bi-weekly peaks in average stock returns over the FOMC cycle do not systematically line up with official information releases from the Fed or with the frequency of speeches by Fed officials.

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Appendix A. Examples of the minutes of the Board of Governors discount rate meeting

DISCOUNT RATES - Requests by two Reserve Banks to increase the discount rate; requests by ten Reserve Banks to maintain existing rates.
Existing rates maintained.
January 5, 1998.

Subject to review and determination by the Board of Governors, the directors of the Federal Reserve Banks of Cleveland and Richmond had voted on December 24, 1997, to establish a basic discount rate of 5-1/4 percent (an increase from 5 percent), with appropriate changes in related rates. The directors of the other ten Reserve Banks had voted to maintain the rates in their existing schedules. At its meeting on December 15, 1997, the Board had considered, but had taken no action on, similar requests by the Federal Reserve Banks of Cleveland and Richmond to increase the discount rate.
At today's meeting, no sentiment was expressed in favor of an increase in the discount rate, and existing rates were maintained.

Participating in this determination: Chairman Greenspan, Vice Chair Rivlin, and Governors Kelley, Phillips, Meyer, Ferguson, and Gramlich.

Background: Office of the Secretary memorandum, January 2, 1998.

Implementation: Wire from Mr. Wiles to the Reserve Banks, January 5, 1998.

DISCOUNT RATES -- Requests by three Reserve Banks to lower the disccunt rate; requests by nine Reserve Banks to maintain existing rates.
Existing rates maintained.
June 19, 1995.

Subject to review and determination by the Board of Governors, the directors of the Federal Reserve Banks of Cleveland and San Francisco had voted on June 8, and the directors of the Federal Reserve Bank of Minneapolis had voted on June 15, 1995, to establish a basic discount rate of 5 percent Ca reduction from 5-1/4 percent), with corresponding one-quarter percentage point reductions in related rates. The directors of the other nine Banks had voted to maintain the rates in their existing schedules. At its meeting on June 12, 1995, the Board had considered, but had taken no action on, similar requests by the Cleveland and San Francisco Banks. Directors of the Reserve Banks requesting a reduction in the discount rate believed that monetary tightening actions taken through February 1995 had set the economy on a path that would contain price pressures and that the run-up in inflation had, in fact, moderated. Moreover, given the signs of a softer economy and the risks of a cumulative decline in economic activity, they felt that a reduction in the discount rate was desirable. In their view, such an action would minimize the risks of excessive monetary tightness and still provide sufficient restraint to meet longer-term inflation objectives.

Directors of the Banks that had voted to reestablish existing rates agreed that the national economy was showing signs of slower growth, but they saw no indications of a cumulating downturn. Some noted that the data on economic activity had been negative for a relatively short time, and they said they needed further confirmation of weakening before requesting a reduction in the discount rate. While the risks of further economic weakness could not be ruled out, some directors commented that the delayed impact of sharply lower long-term interest rates would tend to sustain further economic expansion.

The Board's discussion of the requests today disclosed that, while some members believed that easing of monetary policy might be necessary at some point, no member favored a decrease in the discount rate at this time. Chairman Greenspan acknowledged that the recent economic data displayed weakness, but, in his view, the balance of the

evidence did not at this stage point to a cumulating deterioration in the economy. Even so, he wanted to leave open the possibility of some easing of monetary policy. He would argue at this point against a reduction in the discount rate and would be inclined to postpone consideration of any easing through open market operations until the meeting of the Federal Open Market Committee on July 5 and 6. In the interim, he would urge members to keep an open mind on the need for policy action. Vice Chairman Blinder believed that the requests for a reduction in the discount rate had merit; and he believed that an easing action would be warranted soon, but that the action might appropriately be a reduction in the federal funds rate, an approach that had been recommended by the Federal Reserve Bank of New York. In his view, the longevity of the recovery and the outlook for the economy in mid-1996 would be key considerations in any decision to ease policy.

Governor Kelley saw indications that inflation pressures might be moderating, which gave the Board more latitude to maneuver. He added that if a change were made, it would not need to be a change in the discount rate, but it could be a reduction in the federal funds rate alone. Governor Lindsey stated that the prospects for fiscal contraction suggested that aggregate demand would be lower next year than it otherwise would have been; and, 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, but she also would start with the federal funds rate. Thereupon, at the conclusion of the discussion, the Board maintained existing rates.

Participating in this determination: Chairman Greenspan, Vice Chairman Blinder, and Governors Kelley, Lindsey, and Yellen.

Background; Office of the Secretary memorandum, June 16, 1995.

Implementation: Wire from Mr. Wiles to the Reserve Banks, June 19, 1995.

Appendix B: Sample of information coming out of the Federal Reserve

Below we document news of information emerging from the Federal Reserve. Part 1 presents instances of Fed insiders conveying the essence of meetings to the media prior to official releases covering the meeting content. We present a sampling of both discount rate and FOMC information coming out. Part 2 presents instances of "leaks", intentional or not, of insider information to the private sector.[15]

Part 1) Evidence of Fed insiders conveying discount rate meeting and FOMC information to the media

1. Evidence from the Gonzalez Hearing:

In the Congressional hearings documents, Anna Schwartz cites a paper by Belongia and Kliesen (1994) finding that from March 1989 to May 1993, on 11 of 34 possible occasions, the essence of the directive was "leaked" to the Wall Street Journal within one week of the meeting (these directives were not disclosed in that period until after the following scheduled FOMC meeting)

2. Norris, Floyd, "The Fed Will Act, But Does It Matter?" New York Times, September 22, 1996.

"The man at the sandwich shop took an order from one of my colleagues a few days ago, and, after establishing whether mayonnaise or mustard was desired, had one more question. "Is the Fed going to raise interest rates?" he asked. When fast-food workers know -- and care -- about meetings of the Federal Reserve's Open Market Committee, you can be sure that Wall Street has well discounted the impact of any expected move. And now, thanks to an exceptional leak by a Fed official to Isabelle Clary of Reuters, we know that 8 of the 12 regional banks in the Fed want a higher discount rate. Their request is likely to be granted."

3. Wessel, David. Wall Street Journal, June 19, 1995

"… 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."

> RE: Excerpt from Discount Rate Minute, June 19, 1995
> "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, but she also would start with the federal funds rate."

4. Wessel, David. Wall Street Journal, March 17, 1997

[15] A separate issue regards the recently documented premature media releases of information provided by the Fed to them during lock-up periods prior to announcements, see for example Javers , Eamon. "News organizations respond to Fed lockup questions" CNBC, September 24, 2013: "Eric Hunsader, founder of the market analysis firm Nanex, says that's because he saw simultaneous reactions to the Fed's announcement last week in trading in New York and Chicago. That would be theoretically impossible if the information was released from the Fed's headquarters in Washington. Working off of a list provided by the Fed of news organizations participating in last week's lock up, CNBC contacted each of the news organizations that offer low latency data services to ask whether they transmitted any data out of the Fed's lockup room. A key question is whether or not any organization transmitted information out of the lockup room and into its own computer system before 2 p.m. …– enabling subscribers of that data service to get the information milliseconds before others in Chicago… A spokesperson for Dow Jones declined to say whether or not the organization transmitted data out of the lock up room before 2 pm.…Similarly, a Thomson Reuters spokesperson …declined to answer questions about whether the organization transmitted information out of the lock up room before 2 p.m."

"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."

> RE: Excerpt from Discount Rate Minute, March 17, 1997
> "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."

5. Wessel, David. Wall Street Journal, November 17, 1998

"The stock market is ebullient; …. Nonetheless; the Fed's internal forecasts indicate the economy will slow substantially in the first half of 1999; putting the nearly eight-year-long U.S. expansion at risk."

6. Berry, John "Fed Unlikely to Act On Rates, Experts Say." Washington Post, March 30, 1999

"Federal Reserve officials aren't likely to make any change in short-term interest rates at a policymaking session this 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 as a preemptive action to make sure inflation stays under control, particularly since world financial markets are far more stable than they were last fall when the Fed cut overnight rates by three-quarters of a percentage point in three steps. Other officials argue that the need for such a move isn't at all clear."

7. Wessel, David. Wall Street Journal, 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."

Follow-up Article:

8. Ip, Greg. Wall Street Journal, 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…."

> RE: Excerpt from Discount Rate Minute, 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, but they viewed these developments as helping to restore the balance between demand and potential supply. ...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. "

9. Lahart, Justin. Wall Street Journal, "Ahead of the Tape." February 1, 2005

"On the docket at the Fed's two-day meeting starting today: a discussion on whether its policy-setting committee should adopt a set target level for inflation."

10. Kristina Cooke, Pedro da Costa and Emily Flitter, 2010. "The ties that bind at the Federal Reserve." Reuters, September 30, 2010, http://www.reuters.com/article/2010/09/30/us-usa-fed-idUSTRE68S01020100930

"….the Wall Street Journal published a more detailed account of the divisions on the Fed's policy-setting committee. The newspaper report was credited with moving bond yields 0.20 percentage point, a relatively steep decrease"

11. Julia La Roche, "Meet The Man Responsible for Today's Huge 230 Point Dow Surge", Business Insider, June 6, 2012, http://www.businessinsider.com/jon-hilsenrath-2012-6

"You can thank Jon Hilsenrath, the chief economics correspondent for *The Wall Street Journal*, for today's stock market surge. The Dow is up more than 200 points after Hilsenrath broke the news last night that the Federal Reserve is now considering more action including another round of quantitative easing after a slew of weak economic data."

The article referred to is: Jon Hilsenrath, "Fed Considers More Action Amid New Recovery Doubts", Wall Street Journal, June 6, 2012.

Part 2) Evidence of selective disclosure to private parties and Fed watchers preferential access

12. FOMC Transcript August 16, 2007

"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."

13. Securities Regulation & Law Report, 1989, "Ex-N.Y. Fed Director Pleads Guilty to Leaking Inside Data on Discount Rate" Vol, 21:1, p. 908-909.

"Former New York Federal Reserve Bank Director Robert Rough pleaded guilty…According to the 1988 indictment, Rough leaked information about the Fed's discount rate to now-defunct Bevill, Bresler, & Schulman Inc….Rough allegedly conveyed information concerning the New York directors' confidential discussions… Occasionally, the Federal Reserve would notify the New York Fed and other Fed banks that it was about to announce a change in the discount rate. Rough would disclose that inside information…."

14. Wessel, David. Wall Street Journal, July 7, 1995

"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."

15. Kristina Cooke, Pedro da Costa and Emily Flitter, 2010. “The ties that bind at the Federal Reserve.” Reuters, September 30, 2010, http://www.reuters.com/article/2010/09/30/us-usa-fed-idUSTRE68S01020100930

“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.”

Later in the article, concerning former Fed employees and outsiders:

“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”

“Though rarer, access is sometimes also bestowed upon outsiders. Paul Markowski, a China expert who counts hedge funds and foreign central banks among his consulting clients, has never worked at the Fed but says his relationships with officials there date back to the 1960s.. ..On the same day as the Fed's eventful August meeting, Markowski wrote to his clients: "While I thought they could hold off doing what they did, a senior Fed official told me that after measuring the risk of doing nothing they had little to lose and more to gain.” On Friday, September 24, three days after the September 21 meeting, he described a string of conversations with "three big Feddies”. Earlier in the year, just a day after the April 27-28 gathering, Markowski offered clients: "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."

16. Economic Policy Journal. “OUTRAGEOUS: Bernanke Briefing Elitists in Advance of Fed Moves.” November 23, 2011.

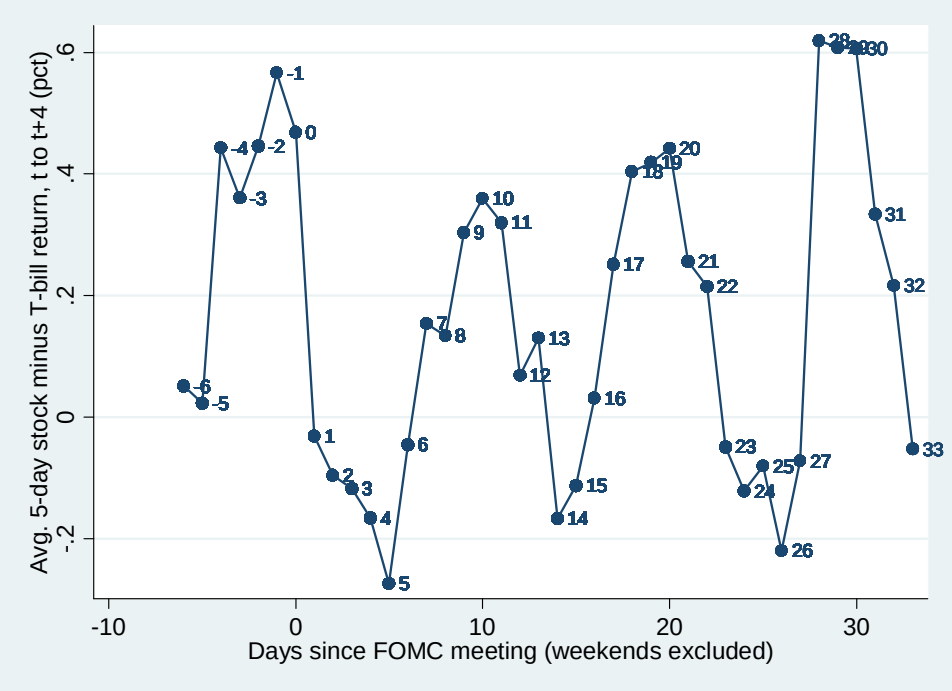
“If you ever suspected the financial game was rigged against you and in favor of the elitist banksters, new evidence has emerged that you are absolutely correct. WSJ's Susan Pulliam reports on the edge Fed chairman Ben Bernanke and other Fed officials are giving the insider elitists. Read this and weep:
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.”

17. Harding, Robin, Tom Braithwaite and Stephen Foley. "Fed leaks rate-setting minutes to banks." Financial Times. April 10, 2013.

On Wednesday the Fed published its March minutes in the morning rather than the afternoon as had been scheduled. The central bank said it was doing so because they had already been accidentally released on Tuesday afternoon to a distribution list, comprising “mostly congressional staffers and trade association members in Washington”. However, on Wednesday afternoon, the Fed published that list, which included lobbyists at Goldman Sachs, JPMorgan Chase and Citigroup, among other banks. Though the list was predominantly comprised of staffers to members of Congress, it also included a significant number of employees working for banks, opening the possibility that they could have passed on the information to traders. Staff at Fifth Third, Barclays, Regions Financial, Wells Fargo, Citi, UBS, US Bancorp, Goldman, JPMorgan and PNC Financial all received the minutes early. Naomi Camper, one of JPMorgan’s top lobbyists, was among the recipients.

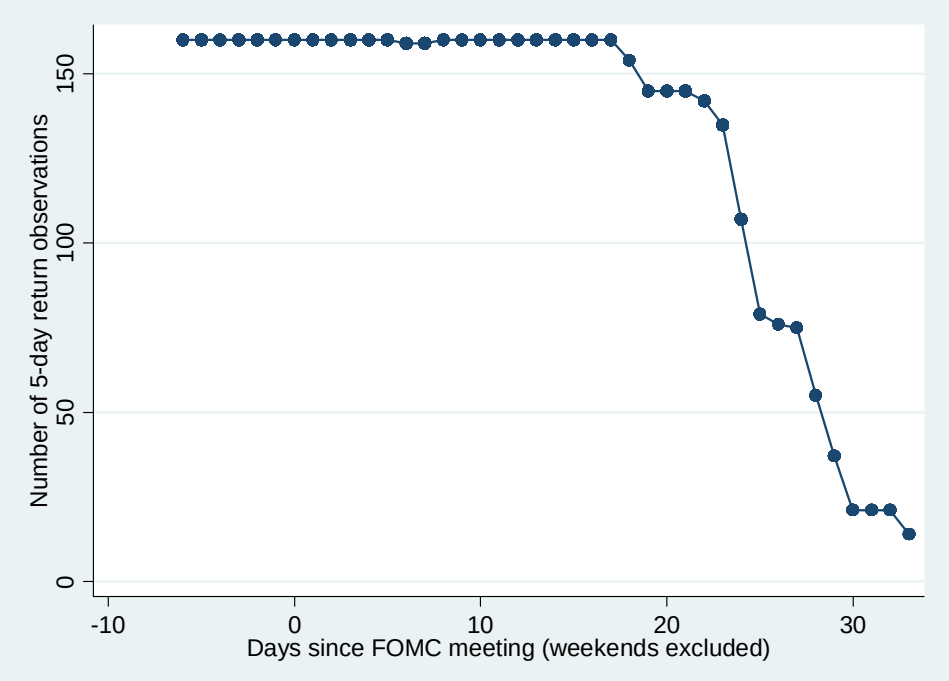
Figure 1. Stock returns over the FOMC cycle, 1994-2013

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

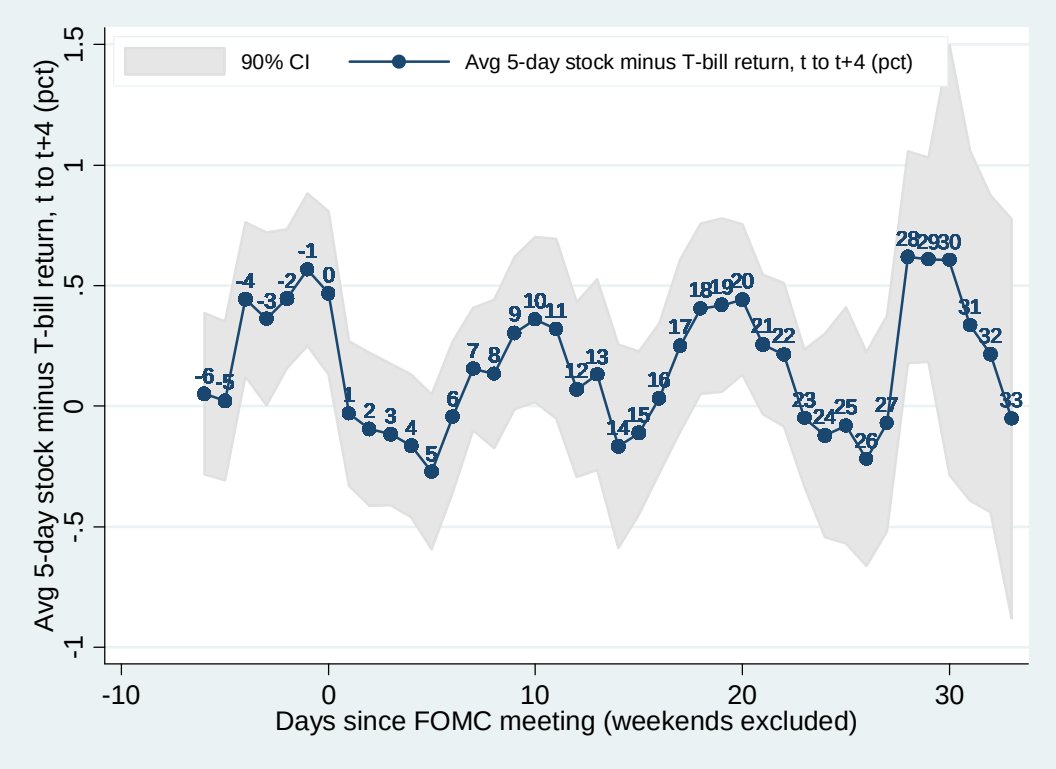


Note: Based on 160 FOMC cycles (8 scheduled FOMC meetings per year). The numbers along the line indicate the value on the horizontal axis. If a given day is day -6 or closer to the next meeting, the 5-day (forward) return for this day is not used in the right part of the graph, so points to the right do not use any data for days -2 and later.

Panel B. Number of 5-day return observations



Panel C. 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 beta category, 1994-2013

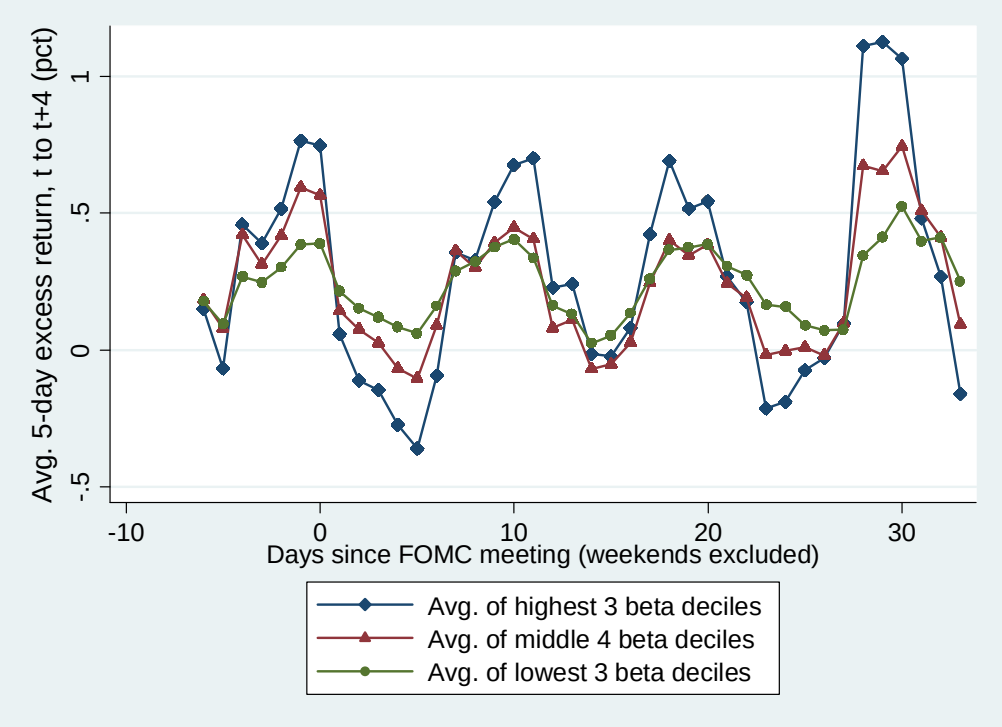
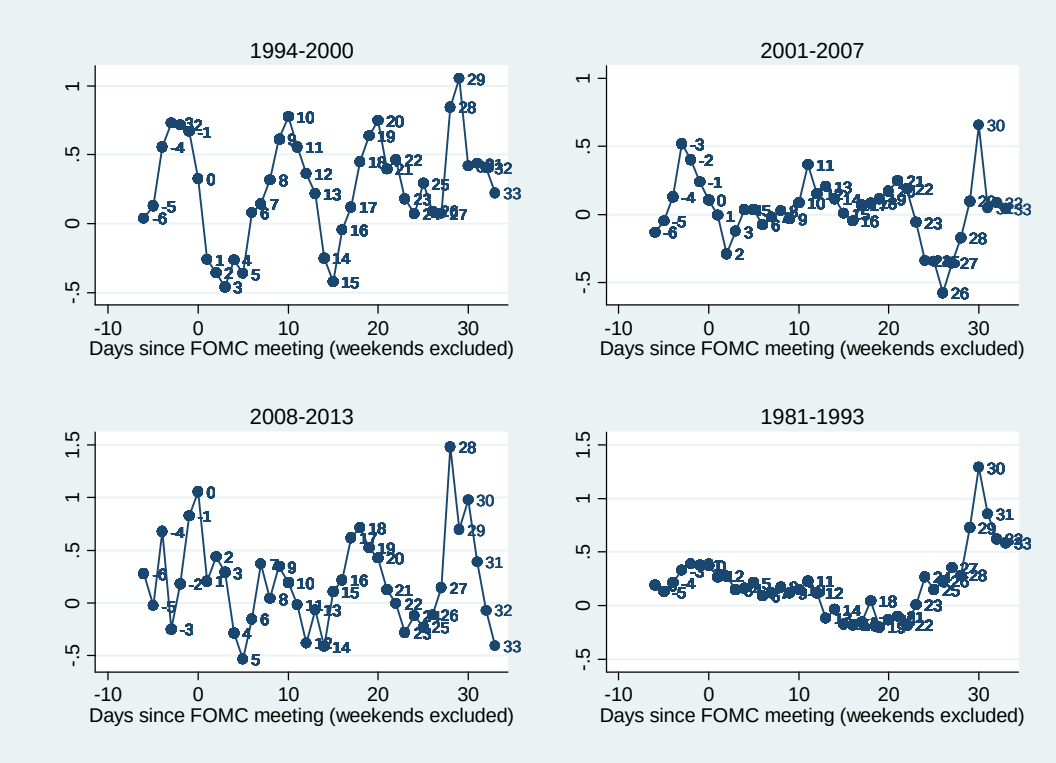


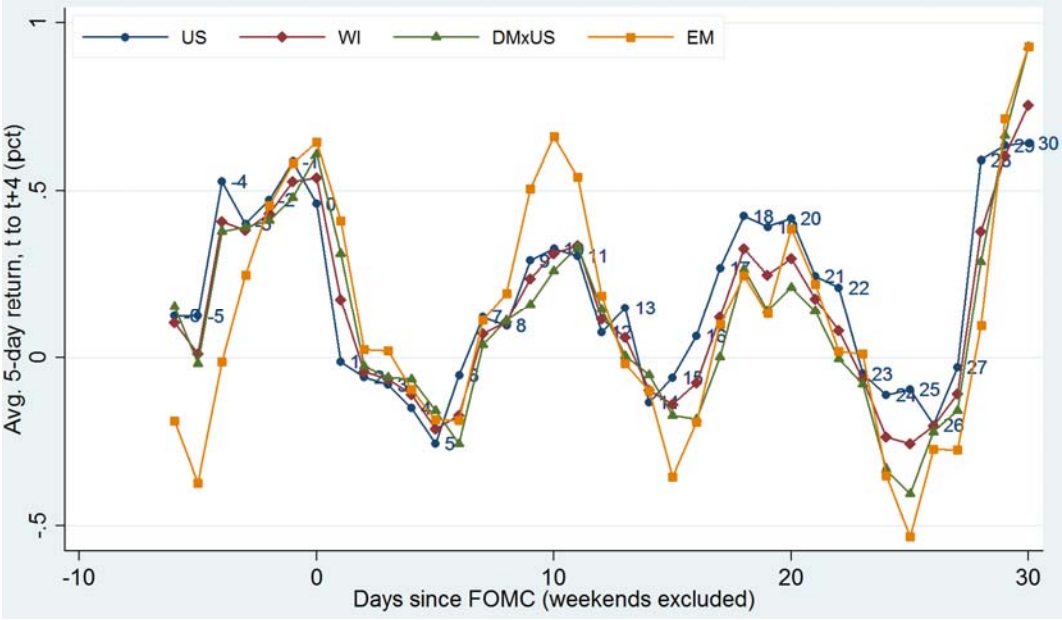
Figure 3. Stock returns over the FOMC cycle, by time period

Average 5-day excess return, t to t+4 (percent)



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

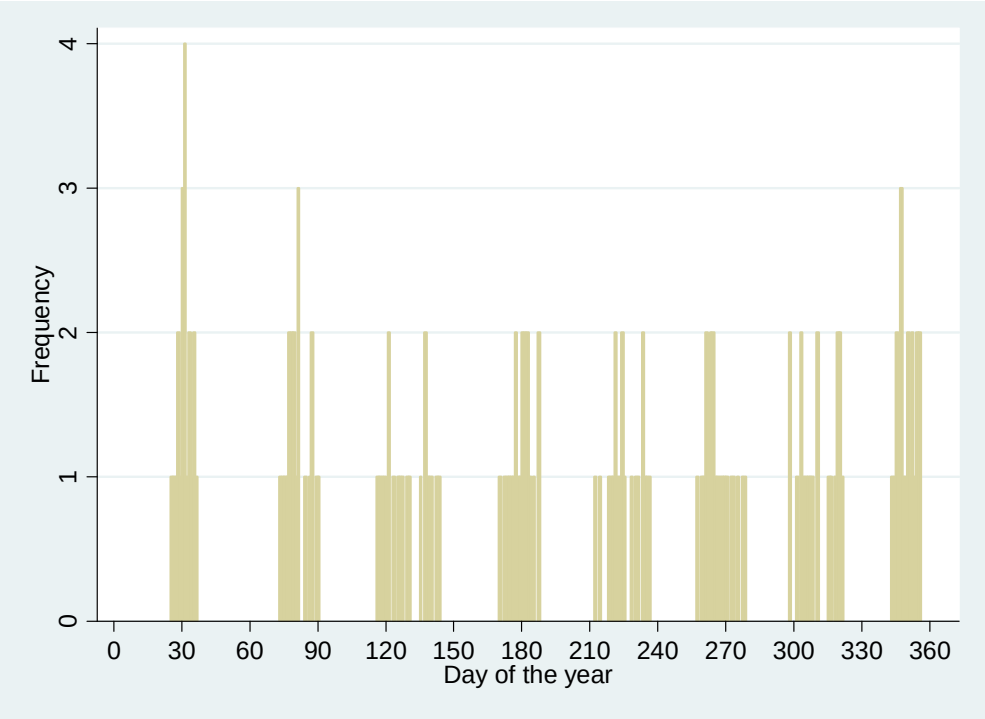
Figure 4. International stock returns over the FOMC cycle, percent, 1994-2013



Note: All returns, including US, are based on the MSCI indices obtained from Bloomberg. WI is the world index, DMxUS is the developed market index excluding US, EM is the emerging market index. All indices are in USD.

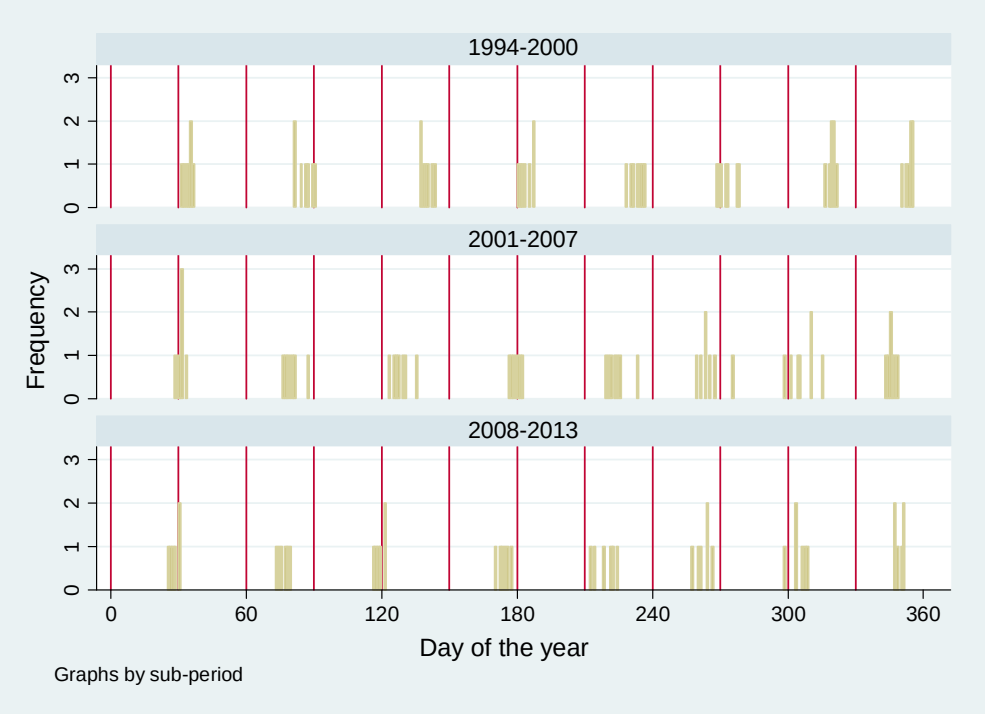
Figure 5. Timing of the eight FOMC meetings within the year

Panel A. Histogram of the day of the year on which FOMC meetings took place, 1994-2013



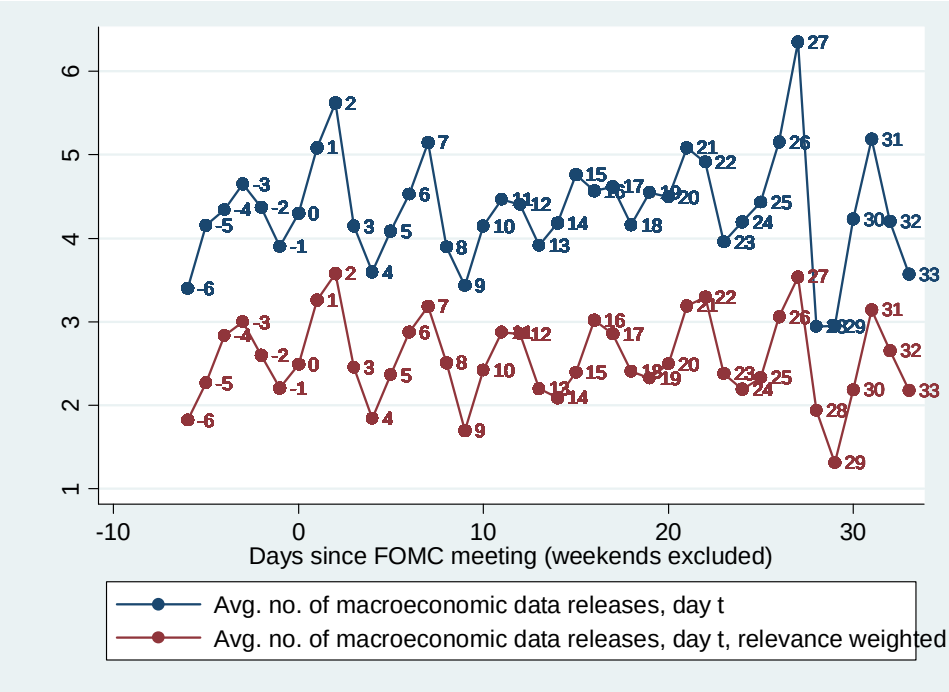
Note: For 2-day meetings, we set the FOMC meeting day equal to the second day.

Panel B. Histogram of the day of the year on which FOMC meetings took place, by sub-period



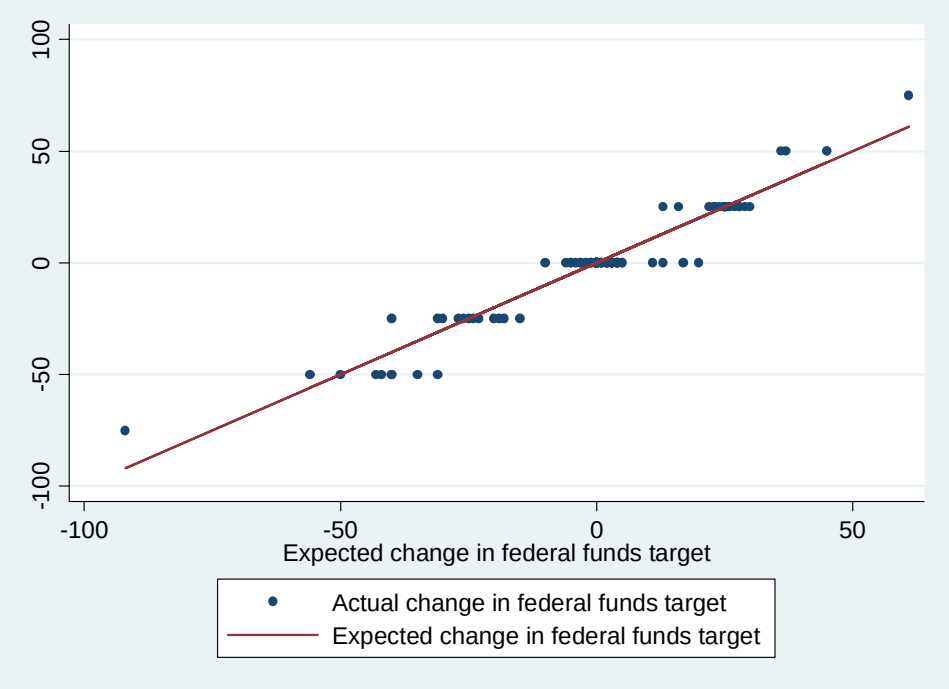
Note: Vertical lines are inserted every 60 days in order to facilitate comparisons across the three graphs.

Figure 6. Number of macroeconomic data releases per day in FOMC cycle time, Bloomberg data, 1996:11-2013:12



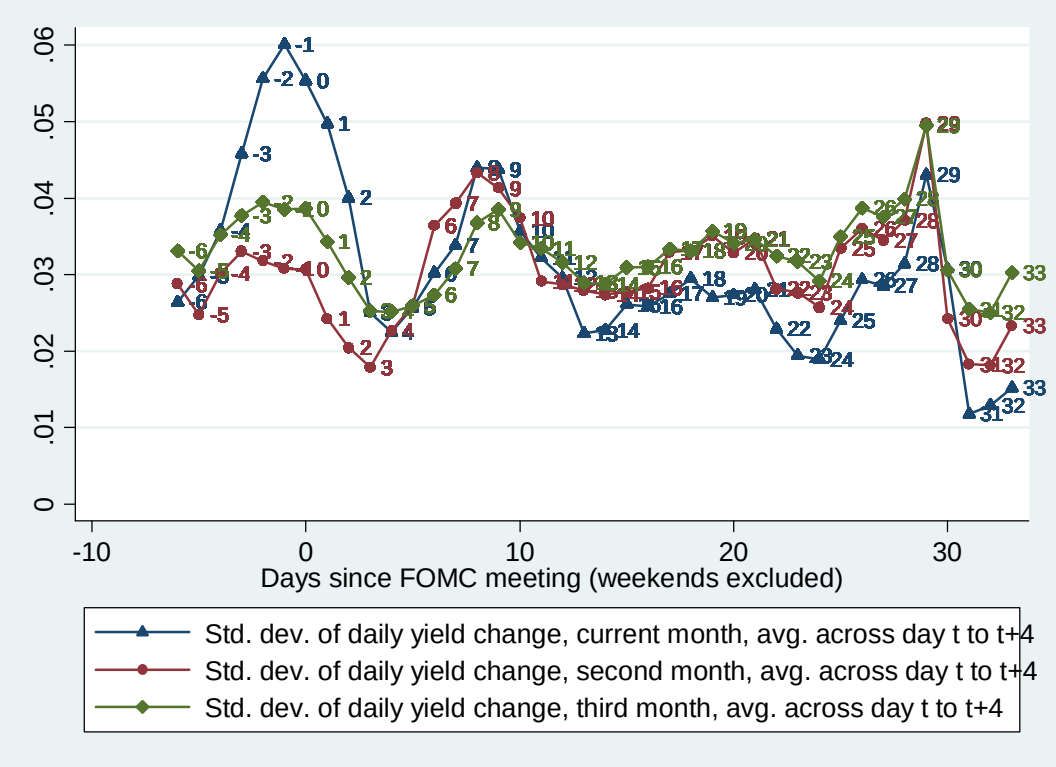
Note: The numbers along the line indicate the value on the horizontal axis.

Figure 7. Expected and actual changes in the federal funds target rate, 1994-2008



Note: The figure is based on 116 scheduled FOMC meetings.

Figure 8. Panel A. Volatility in federal funds futures yields over the FOMC cycle for the first, second and third month federal funds futures contracts, 1994-2013



Panel B. Volatility in the effective federal funds rate over the FOMC cycle, 1994-2013

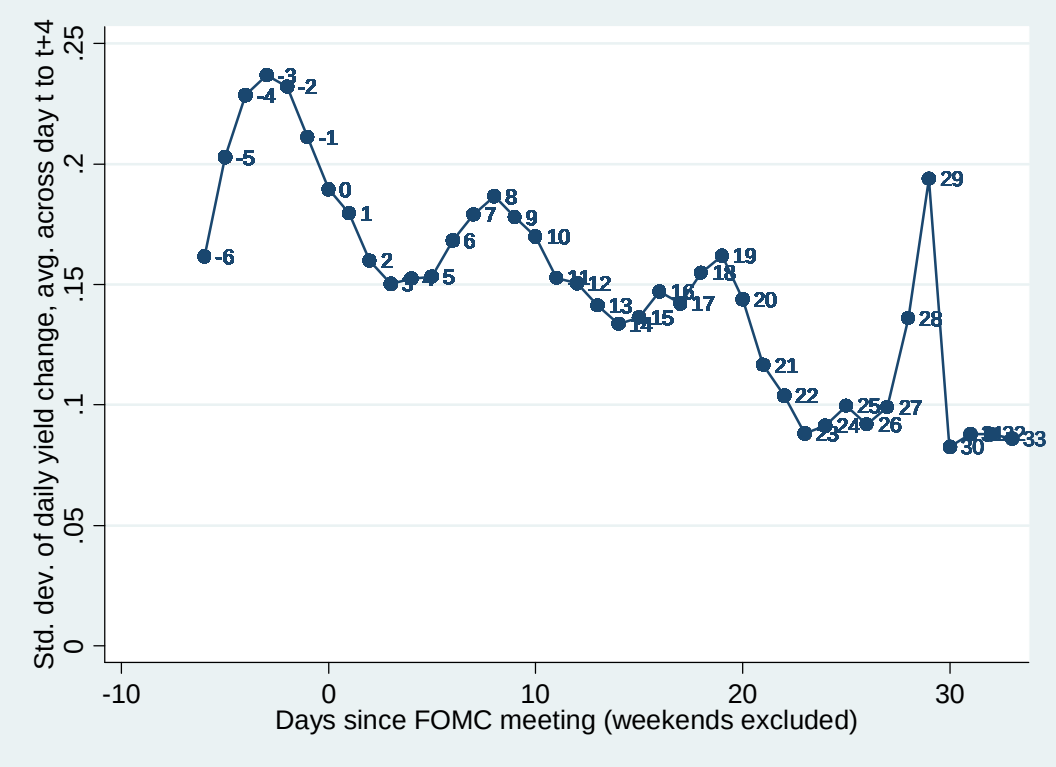


Figure 9. Probability that a given day in FOMC cycle time is the end of a reserve maintenance period, 1994-2013

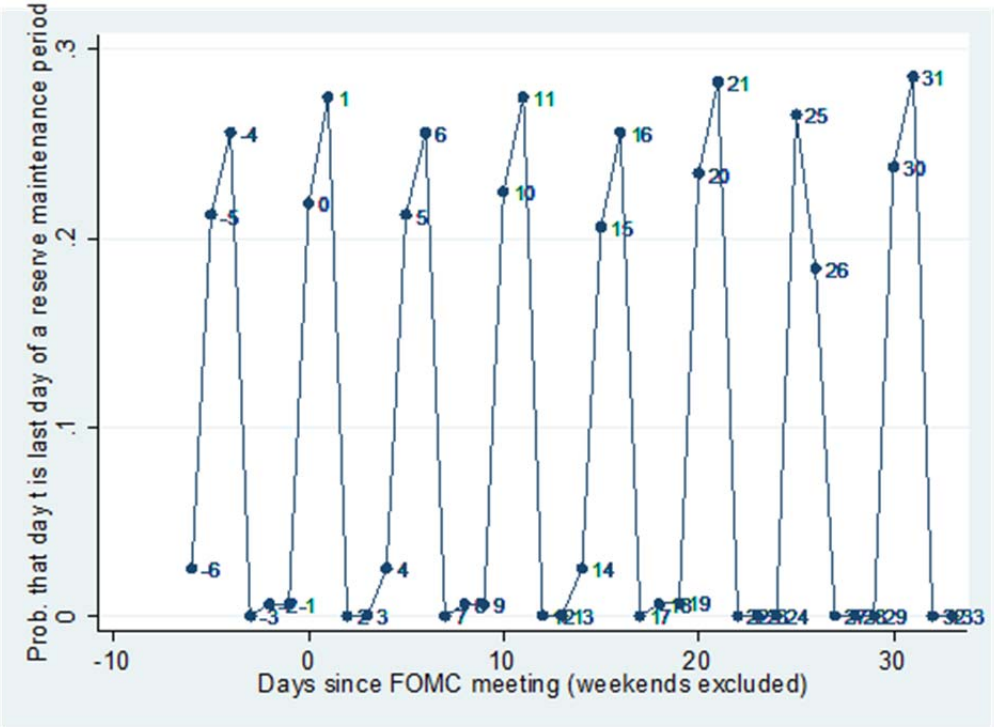


Figure 10. Histogram of which day of the month (in calendar time) FOMC announcements are made, 1994-2013

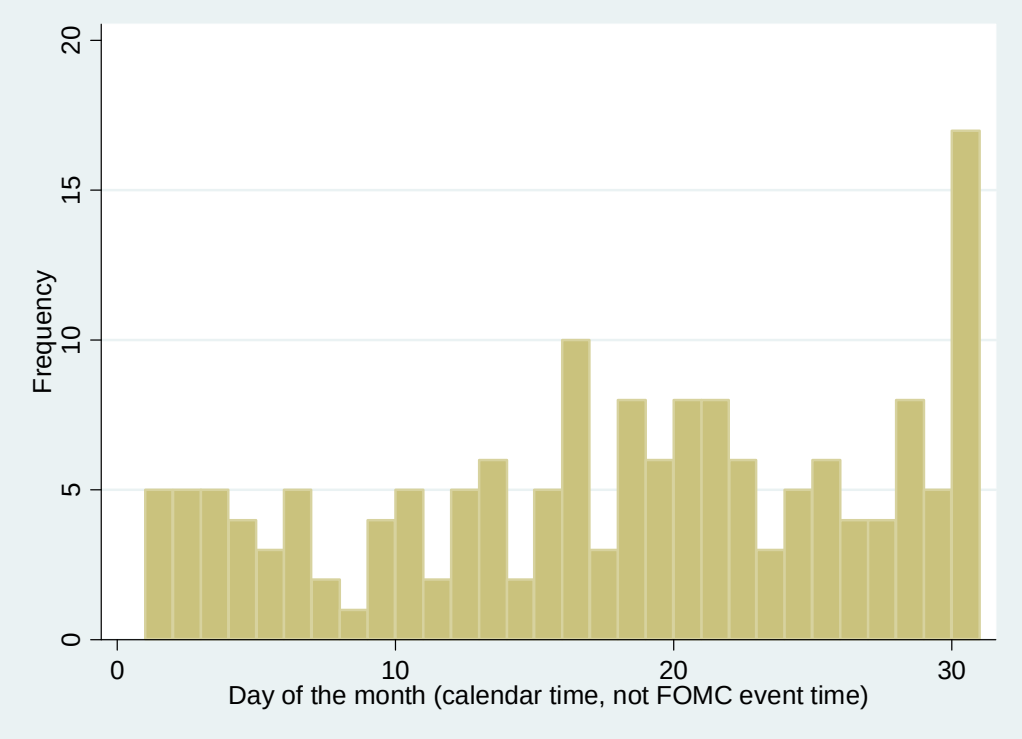
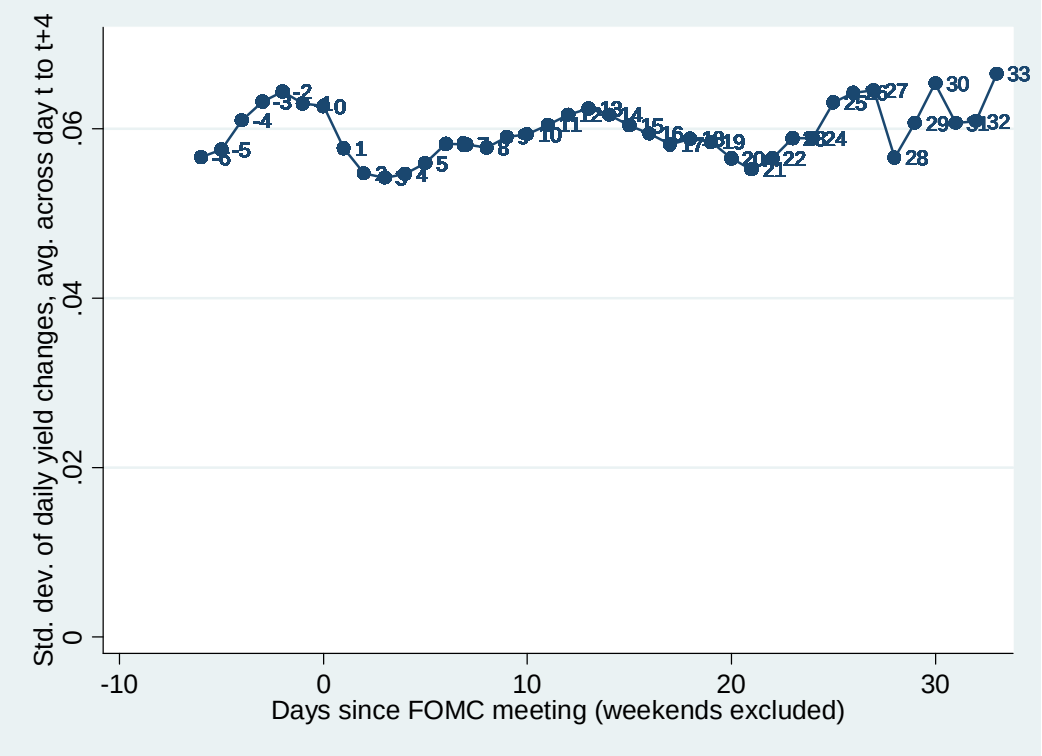


Figure 11. Panel A. Volatility in 10-year Treasury yields over the FOMC cycle, 1994-2013



Panel B. Volatility of the excess stock return over the FOMC cycle, 1994-2013

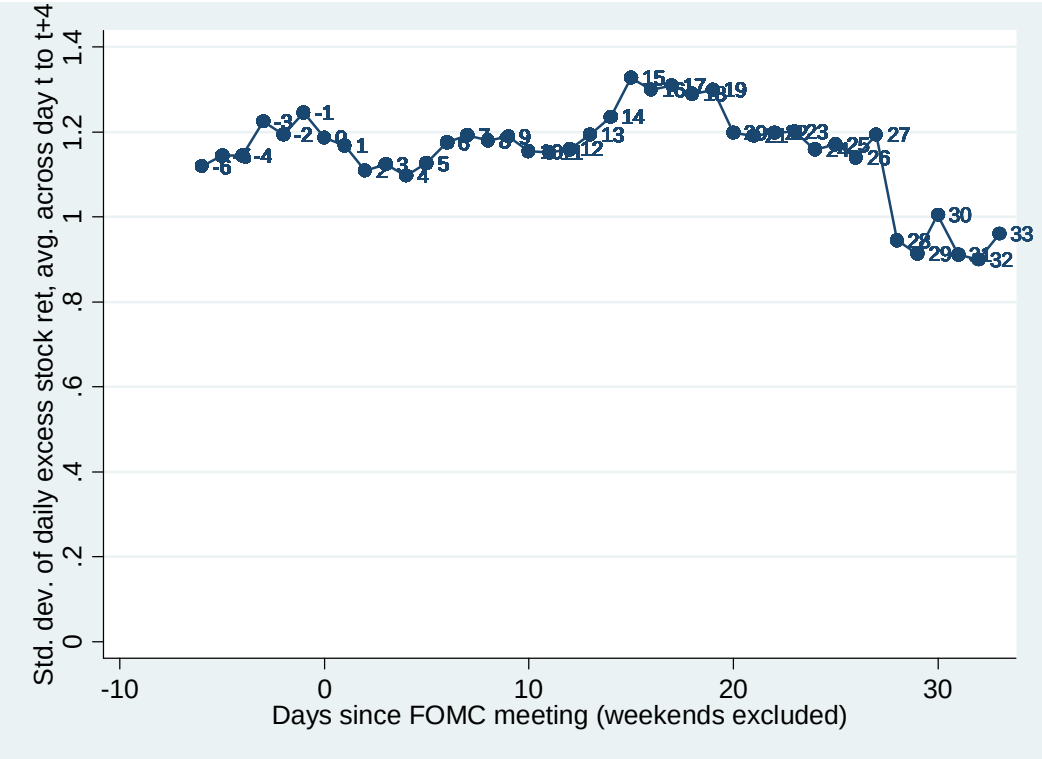


Figure 12. Probability of an inter-meeting federal funds target change, 1982:09-1993:12

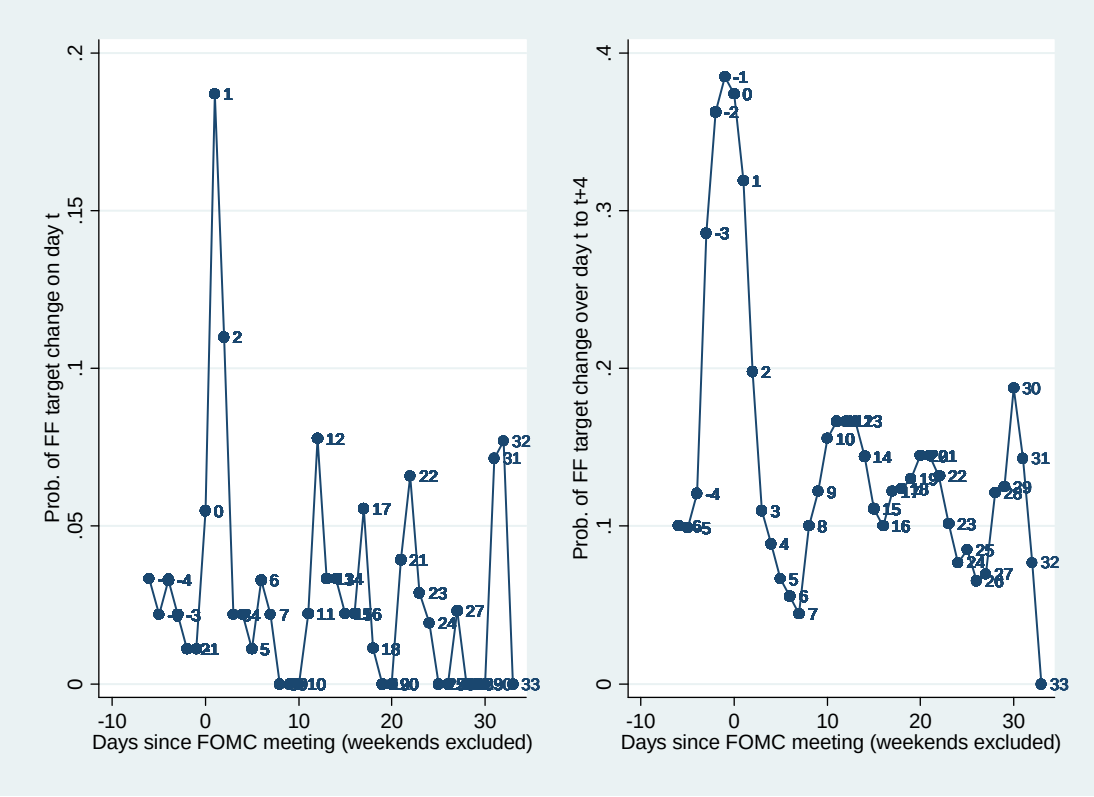
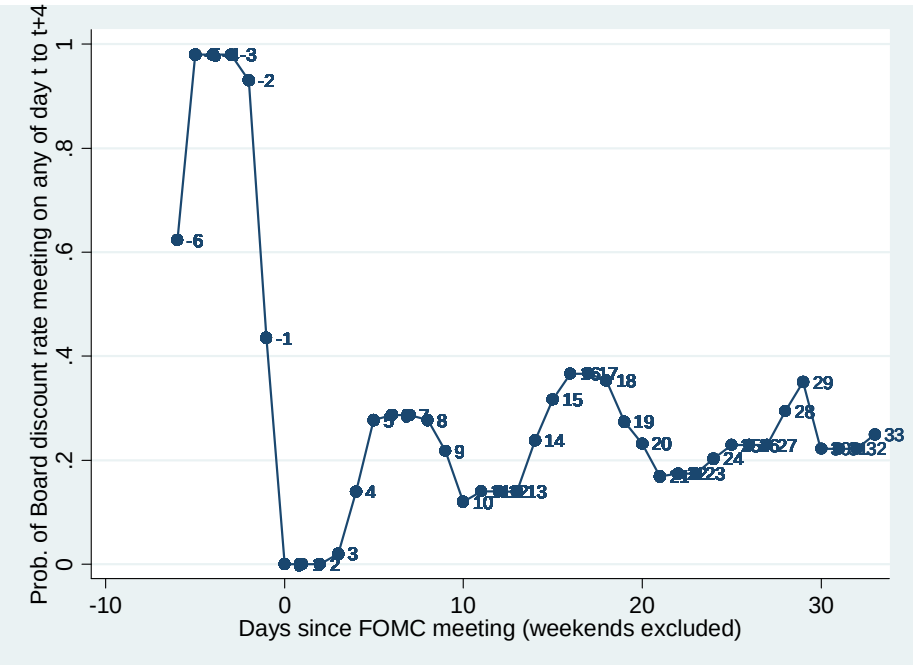


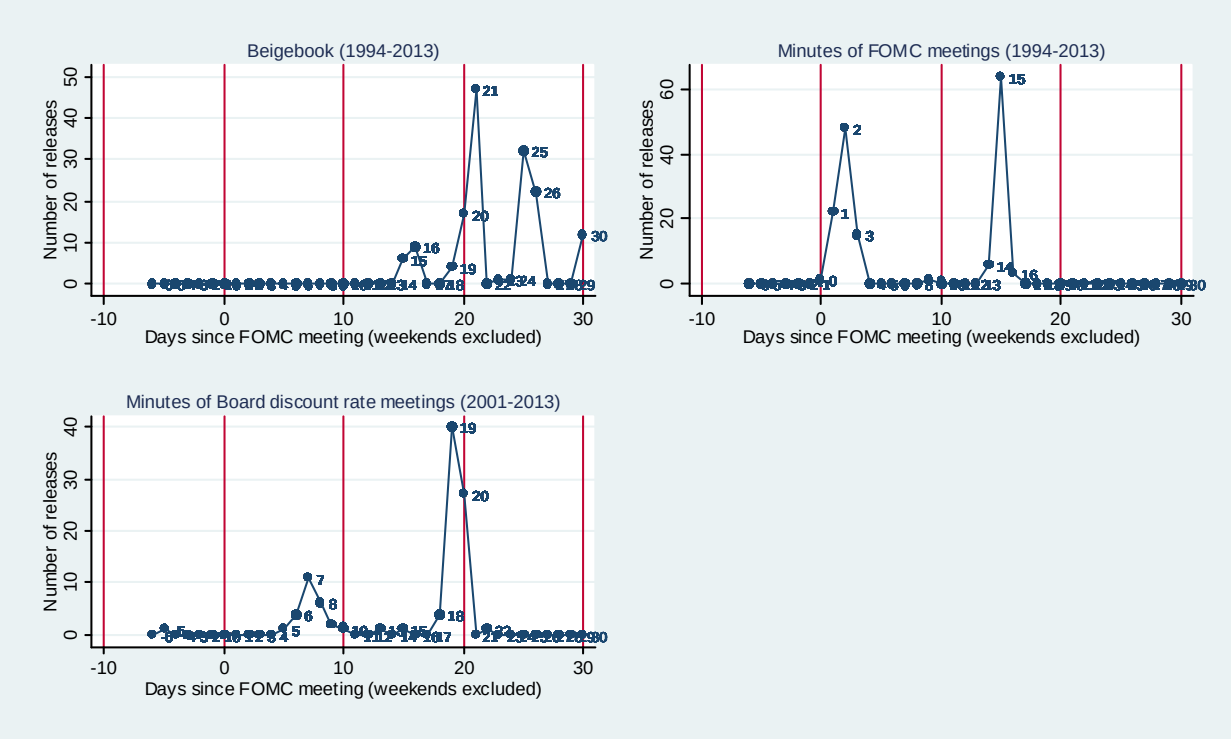
Figure 13. Probability of Board of Governors discount rate meeting on one of day t to t+4, 2001:06-2013:12



Note: We code cases of discount rate minutes, but no meeting, as a non-meeting.

Figure 14. Releases of Federal Reserve documents over the FOMC cycle

Panel A. Public releases



Panel B. Releases of documents internally within the Federal Reserve

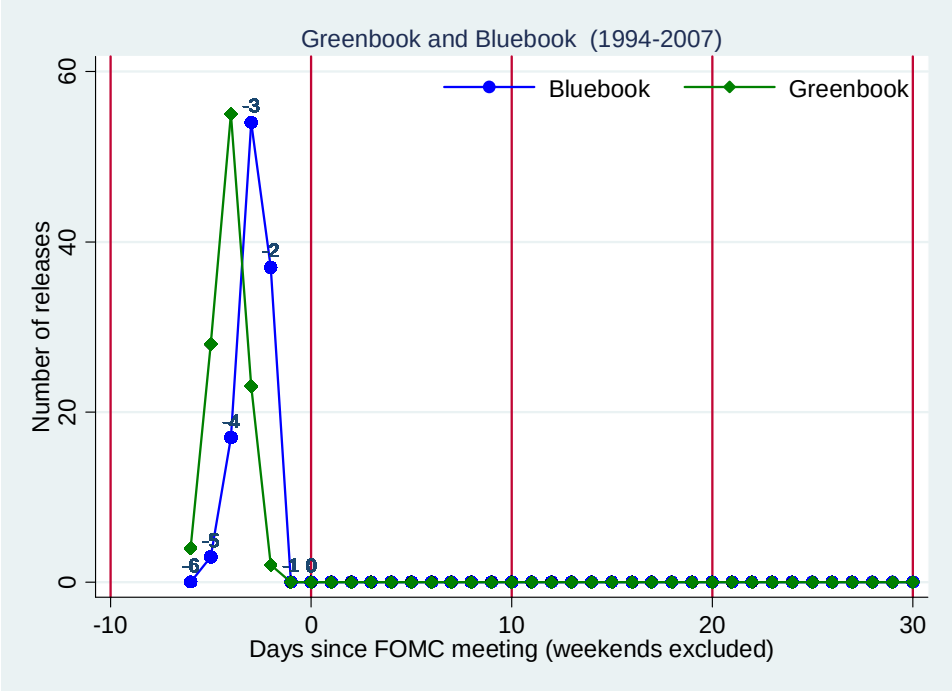
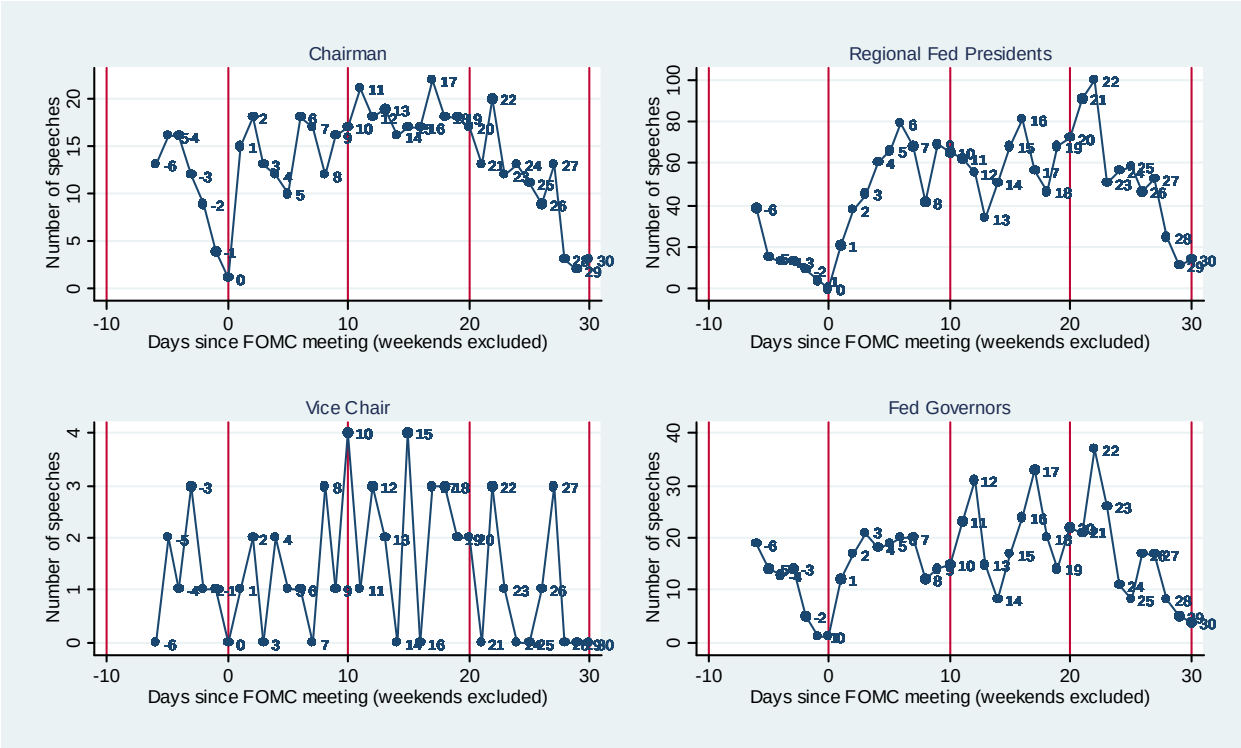
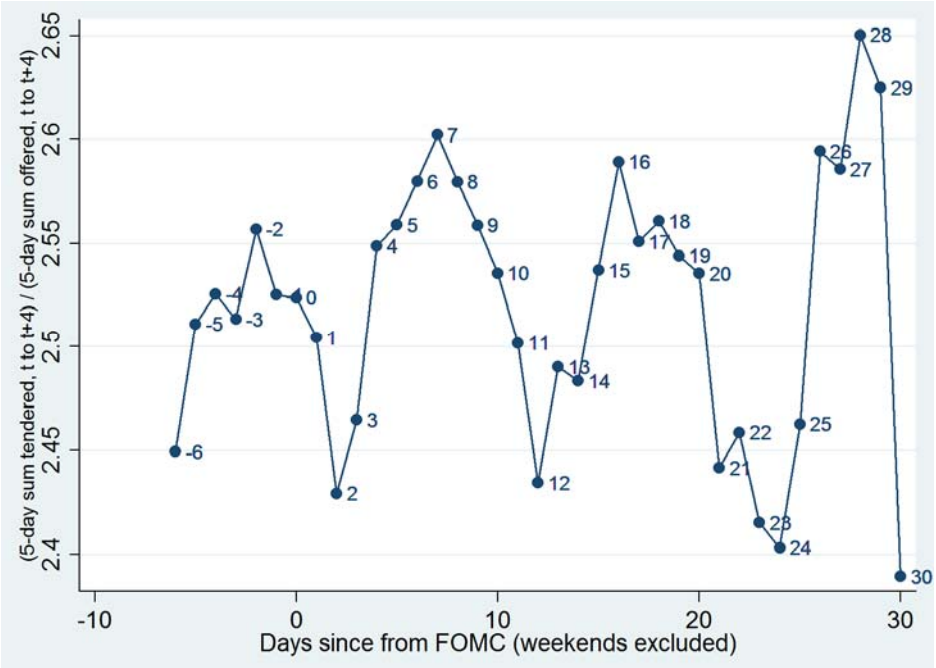


Figure 15. Speeches by Federal Reserve officials over the FOMC cycle



Note: The figure displays the total number of speeches and testimonies given by Fed officials at each point of the FOMC cycle during the period 1994:01-2013:12. The dates of speeches have been collected from the Federal Reserve Board website and from the websites of the regional Feds.

Figure 16. Primary dealer oversubscription in Treasury auctions



Note: The data on Treasury auctions are obtained from the Treasury Direct website. The sample contains all notes and bonds issued with maturities of 2, 3, 5, 7, 10 and 30 years. The figure reports the ratio of the 5-day total amount tendered to the 5-day total amount offered, averaged over each day in the FOMC cycle. We merge the FOMC cycle date onto the Treasury issue date (rather than the auction date), which is when the auction is settled and transfer of funds takes place. The sample covers the period 1994:01-2008:06.

Table 1. Regressions of daily excess stock returns on FOMC cycle dummies, 1994-2013
Panel A. Total US stock market

	Dependent variable: Excess return on stocks over T-bills			
	(1)	(2)	(3)	(4)
Dummy=1 in Week 0	0.136***	0.136***	0.115***	0.115***
	(2.76)	(2.76)	(2.59)	(2.59)
Dummy=1 in Week 2, 4, 6	0.101***		0.079***	
	(2.68)		(2.59)	
Dummy=1 in Week 2		0.083*		0.062
		(1.75)		(1.46)
Dummy=1 in Week 4		0.108**		0.086*
		(2.00)		(1.75)
Dummy=1 in Week 6		0.179**		0.157*
		(1.99)		(1.81)
Dummy=1 in Week -1, 1, 3, 5			-0.021	-0.021
			(-0.98)	(-0.98)
Constant	-0.021	-0.021		
	(-0.98)	(-0.98)		
N (days)	5214	5214	5214	5214

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

Panel B. Beta-sorted portfolios

	Dependent variable: Excess return on							
	High beta stocks (avg across top three beta deciles)		Medium beta stocks (avg across four middle beta deciles)		Low beta stocks (avg across bottom three beta deciles)		High beta stocks minus low beta stocks	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dummy=1 in Week 0	0.169***	0.169***	0.119***	0.119***	0.058***	0.058***	0.111**	0.111**
	(2.64)	(2.64)	(2.83)	(2.83)	(2.89)	(2.89)	(2.24)	(2.24)
Dummy=1 in Week 2, 4, 6	0.130***		0.080**		0.057***		0.074**	
	(2.68)		(2.49)		(3.44)		(2.03)	
Dummy=1 in Week 2		0.124**		0.078**		0.056***		0.068
		(2.04)		(2.00)		(2.83)		(1.48)
Dummy=1 in Week 4		0.121*		0.071		0.056**		0.065
		(1.72)		(1.47)		(2.20)		(1.27)
Dummy=1 in Week 6		0.234**		0.149		0.069**		0.166**
		(2.20)		(2.23)		(2.08)		(2.03)
Constant	-0.018	-0.018	-0.00005	-0.00005	0.019**	0.019**	-0.037*	-0.037*
	(-0.62)	(-0.62)	(-0.00)	(-0.01)	(2.05)	(2.05)	(-1.68)	(-1.68)
N (days)	5214	5214	5214	5214	5214	5214	5214	5214

Table 2. International stock returns over the FOMC cycle
Panel A. Dependent variable: One-day return on an MSCI equity index on day t

	(1) WI	(2) DMxUS	(3) EM	(4) CA	(5) UK	(6) DE	(7) FR	(8) CH	(9) JP
Dummy=1 in week 0	0.12***	0.11**	0.14***	0.16***	0.088*	0.11*	0.16**	0.11**	0.075
	(2.97)	(2.31)	(2.85)	(3.54)	(1.88)	(1.88)	(2.54)	(2.39)	(1.32)
Dummy=1 in week 2, 4, 6	0.067**	0.043	0.099***	0.11***	0.038	0.062	0.068	0.089**	0.026
	(2.23)	(1.28)	(2.66)	(2.86)	(1.06)	(1.37)	(1.41)	(2.45)	(0.62)
Constant	-0.016	-0.0097	-0.034	-0.025	-0.0063	-0.0072	-0.020	-0.018	-0.012
	(-0.86)	(-0.49)	(-1.51)	(-1.17)	(-0.29)	(-0.26)	(-0.74)	(-0.84)	(-0.46)
N (*days*)	5214	5214	5214	5214	5214	5214	5214	5214	5214
Dummy=1 in week 0	0.12***	0.11**	0.14***	0.16***	0.088*	0.11*	0.16**	0.11**	0.075
	(2.97)	(2.31)	(2.85)	(3.54)	(1.88)	(1.88)	(2.54)	(2.39)	(1.32)
Dummy=1 in week 2	0.061*	0.040	0.13***	0.090*	0.040	0.094*	0.059	0.10**	0.041
	(1.67)	(1.00)	(2.92)	(1.94)	(0.91)	(1.69)	(1.09)	(2.26)	(0.83)
Dummy=1 in week 4	0.063	0.034	0.054	0.11**	0.026	0.016	0.064	0.081	-0.0015
	(1.44)	(0.71)	(0.98)	(2.18)	(0.52)	(0.25)	(0.83)	(1.51)	(-0.03)
Dummy=1 in week 6	0.14*	0.11	0.16*	0.15	0.093	0.13	0.16	0.065	0.088
	(1.76)	(1.12)	(1.67)	(1.52)	(0.91)	(1.00)	(1.30)	(0.67)	(0.73)
Constant	-0.016	-0.0097	-0.034	-0.025	-0.0063	-0.0072	-0.020	-0.018	-0.012
	(-0.86)	(-0.49)	(-1.51)	(-1.17)	(-0.29)	(-0.26)	(-0.74)	(-0.84)	(-0.46)
N (*days*)	5214	5214	5214	5214	5214	5214	5214	5214	5214

Panel B. Dependent variable: One-day return on an MSCI equity index on day t+1

	WI	DMxUS	EM	UK	DE	FR	CH	JP
Dummy=1 in week 0	0.13***	0.15***	0.19***	0.13***	0.14**	0.13*	0.13***	0.11*
	(3.30)	(3.29)	(3.77)	(2.67)	(2.40)	(1.90)	(2.83)	(1.88)
Dummy=1 in week 2, 4, 6	0.092***	0.088***	0.18***	0.044	0.10**	0.053	0.10***	0.088**
	(3.09)	(2.66)	(4.75)	(1.25)	(2.28)	(1.17)	(2.89)	(2.15)
Constant	-0.025	-0.031	-0.065***	-0.014	-0.024	-0.011	-0.026	-0.036
	(-1.35)	(-1.52)	(-2.84)	(-0.65)	(-0.85)	(-0.38)	(-1.19)	(-1.41)
N (*days*)	5213	5213	5213	5213	5213	5213	5213	5213
Dummy=1 in week 0	0.13***	0.15***	0.19***	0.13***	0.14**	0.13*	0.13***	0.11*
	(3.29)	(3.29)	(3.77)	(2.67)	(2.40)	(1.90)	(2.83)	(1.88)
Dummy=1 in week 2	0.086**	0.081**	0.19***	0.029	0.14**	0.054	0.086*	0.098**
	(2.34)	(2.03)	(4.15)	(0.66)	(2.50)	(0.99)	(1.96)	(2.04)
Dummy=1 in week 4	0.084**	0.073	0.14***	0.036	0.050	0.017	0.11**	0.068
	(2.01)	(1.53)	(2.73)	(0.73)	(0.80)	(0.25)	(2.11)	(1.13)
Dummy=1 in week 6	0.18**	0.23***	0.26***	0.20**	0.16	0.28***	0.19**	0.15
	(2.51)	(2.71)	(3.33)	(2.30)	(1.60)	(2.71)	(2.21)	(1.18)
Constant	-0.025	-0.031	-0.065***	-0.014	-0.024	-0.011	-0.026	-0.036
	(-1.35)	(-1.52)	(-2.84)	(-0.65)	(-0.85)	(-0.38)	(-1.19)	(-1.41)
N (*days*)	5213	5213	5213	5213	5213	5213	5213	5213

Note: t-statistics robust to heteroscedasticity are in parentheses. *** indicates significance at the 1 pct level, ** significance at the 5 pct level, and * significance at the 10 pct level. The left-hand-side variable are daily simple returns to various MSCI equity indices, expressed in percent. To account for time zone differences, panels A and B report the results for returns realized on day t and on day t+1 relative to the dating of the FOMC cycle, respectively. For example, if the FOMC meeting is on day t, in panel B we match this date with the return realized on day t+1. The sample period is 1994:01-2013:12. 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 in columns (1)-(3) are in USD. Returns in columns (4)-(9), for Canada (CA), UK, Germany (DE), France (FR), Switzerland (CH) and Japan (JP), are expressed in the local currency.

Table 3. Profitability of various trading strategies, 1994-2013

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	**8.47**	**19.99**	**0.42**
Alternating FOMC week strategies for the overall stock market			
B. Hold stocks in weeks 0, 2, 4, 6 only	**11.58**	**13.92**	**0.83**
Hold stocks in week 0 only	4.76	9.06	0.53
Hold stocks in week 2 only	2.44	6.78	0.36
Hold stocks in week 4 only	3.02	6.69	0.45
Hold stocks in week 6 only	0.93	1.57	0.59
C. Hold stocks in weeks -1, 1, 3, 5 only	**-2.67**	**15.04**	**-0.18**
D. Long stocks in weeks 0, 2, 4, 6 and short stocks in weeks -1, 1, 3, 5 (strategy B minus strategy C)	14.24	21.78	0.65
Alternating FOMC week strategies for high beta stocks			
E. Hold high beta stocks in weeks 0, 2, 4, 6 only	16.51	21.87	0.75
F. Hold high beta stocks in weeks -1, 1, 3, 5 only	-1.99	19.06	-0.10
G. Long high beta stocks in weeks 0, 2, 4, 6 and short high beta stocks in weeks -1, 1, 3, 5 (strategy E minus strategy F)	18.28	28.34	0.65

Table 4. Regressions of daily excess stock returns on FOMC cycle dummies and controls, 1994-2013

	Dependent variable: Excess return on stocks				
	(1) Baseline from Table 1	(2)	(3)	(4)	(5)
Dummy=1 in Week 0	0.136***	0.147***	0.136***	0.13***	0.13***
	(2.76)	(2.60)	(2.75)	(2.74)	(2.66)
Dummy=1 in Week 2, 4, 6	0.101***	0.108**	0.101***	0.099***	0.100***
	(2.68)	(2.50)	(2.67)	(2.65)	(2.61)
Number of macro data releases, relevance weighted		0.019*			
		(1.94)			
Dummy for high payment flow day				0.074*	
				(1.65)	
Number of corp. earnings announcements ($x10^4$)					0.35
					(0.20)
Fraction of positive corporate earnings surprises ($x10^4$)					-0.74
					(-0.08)
Dummies for day of the reserve maintenance period	No	No	Yes	No	No
Constant	-0.021	-0.068**	-0.031	-0.033	-0.021
	(-0.98)	(-2.1)	(-1.23)	(-1.45)	(-0.34)
N (days)	5214	4475	5214	5214	5118

t-statistics robust to heteroscedasticity in parenthesis.

The left hand side variables are in percent, so (for example) 0.1 means 10 basis points per day.

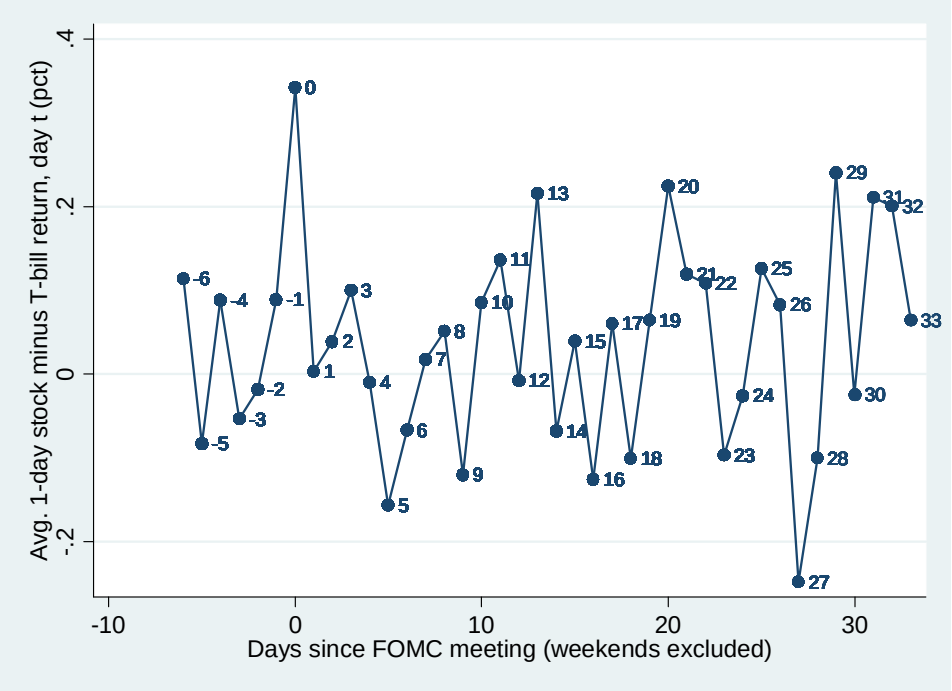
*** means significant at the 1 pct level, ** significant at the 5 pct level, and * significant at the 10 pct level.

Table 5. Expected and surprise components of federal funds target changes in basis points, daily data, 1994-2008:06

Actual change	Number of changes	Avg. expected change	Avg. surprise	Avg. absolute value of surprise
-75	1	-92	17	17
-50	8	-42	-8	9
-25	12	-25	0	5
0	65	1	-1	2
25	25	25	0	2
50	4	41	9	9
75	1	61	14	14

Note: The table is based on 116 scheduled FOMC meetings.

Appendix Figure 1. Stock returns over the FOMC cycle, 1994-2013.
Average 1-day stock return minus bill return over the FOMC cycle, percent



Appendix Table 1. Meeting schedule of regional Federal Reserve banks

Regional Fed	Body	Meeting schedule from bylaws
Cleveland	Board of Directors	2nd Thursday of each month
	Executive Committee	Bi-weekly in the interval between Board meetings
St. Louis	Board of Directors	8 times per year
	Executive Committee	Alternate Thursdays following the Board meeting
Dallas	Board of Directors	2nd Thursday of each month
	Executive Committee	4th Thursday of each month, and 1st Thursday of a month after month with five Thursdays
Kansas	Board of Directors	1st Thursday following the 2nd Tuesday of each month
	Executive Committee	2nd Thursday following the monthly Board meeting
Philadelphia	Board of Directors	3rd Thursday of each month
	Executive Committee	1st Thursday of each month and 4th or 5th Thursday in each month with five Thursdays
Richmond	Board of Directors	2nd Thursday of each month
	Executive Committee	2nd and 4th Thursday of each month
Chicago	Board of Directors	7 times a year in person, in between bi-weekly by phone
	Executive Committee	Unspecified
NY	Board of Directors	3rd Thursday of each month
	Executive Committee	Unspecified
Atlanta	Board of Directors	Preceding the FOMC meeting
	Executive Committee	Unspecified
Boston	Board of Directors	Monthly
	Executive Committee	Unspecified
Minneapolis	Board of Directors	Unspecified
	Executive Committee	Unspecified
San Francisco	Board of Directors	Unspecified
	Executive Committee	Unspecified