Stock returns over the FOMC cycle

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OUTLINE

Fact: *Since 1994 the US 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).

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

(4) 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.

(5) Information processing/decision making within the Fed tends to happen bi-weekly in FOMC cycle time.

Channels for how the information gets from the Federal Reserve to the market:

- Rule out the Federal Reserve signaling policy via open market operations post-1994
- 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
- Discussion of quiet policy communications and unintended information flows.

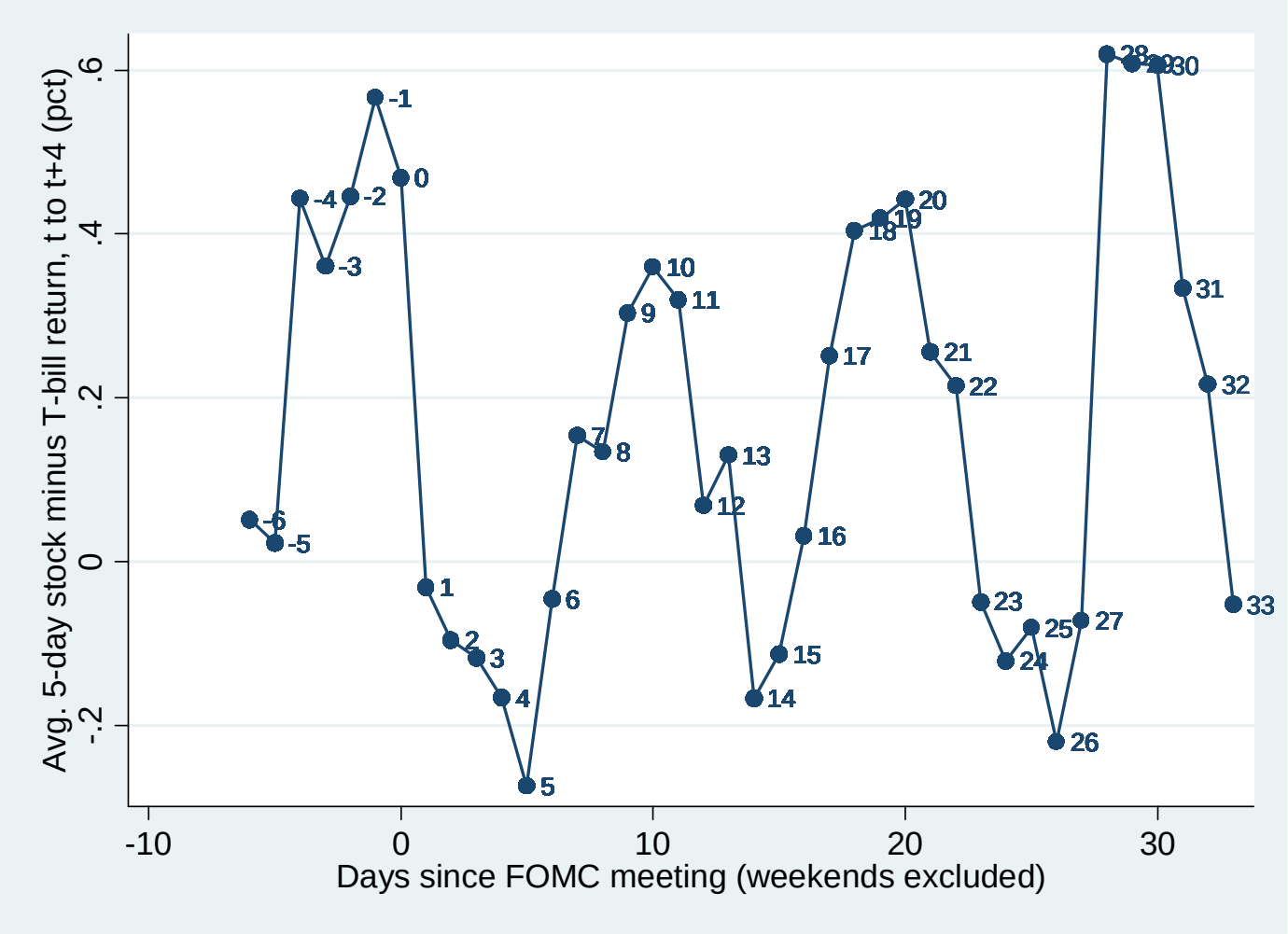
OUR NEW FACT:

Since 1994 the US equity premium follows an alternating weekly pattern measured in FOMC cycle time, i.e. in time since the last FOMC 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).

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

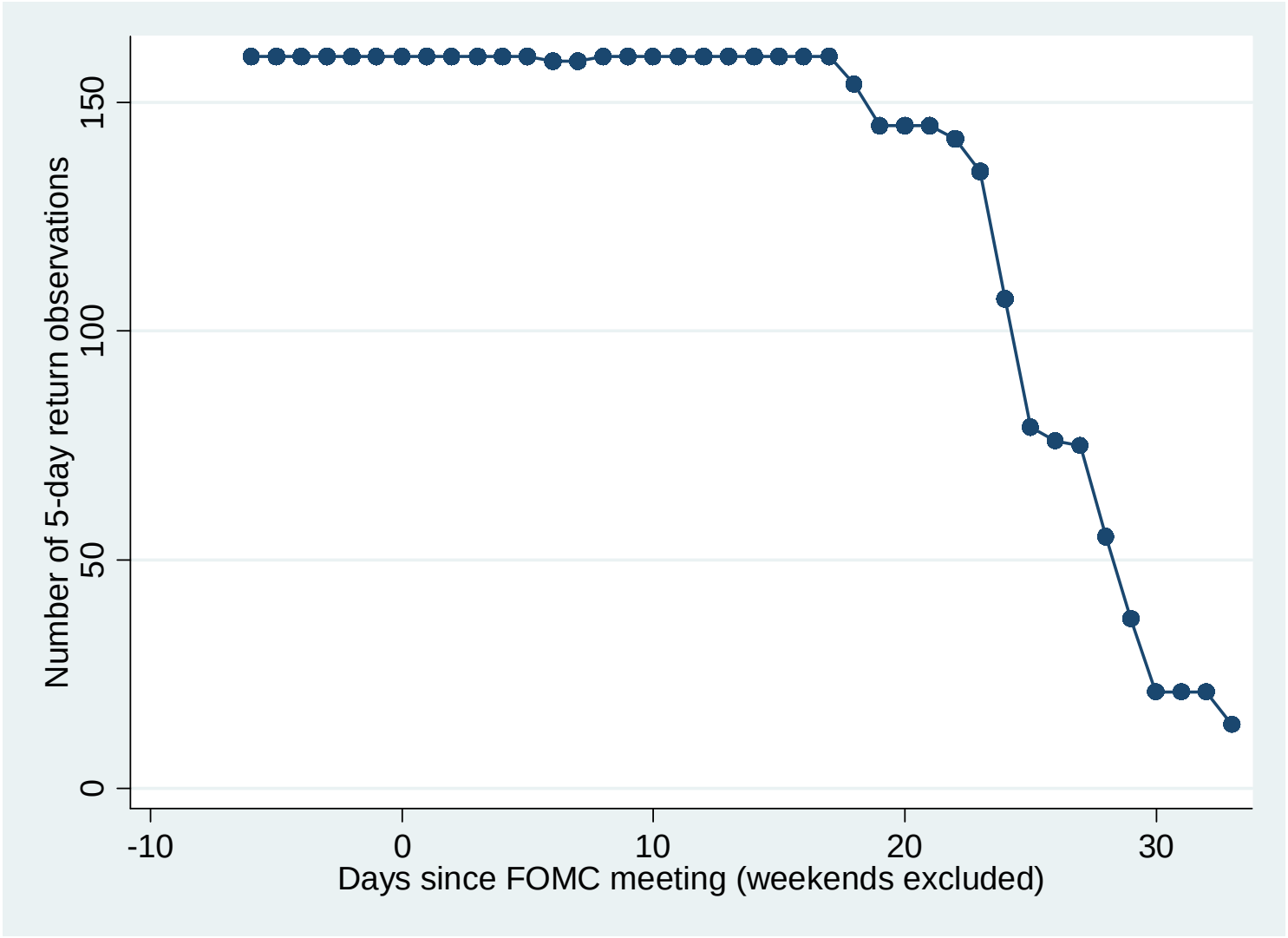
Panel A. Average 5-day stock return minus bill return over the FOMC cycle, percent



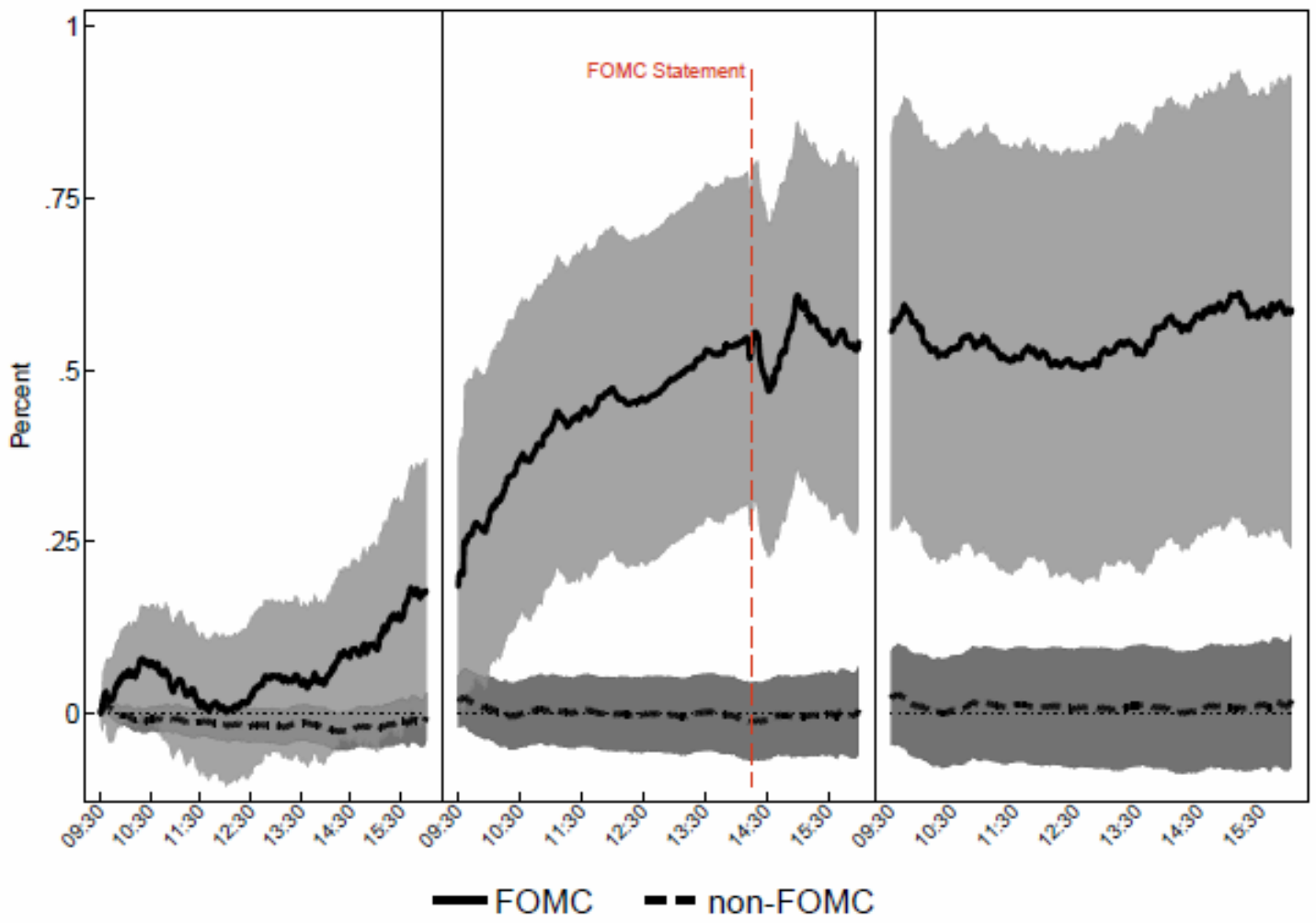
Based on 160 FOMC cycles (8 scheduled FOMC meetings per year). The numbers along the line indicate the value on the horizontal axis.

Note: 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

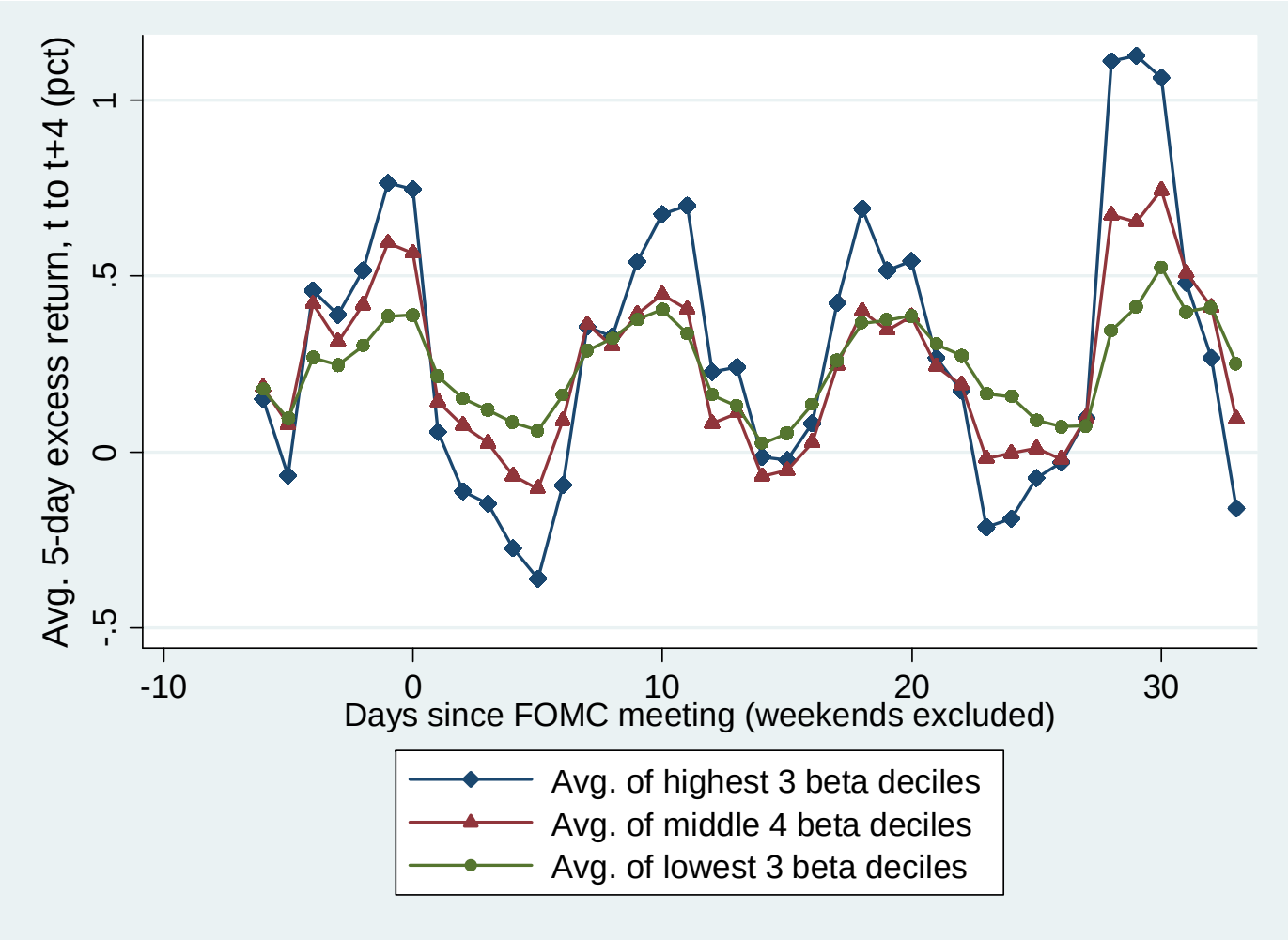


We got interested in the FOMC cycle because of Lucca and Moench's finding (JF, forthcoming): The stock market on average does well (50bps) the 24 hours from 2pm-2pm before the FOMC announcement



The new fact is even more dramatic for high-beta stocks:

Figure 2. Stock returns over the FOMC cycle, by beta category, 1994-2013



- Note how the CAPM seems to work during the high-return periods, but not at all during the low-return periods.

Each of the peaks are statistically significant:

Let day 0 in event time by the date of the FOMC announcement.
Week -1: Days -6,…,-2
Week 0: Days -1,…,3
Week 1: Days 4,…,8
Week 2: Days 9,…,13
Week 3: Days 14,…,18
Week 4: Days 19,…,23
Week 5: Days 24,…,28
Week 6: Days 29,…,33

Test whether:

- Average excess return in even weeks in FOMC cycle time is statistically different from that in odd weeks in FOMC cycle time
- Average excess return is significantly positive in even weeks but not odd weeks in FOMC cycle time
- The CAPM does significantly better in even weeks.

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.

- Average excess returns in each of the four even weeks in FOMC cycle time are sign. higher than average excess return in odd weeks at the 10 percent level or better.
- Equity premium is significantly positive only in even weeks.

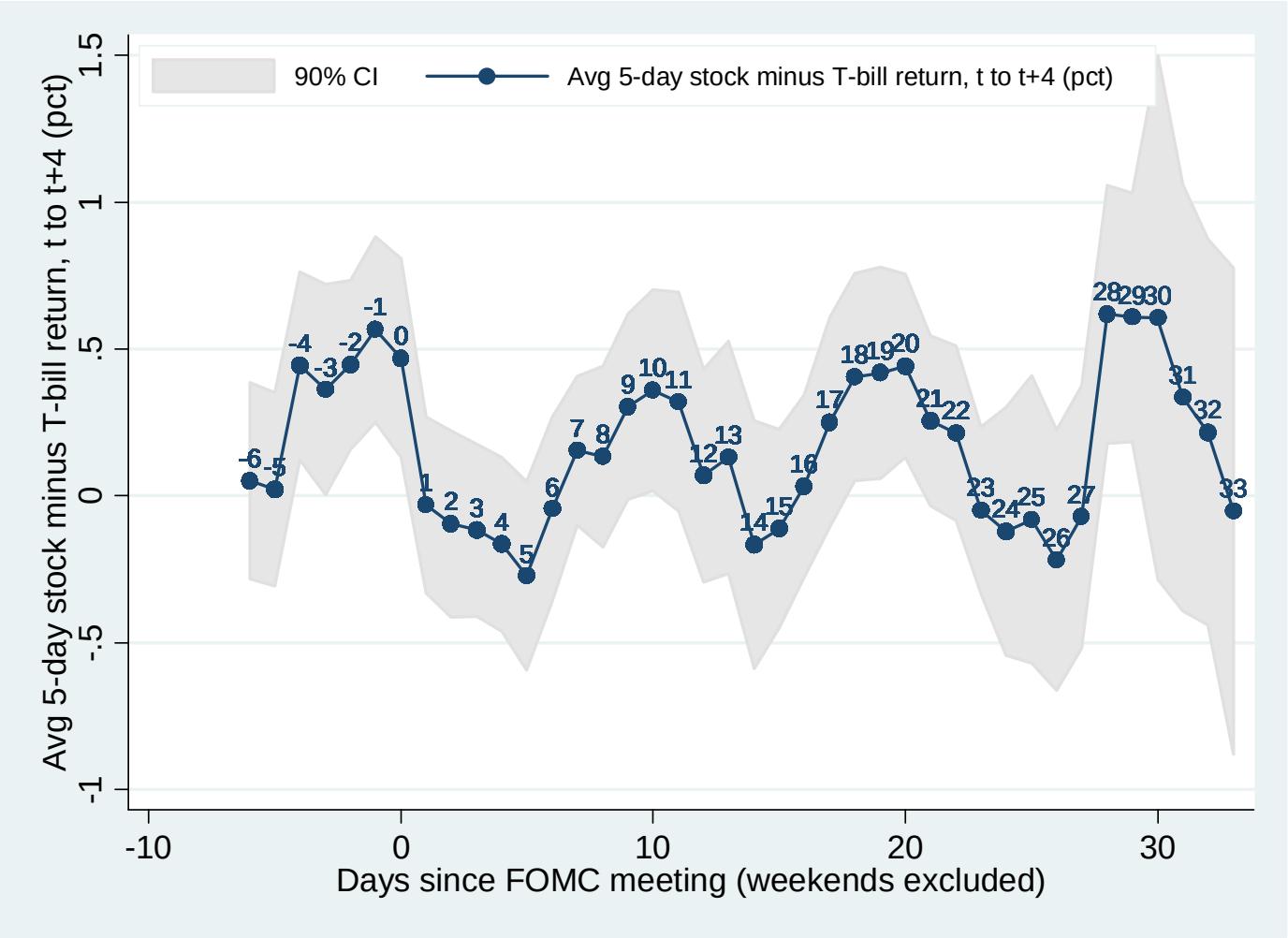
Panel B. Beta-sorted portfolios

	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

- Column (7): CAPM performance is poor in odd weeks where high-beta stocks significantly underperform low-beta stocks (intercept is negative and significant at 10 pct level). CAPM does better in even weeks (excess return on high over low beta stocks is significantly higher in even than odds weeks).

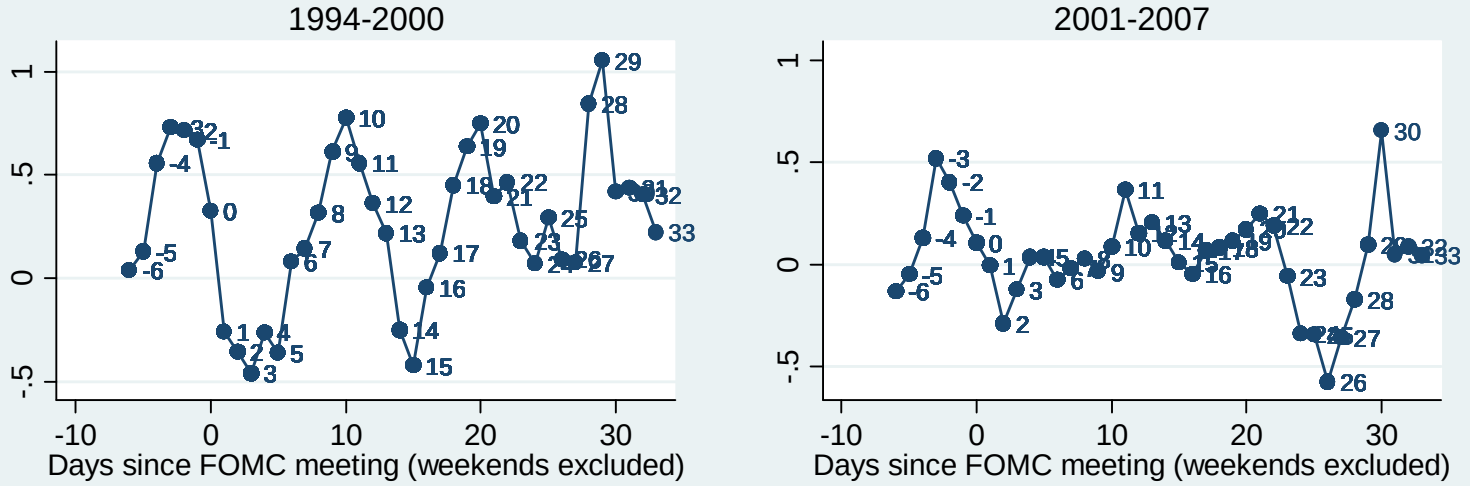
Our initial graph, with confidence intervals (bootstrapped):

Figure 1, Panel C. Average 5-day stock return minus bill return over the FOMC cycle, percent, with 90 percent bootstrapped confidence band



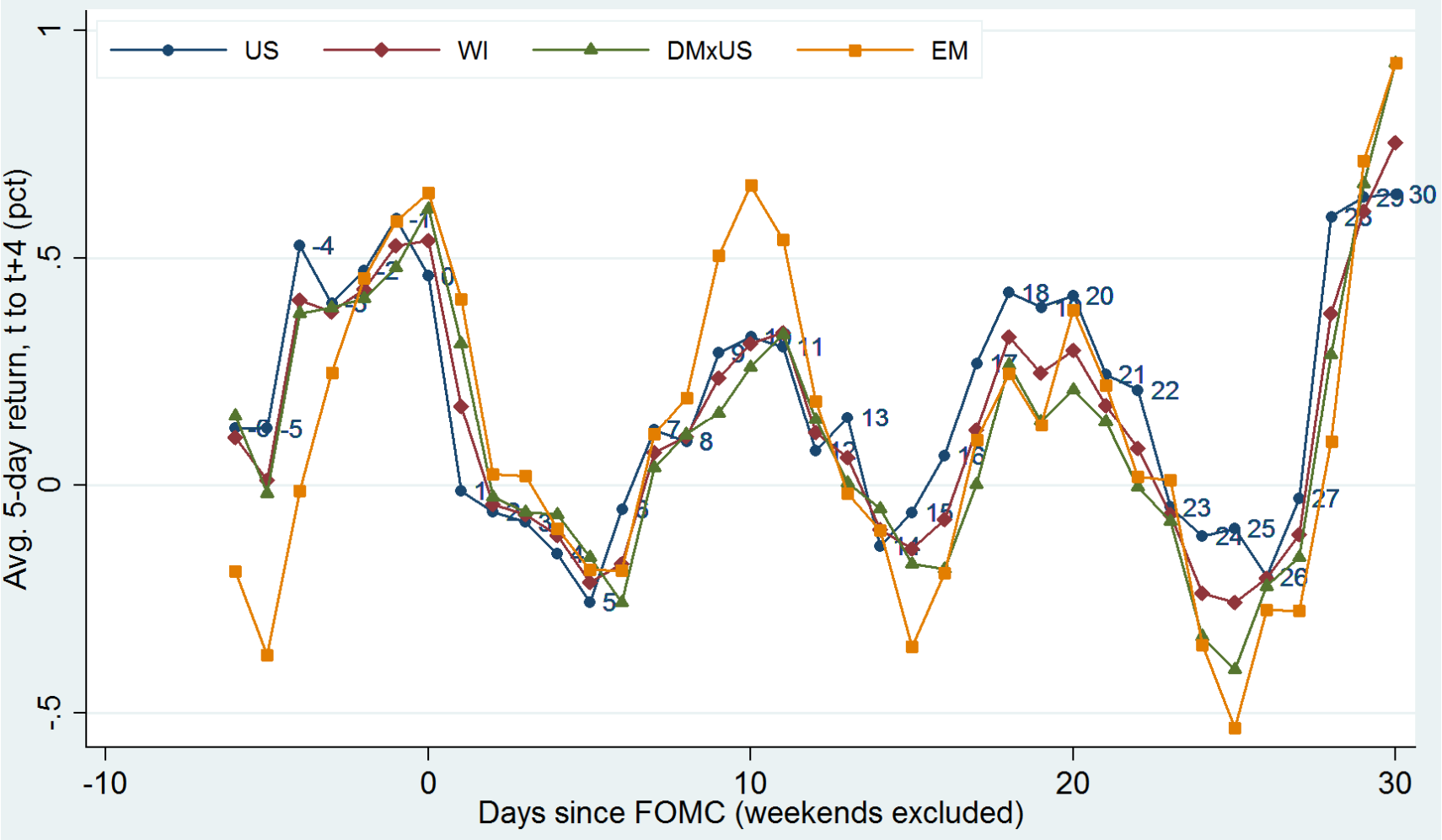
Sub-sample robustness, across three sub-periods of 1994-2013:

Figure 3. Stock returns over the FOMC cycle, by time period.
Average 5-day excess return, t to t+4 (percent)



International stock returns over the FOMC cycle: Same bi-weekly pattern!

Figure 1. International stock returns over the FOMC cycle, percent, 1994-2013



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

Table 2. International stock returns over the FOMC cycle
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 in parentheses. The dept. variable is the daily simple return to various MSCI equity indices (from Bloomberg), expressed in percent. To account for time zone differences, panels B reports returns realized on day t+1 relative to the dating of the FOMC cycle. Sample period is 1994:01-2013:12. Returns in columns (1)-(3) are in USD. Returns for individual countries are in local currency.

Economic significance: Trading strategies based on the FOMC cycle

Table 2. 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

EVIDENCE THAT THE NEW FACT IS DRIVEN BY NEWS COMING FROM THE FEDERAL RESERVE

The most likely explanation of the fact is that it's driven by news coming out of the Fed during the high-return weeks:

- We will not be able to distinguish whether the risk premium that results from this news is due to:
  1) The news being about monetary policy shocks and there being a risk premium for monetary policy uncertainty.
  2) The news being about the economy (monetary policy decisions reflecting macro news) and there being a risk premium for macro news.

- But we will, hopefully, be able to convince you that the news is likely to be coming from the Fed.

In the order of general to specific facts supporting this story.

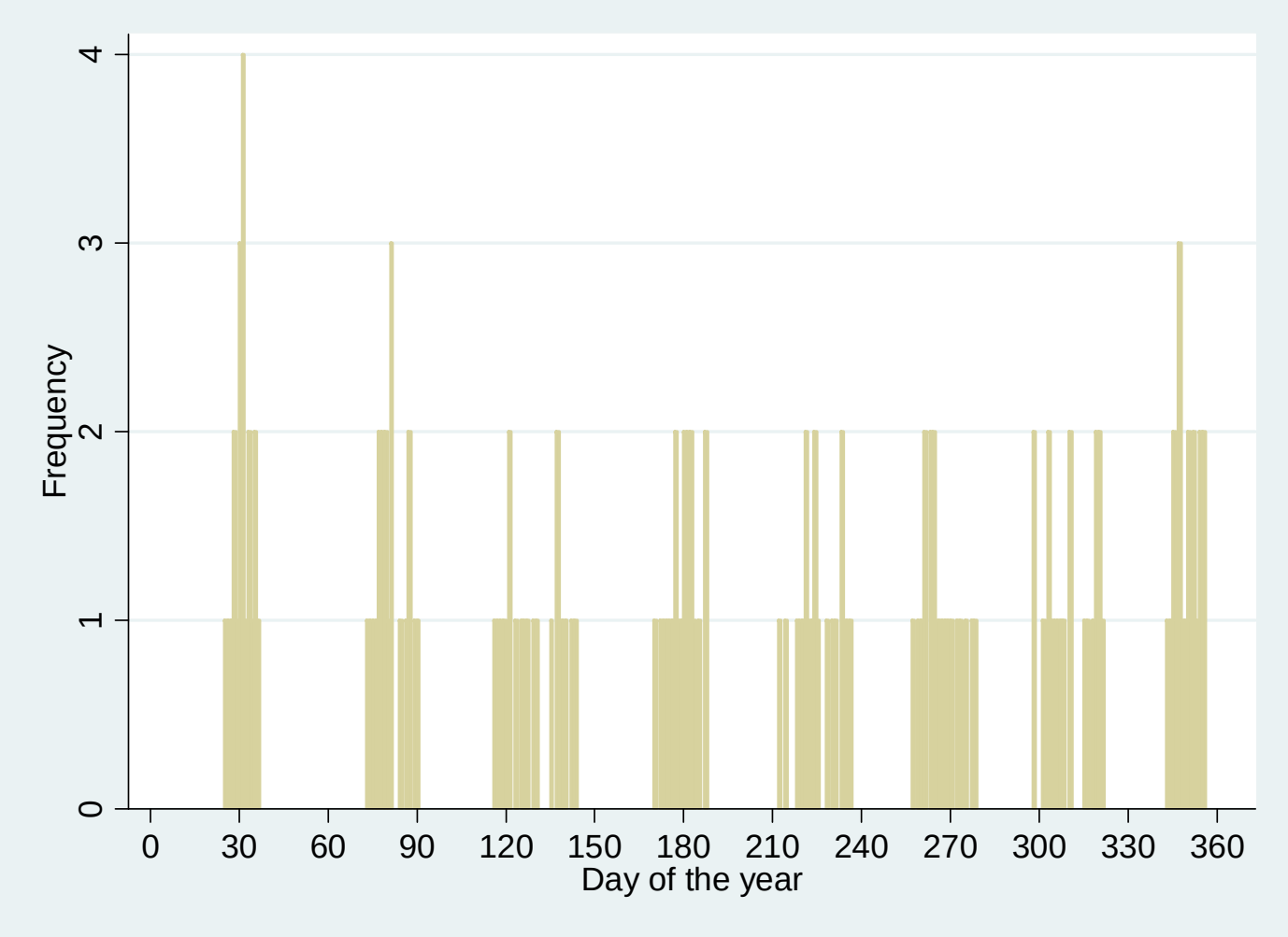
1) The FOMC calendar is quite irregular and changes across sub-periods over which our finding is robust

Since 1981, the FOMC meets at scheduled times 8 times per year. The schedule of meetings for a particular year is announced ahead of time.

The time between meetings varies across meetings and years. Schedule does not line up with any kind of bi-weekly timing in regular calendar time.

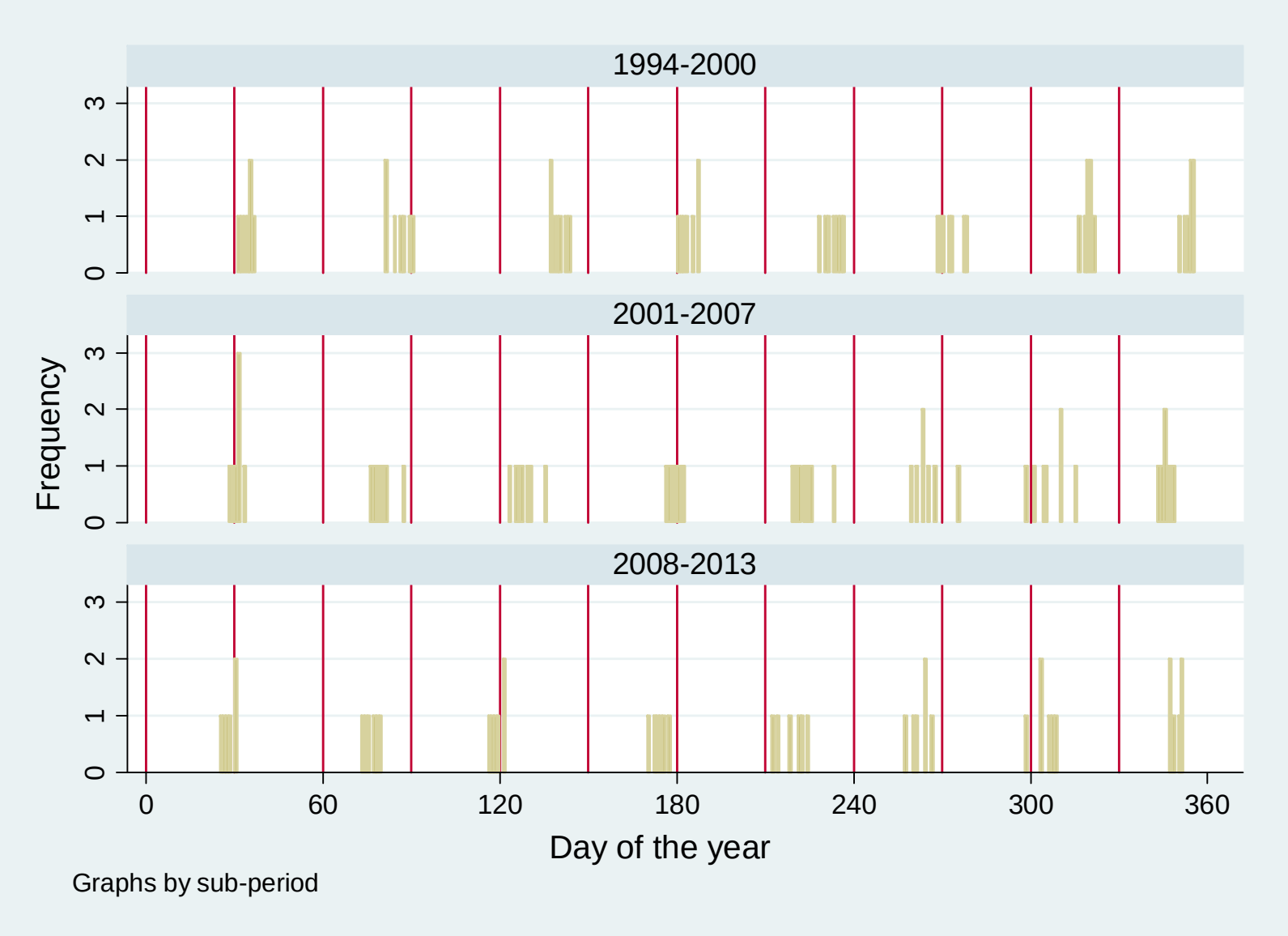
Figure 2. Timing of the eight FOMC meetings within the year

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.

2) Even weeks in FOMC cycle time do not line up with other macro releases

Data for all non-FOMC macro announcements in Bloomberg for Nov 1996-Dec 2013.

- 16,396 non-Fed macro releases. Number of releases per day ranges from 0 to 21 with an average of 3.7.
- Over 100 different types of macro data releases, with 91 types having at least 50 releases over the sample period.
- The data includes a "relevance" variable which is between 0 and 1 and measures how many Bloomberg users have set up ``alerts'' for that macro variable.
- There is a clear weekly pattern in FOMC cycle time, not a bi-weekly pattern.
- Controlling for the number of announcements doesn't change our regression results much (even if you de-trend the series), see Table 4 below.

For the 2pm-2pm pre-FOMC period, we also tried dropping all 5-minute windows with any macro announcement (including overnight returns in case of announcements before the open).

- This reduces the pre-FOMC effect (which is 50 bps) by about 15 bps, but also drops a bunch of minutes where macro news comes out but may not be the main driver of returns.

Figure 5. Number of macro announcements per day in FOMC cycle time, Bloomberg data 1996:11-2013:12.

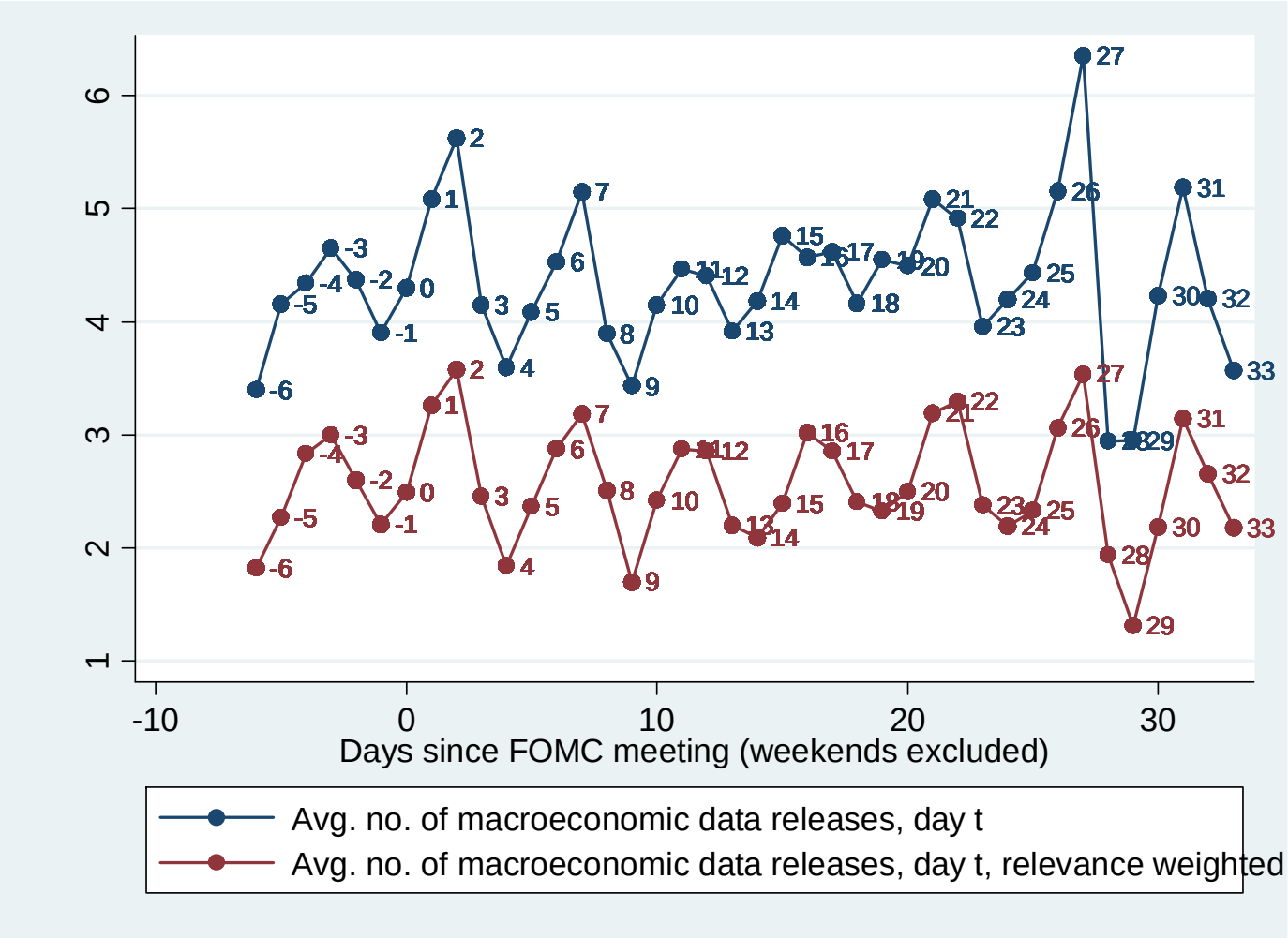


Table 4. Regressions of daily excess stock returns on FOMC cycle dummies with controls, 1994-2013

	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.

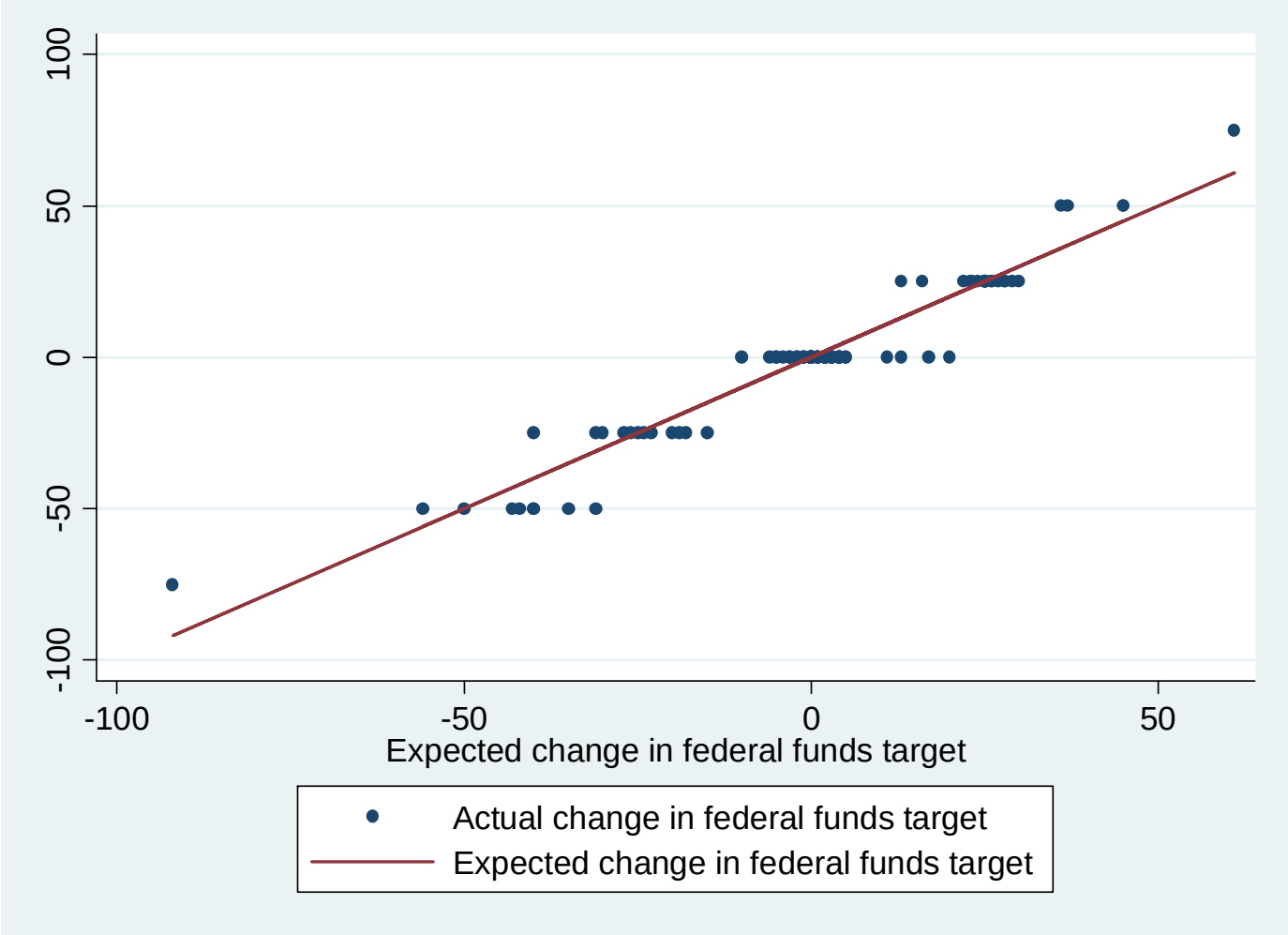
3) Well-documented that news about monetary policy mainly comes out in between meetings, not at the FOMC announcement

- It is well known that when the Fed changes the fed funds target, this is to a large extent expected by the day before. Let's review this.
- Using Kuttner data, 1994-2008, on expected fed fund target changes extracted from Fed funds futures (116 FOMC meetings):

Table 3. 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

Figure 3. Expected and actual changes in federal funds target rate, 1994-2008:06



Note: The line is the 45 degree line.

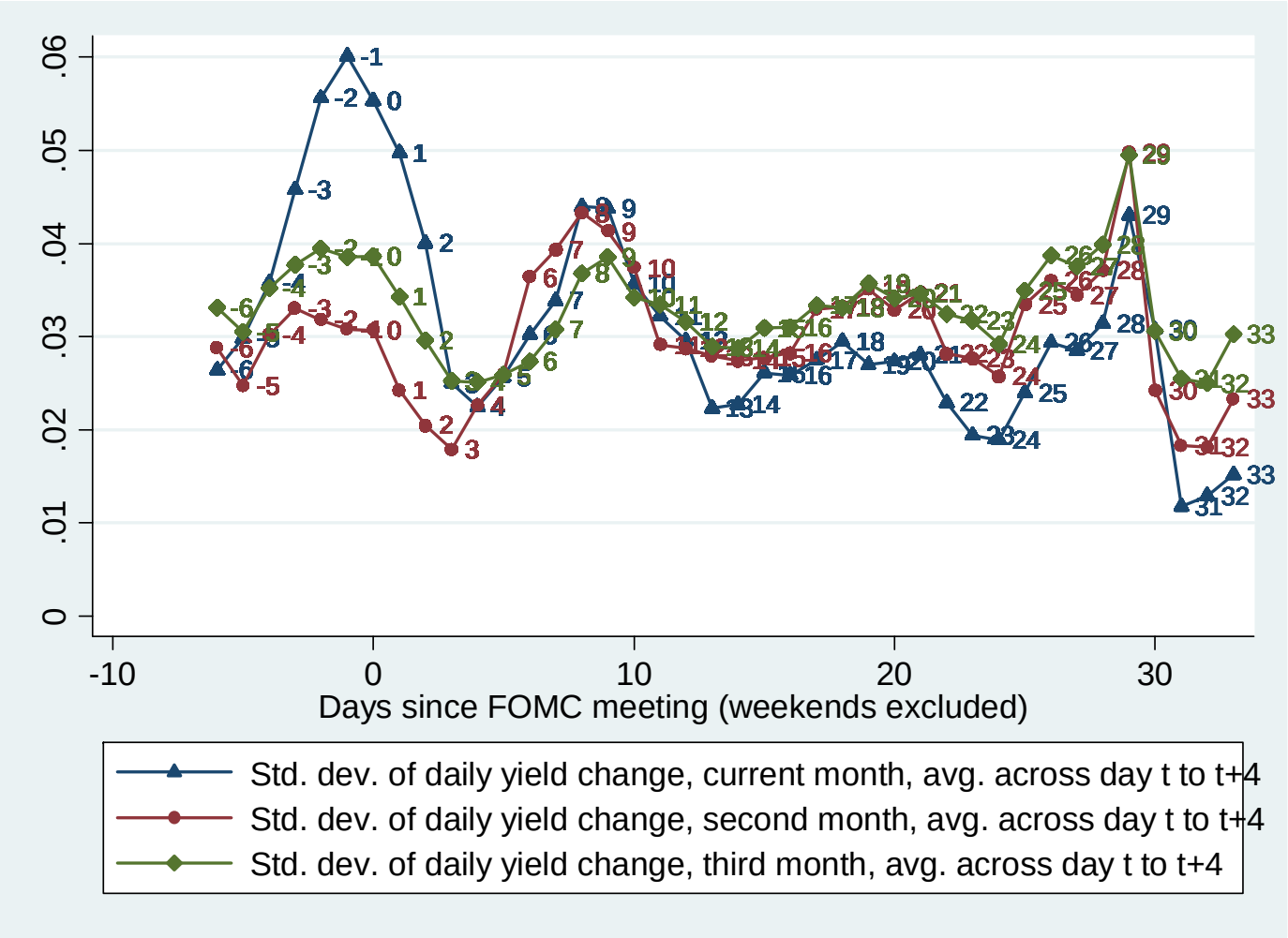
- Regressing actual change in federal funds target on expected value of this change: Regression coefficient=1.02, t-statistic=41, R^2=0.94
  (for clarity the graph does not include the regression line).

4) 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

- Consider the first federal funds futures contract which is based on the average effective federal funds rate for the current calendar month.
- Next FOMC meeting may not fall in current calendar month and news about monetary policy may be about not only the current meeting but also the next one (or later) → Also consider the second and third federal fund futures contracts.

- For each day in FOMC cycle time, calculate the yield change for a given futures contract as the change from day t-1 to t.
- Then calculate standard deviation of all available yield changes for that day in FOMC cycle time (so for day 0, for example, calculate std. dev. across 160 obs. of daily yield changes from day -1 to 0).
- Average these standard deviations across day t up to t+4 in FOMC cycle time.

Figure 4. 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

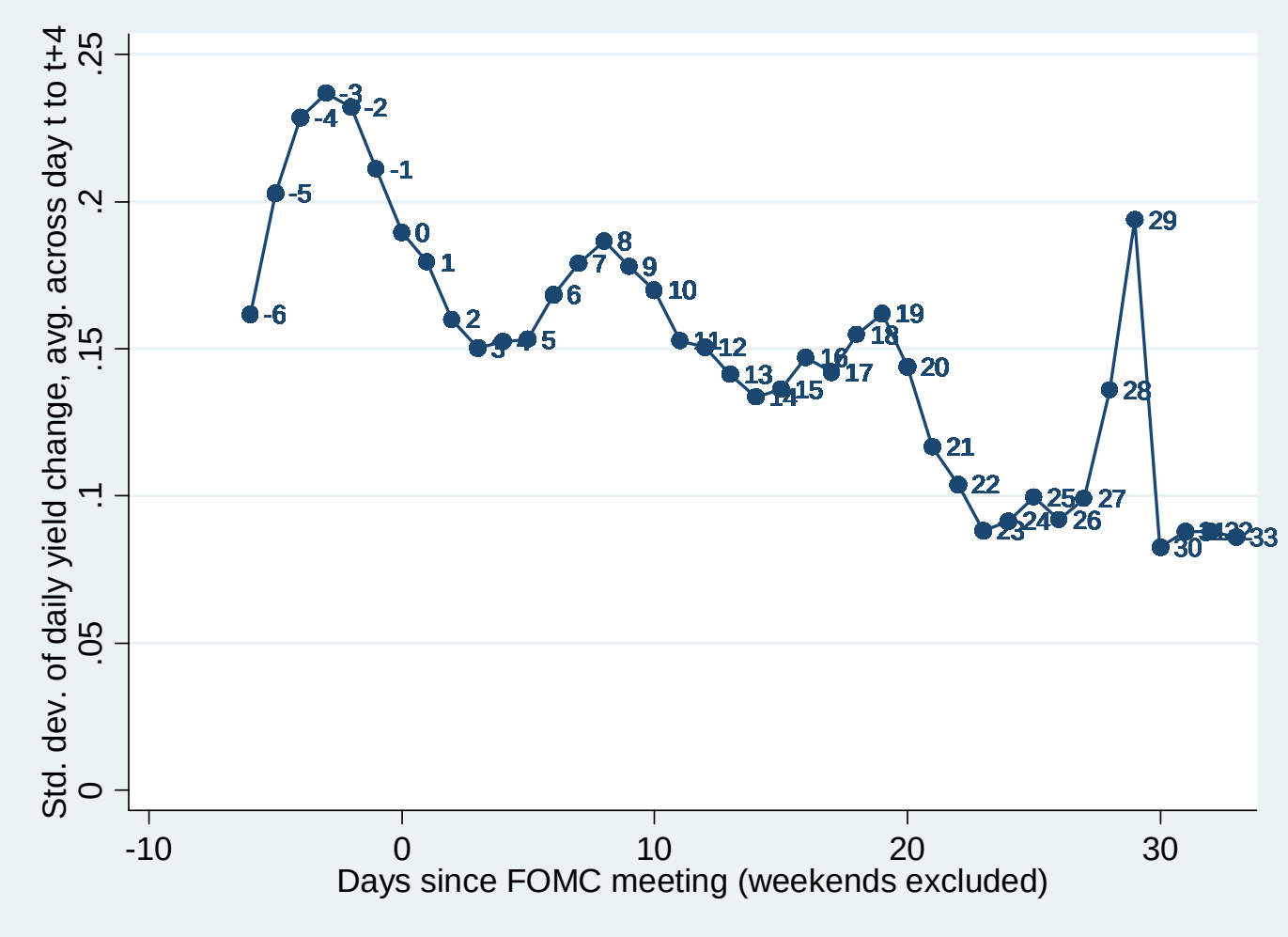


- Clear peaks in fed funds futures yield volatility in the even weeks in FOMC cycle time with volatility roughly twice as high in even as in odd weeks.

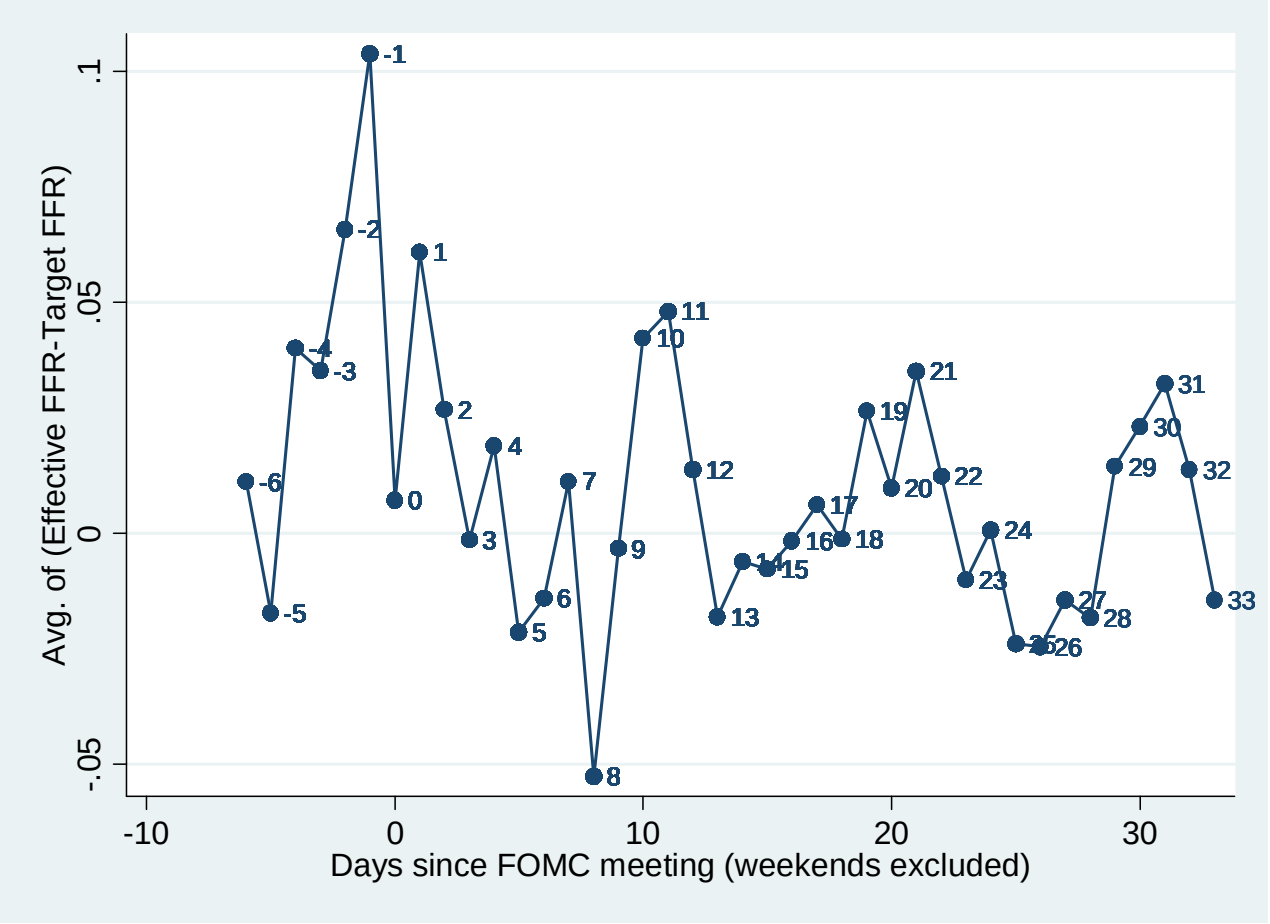
Changes in expected monetary policy may be reflected not only in futures contracts but also in the daily effective federal funds rate.

- Will be the case if financial institutions adjust their demand for federal funds as they get news about the future federal funds rate
- And the Fed's open markets desk does not fully adjust its open markets operations to keep the effective funds rate equal to the current target rate.

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



Extra graph: Average of Effective FFR-Target FFR over the cycle (this is about means, not about risk but if the effective rate was always at the target there could be no standard deviation between meetings):



To ensure that these volatility peaks in effective fed funds rate 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.

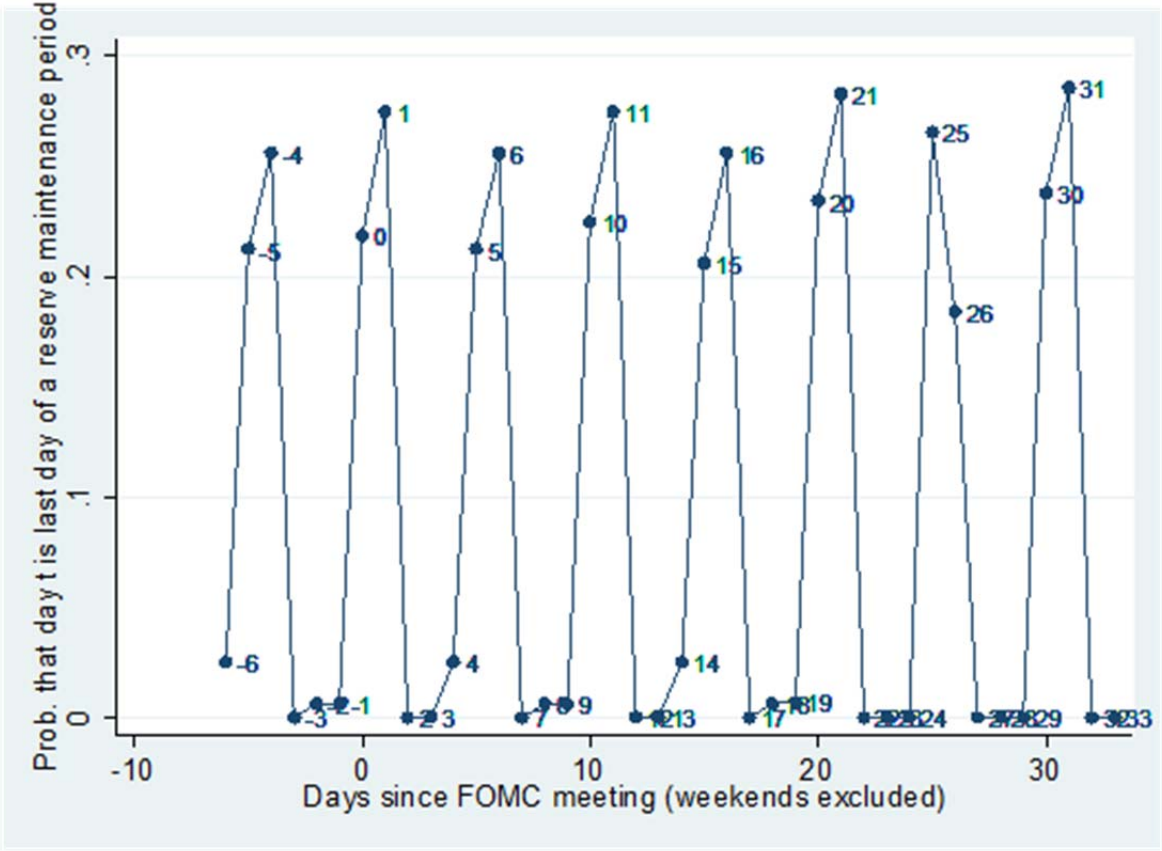
- The two main determinants documented in the literature are the reserve maintenance period and high payment flow days.

Ends of reserve maintenance periods:

- Reserve maintenance periods in the US are two weeks long.
- Over a given RMP, banks have to hold an average amount of reserves which (since 1998) is known at the start of the RMP, calculated based on an earlier computation period.
- They also often hold excess reserves, historically for transactions purposes (to avoid overdrafts), recently because of QE (and interest on reserves).
- Fed funds rate volatility tends to be higher on the last day of an RMP (Hamilton 1996).
- BUT: RMPs are in calendar time, with no exceptions around holidays.

Because they are in calendar time and the Fed calendar is not, the prob. that a given day in FOMC cycle time is the last day of an RMP has a weekly pattern, not bi-weekly, and controlling for day-of-the-RMP dummies doesn't affect our results (Figure 9 below, Table 4 above).

Figure 5. Probability that a given day in FOMC cycle time is the end of a reserve maintenance period, 1994-2013



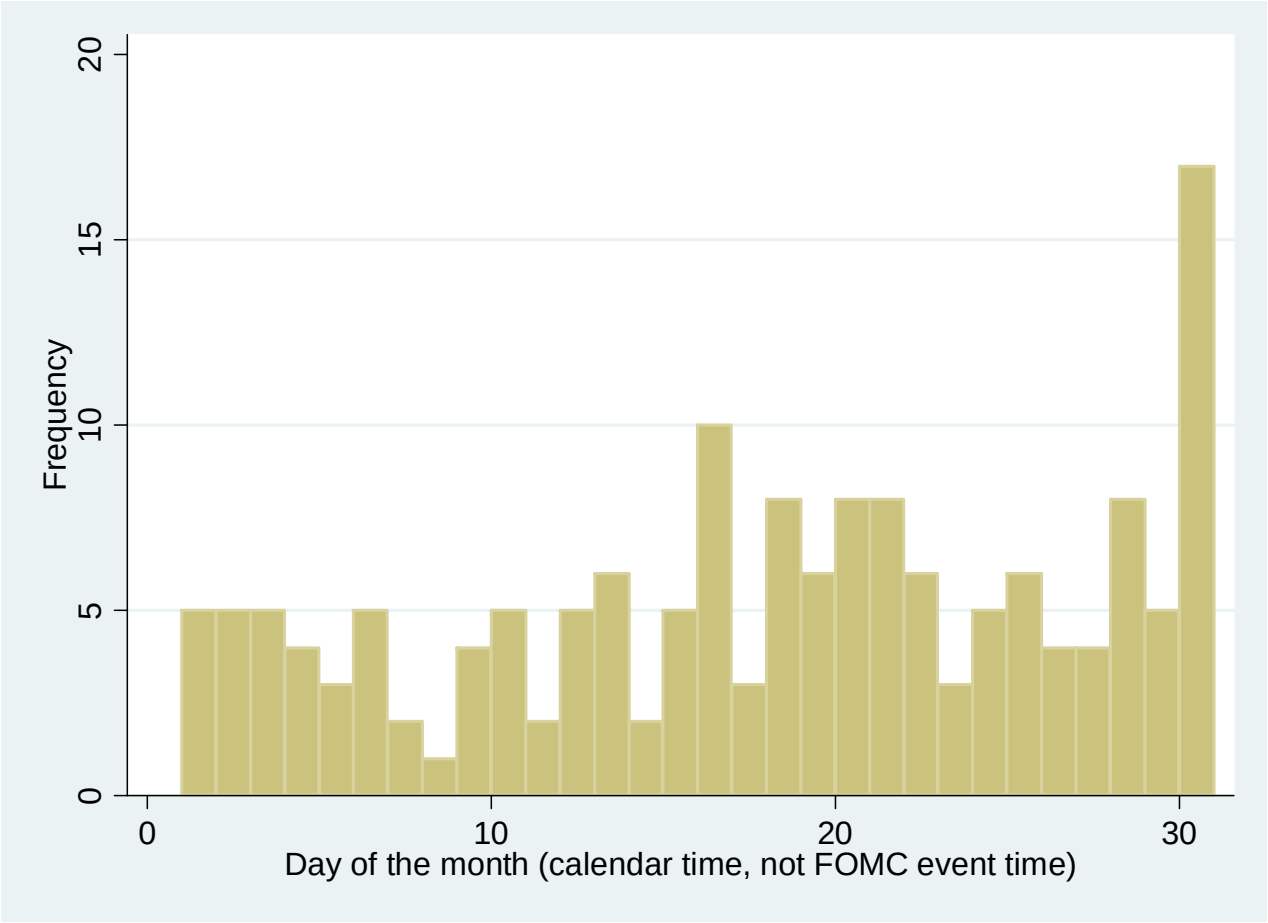
High payment flow days:

From Judson and Klee (2009): ``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 days with high payment flows 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.
- We add the 25th of the month following Judson and Klee (2009).
  - There are more FOMC meetings at the end of the month and a bit after the middle (Figure 10).
  - But controlling for a dummy for a given day being a high payment flow day doesn't affect our results (Table 4 above).

Figure 6. Histogram of which day of the month (in calendar time) FOMC announcements are made, 1994-2013



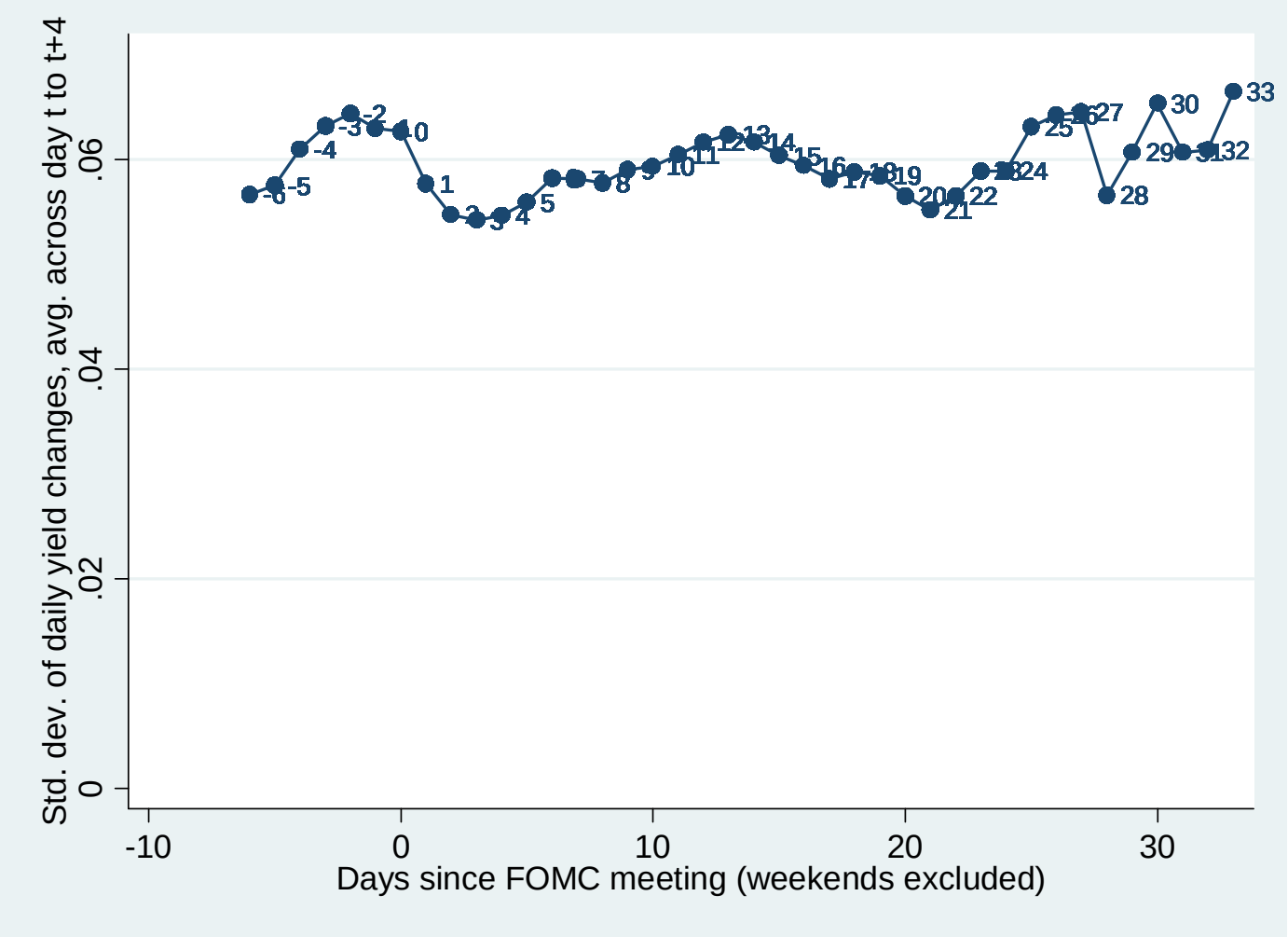
To support the argument that news originate from monetary policy we show that, in general, volatility in assets markets is not elevated in even weeks in FOMC cycle time.

- 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.

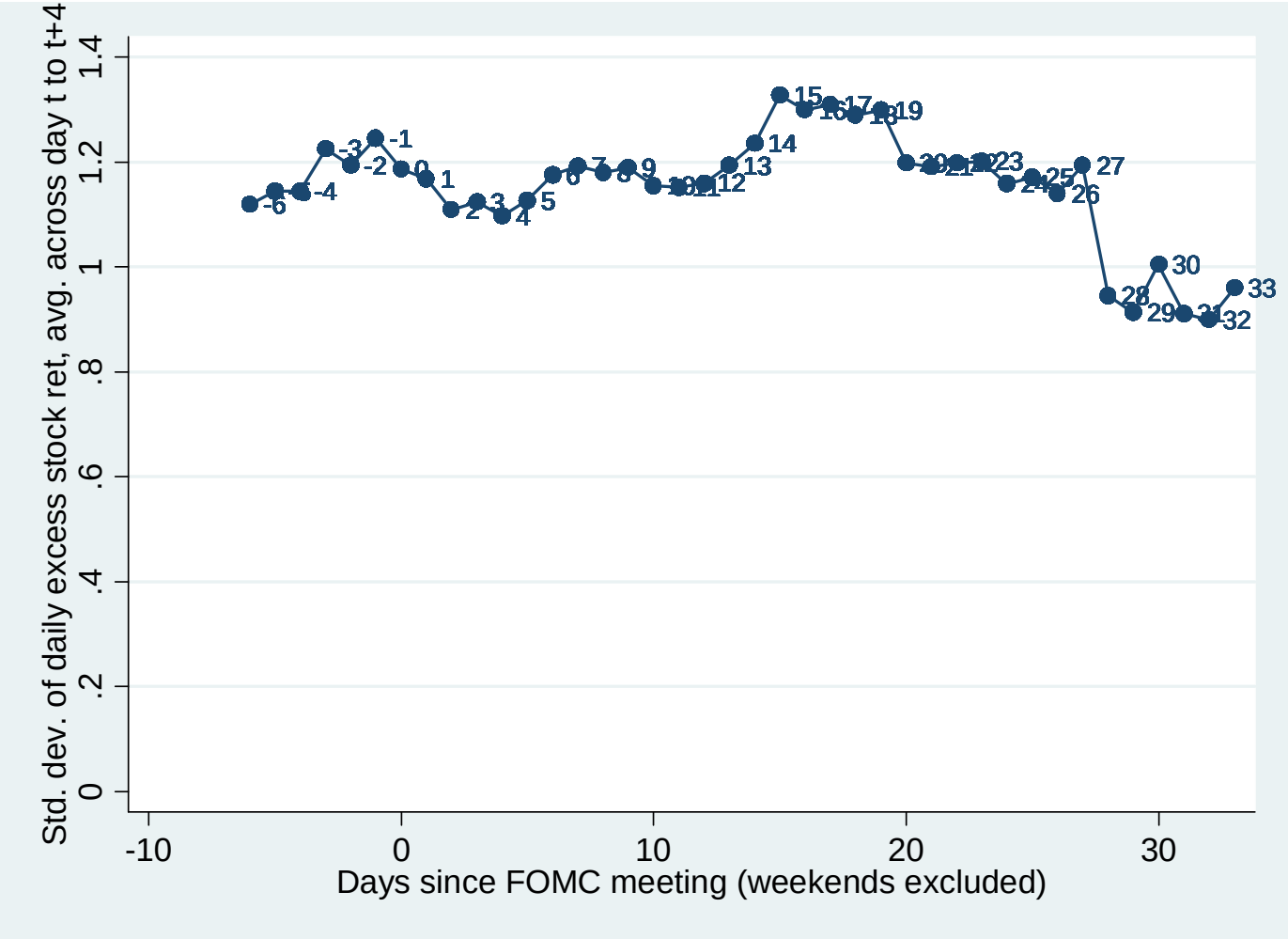
- So it is not so much the total volatility that moves over the FOMC cycle as the amount of volatility coming from news that drive federal fund futures and effective federal funds rates.

- Monetary policy news (or macro news being revealed via monetary policy news) is the obvious candidate.

Figure 7. 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



5) Information processing/decision making within the Fed tends to happen bi-weekly in FOMC cycle time.

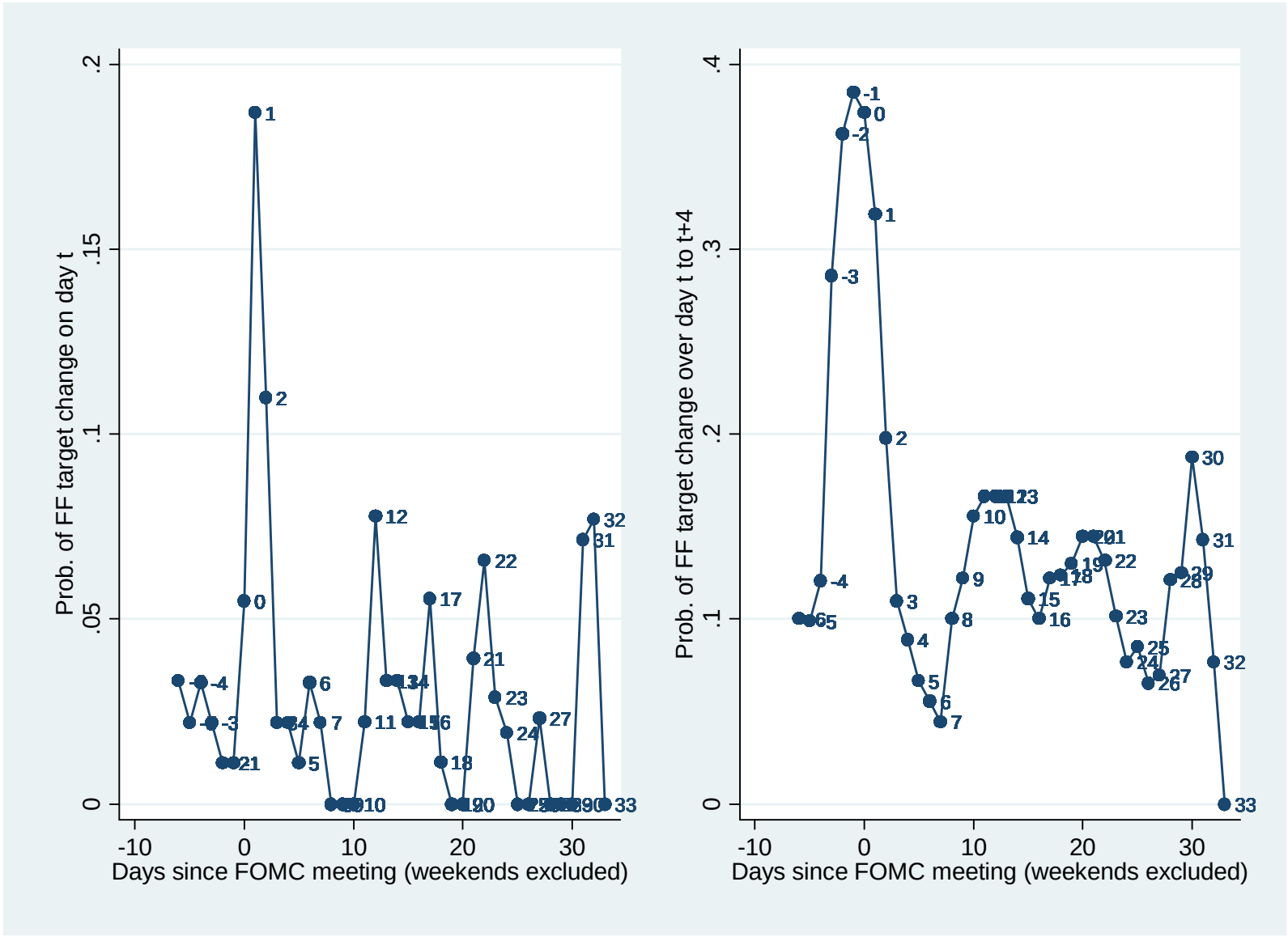
a) Federal funds target changes before 1994 tend to be bi-weekly in FOMC cycle time

Since 1994, Fed has mainly changed federal funds target at scheduled FOMC meetings: Only 7 of 60 changes over 1994-2013 were between meetings.

This differs from pre-1994 period when it was more common to change target in between meetings than at the meetings:

- From 1982:09 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.
- So for pre-1994 period can use target change dates to learn about when information processing/decision making happens within the Fed.

Figure 12. Probability of an inter-meeting federal funds target change, 1981-1993



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

- The discount rate (called the primary credit rate since 2003) 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.

- Each regional fed's board/executive committee meet to decide on discount rate recommendations. Under the Federal Reserve Act of 1913, this happens at least every 2 weeks (in calendar time).

Federal Reserve Act; Section 14: Open-Market Operations

Every Federal reserve bank shall have power:
(…)
To establish from time to time, subject to review and determination of the Board of Governors of the Federal Reserve System, rates of discount to be charged by the Federal reserve bank for each class of paper, which shall be fixed with a view of accommodating commerce and business; but each such bank shall establish such rates every fourteen days, or oftener if deemed necessary by the Board;
[12 USC 357. As amended by acts of April 13, 1920 (41 Stat. 550); March 4, 1923 (42 Stat. 1480); Aug. 23, 1935 (49 Stat. 706).]

- The discount rate itself is not that important (pre-crisis borrowing was typically less than $1B).

- Instead, the discount rate recommendations from the regional feds serve as a way for the regional feds to express their policy views regarding the fed funds target.

    - Larry Meyer (2004): "While the Reserve Bank presidents are not part of the premeeting discussions at the Board, they have their own devices for influencing the policy discussion in between meetings. They do this specifically through requests to change the discount rate."

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

- 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.

- 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.

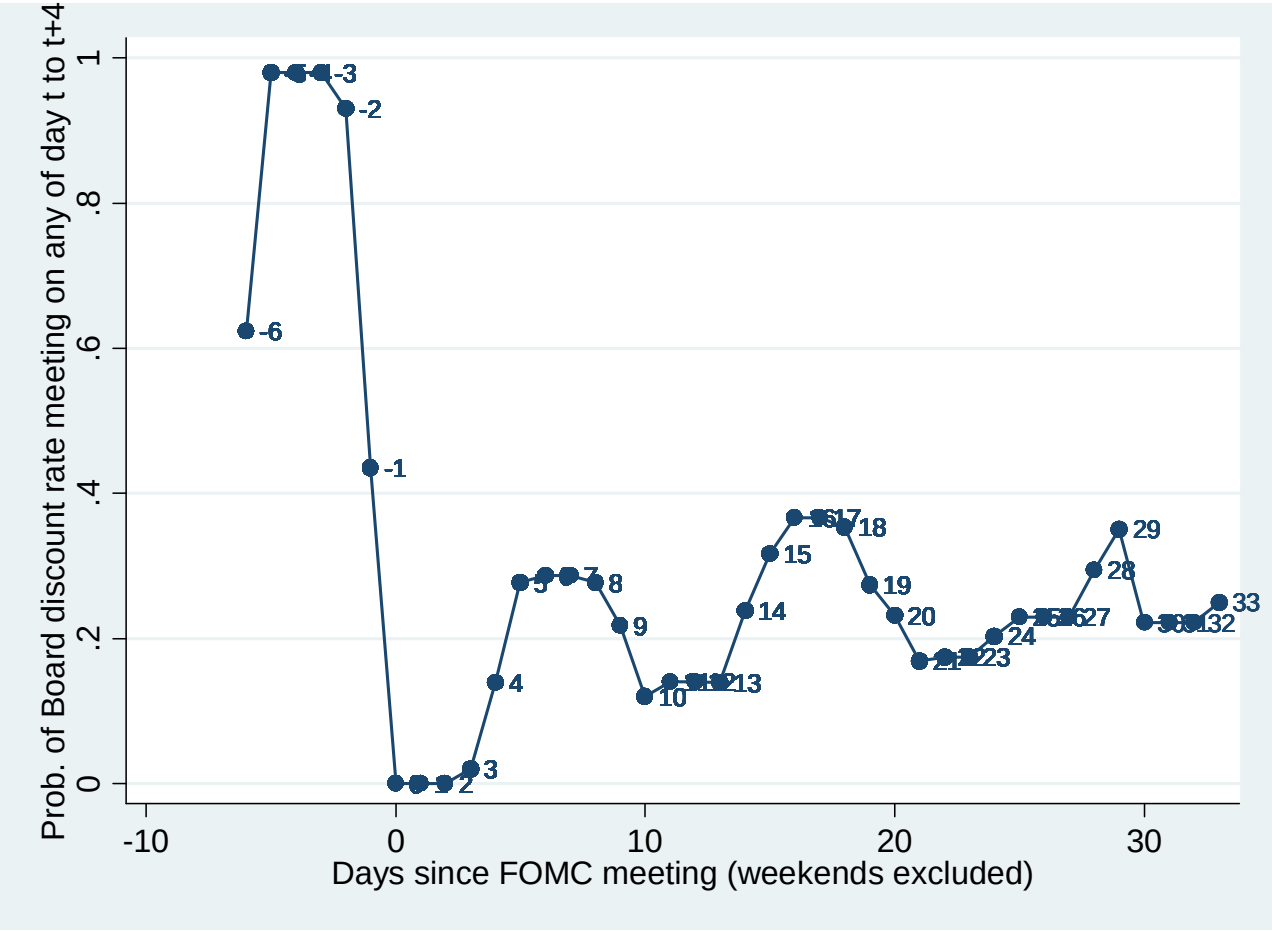
- Disproportionately take place in the even weeks in FOMC cycle time.

    - There is always a discount rate meeting within a few days of a scheduled FOMC meeting.

    - 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.

Figure 8. 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.

- Although these Fed Board meetings are referred to as discount rate meetings, they involve a lot more than discussions of regional fed views.

- In particular, they involve briefings by Fed staff. There are no transcripts but this is clear from Axilrod (2009) who state that the staff makes presentations about the latest economic and financial developments.

- 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.

- Many papers in the literature document that information about the regional feds policy views and economic updates from Federal Reserve staff would be would be relevant for asset prices 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. For example:

  Tootell (2000):

  - 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):

  - 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).
  - The average discount rate change request has predictive power for one- and two-month ahead changes in the federal funds 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. 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):

- Similar conclusions as Romer and Romer's pertain to the Fed staff forecasts of future output and the future path of the federal funds rate.

Peek, Rosengren and Tootell (1999, 2003):

- Bank supervision duties of the Fed lead to valuable information. Confidential bank information (CAMEL ratings) could be used to improve upon both private sector and Greenbook forecasts of inflation and unemployment rates.

- Important caveat: 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 did a FOIA request for discount rate minutes for 1994:01-2001:05).

  - Were some of the weekly meetings “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.

POSSIBLE MECHANISMS FOR HOW INFORMATION GETS FROM THE FEDERAL RESERVE TO ASSET MARKETS

a) Signaling via open market operations? No.

- 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? No: Line up with week 4 in FOMC cycle time, but not week 0, 2, 6.

FOMC statement: Doesn't explain high week 0 returns.

- Released publicly just after FOMC meeting, typically around 2.15pm.
- But as shown by Lucca and Moench (2013) the return in week 0 in FOMC cycle time is earned prior to the FOMC statement.

Beigebook:

- Summarizes economic conditions across the 12 regional fed districts.
- Made public 2 weeks *prior* to each scheduled FOMC meeting.

Minutes of FOMC meetings:

- Before Dec 2004, released on avg. 47 days after meeting (i.e. after next FOMC meeting). Since Dec 2004 released on average 21 days after the meeting.

Minutes of Board of Governors discount rate meetings:

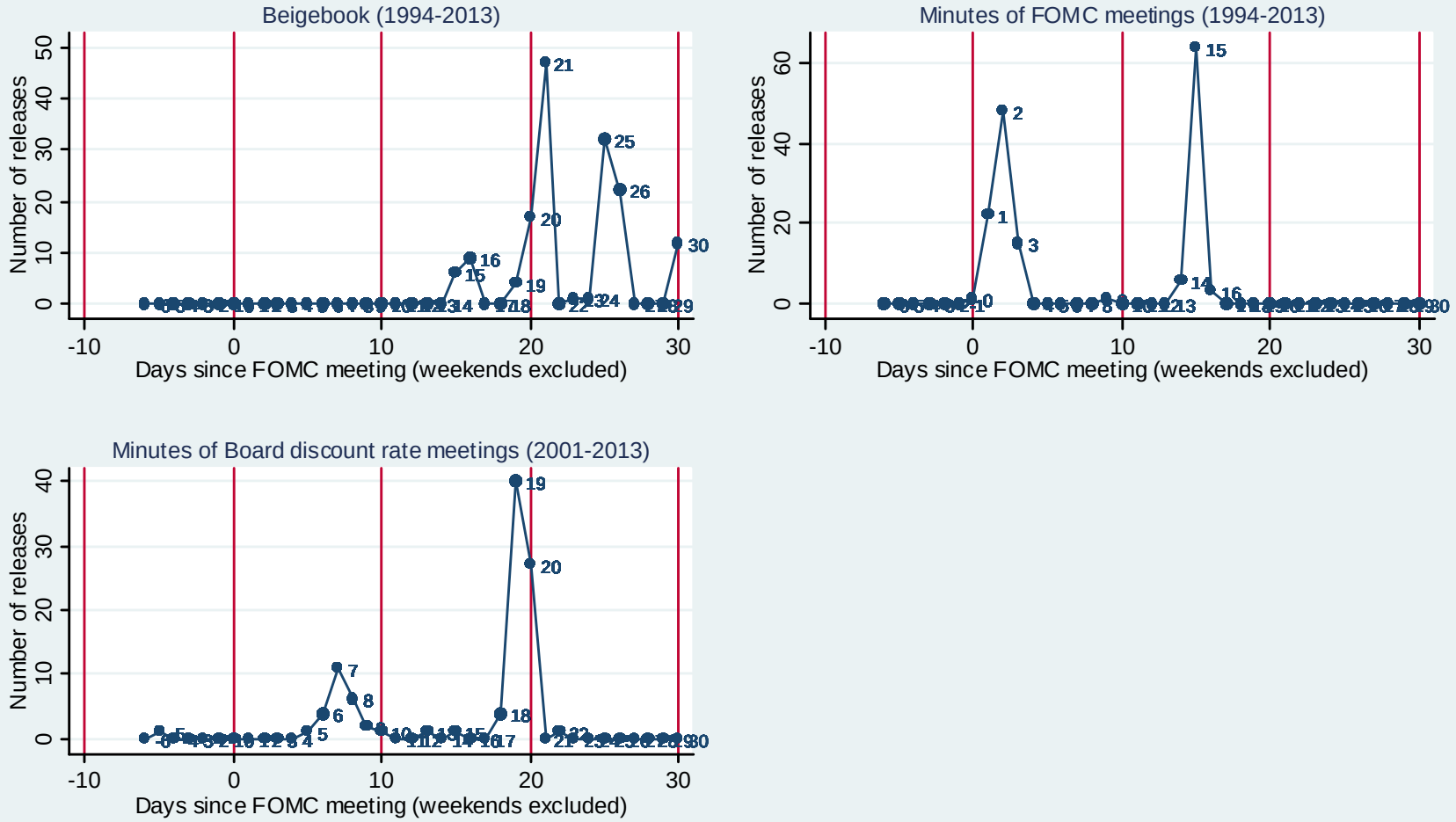
- Released in bunches 8 times per year, around 4 weeks after the FOMC meeting.

Green/Blue/Teal books and FOMC transcripts: Not public until 5 years later.

- Released within Fed a few days before FOMC meeting, more shortly.

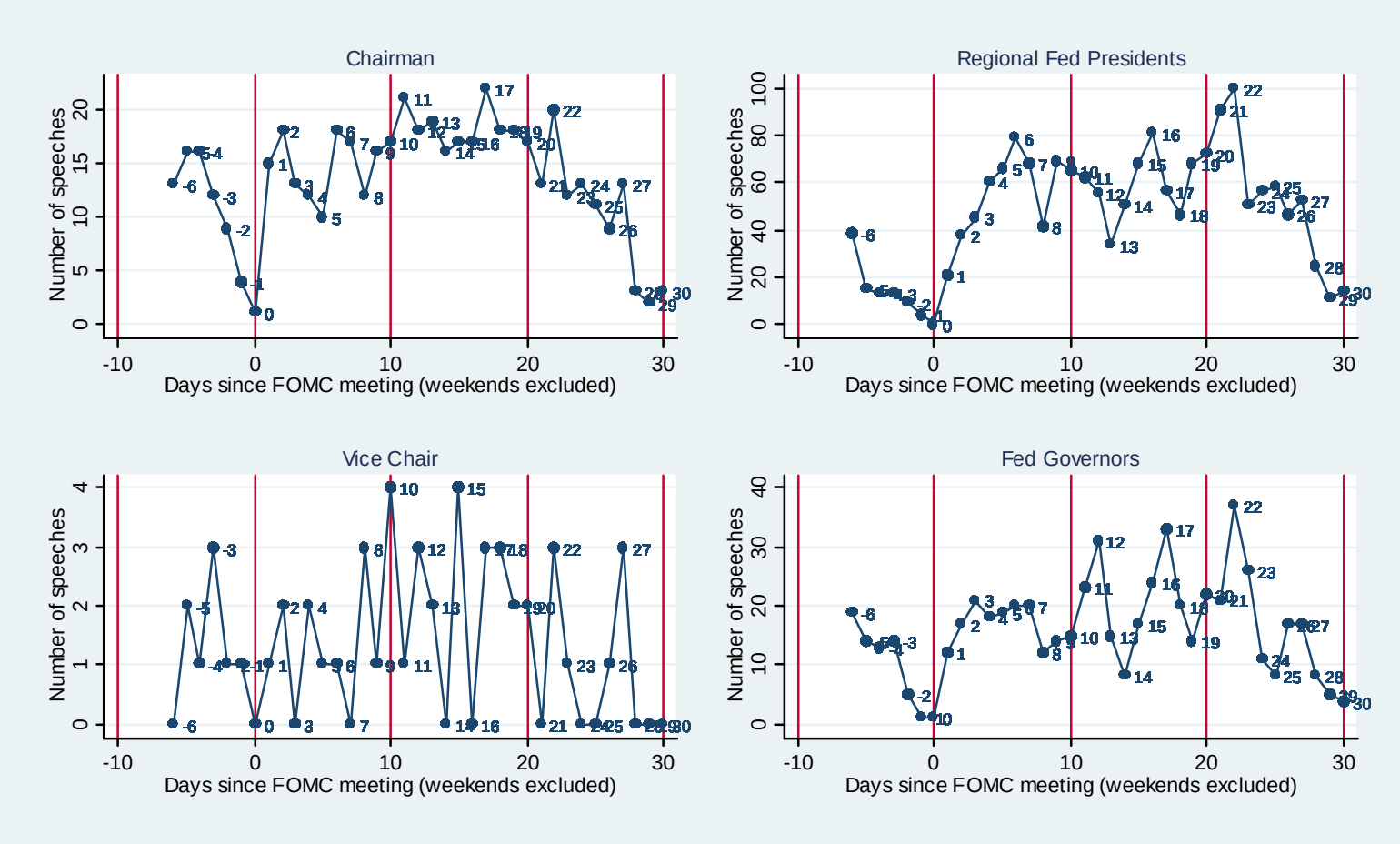
Figure 9. Releases of Federal Reserve documents over the FOMC cycle

Panel A. Public releases



- Beigebook and DR minutes line up with week 4 in FOMC cycle time.
- FOMC minutes don't line up with even week returns (remember that week 0 return is earned before the announcement on day 0).

Figure 10. 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. Data collected from Federal Reserve Board website and from websites of regional Feds.

- Peak in speech frequency of regional Fed pres's in week 4 in FOMC cycle time.

c) "Subtle" communication and unintended communication by the Fed

Might the Fed want to get information out as part of optimal policy?

- Long literature on the optimal amount of central bank communication. Survey by Blinder, Ehrmann, Fratzscher, de Haan and Jansen (2008).
- Communication guides market expectations about interest rates and inflation and for reduces uncertainty about policy rule.

Greenspan is known for his objections to full public disclosure and a preference for having flexibility in terms of policy and disclosure:

- Public disclosure is sometimes undesirable due to the risk of overreaction of market prices
- Public disclosure induces risk that the Fed's decision making would be less conditional due to the market's inability to fully understand contingencies in policy statements.

Greenspan letter of September 23, 1991, to 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:

- Prior to February 1994, the market had to infer policy changes from open market operations and from any "subtle" communication by the Fed.
- As part of Congressional hearings in 1993 (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)).
- 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.

Observation: 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.

- Perhaps Fed has had a continued preference for "making changes either quite publicly or more subtly, as conditions warrant"
- Given that target changes are now immediately public it has therefore has reduced its use of intermeeting changes of the fed funds target.

What direct evidence is there for continued use of subtle communication?

- Appendix B, Part 1 list twelve *samples* of "subtle" information coming from Fed.
- Except for the first item, these articles 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.

Item number 7 is a David Wessel article from 12/18/2000 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.*

More directly, Larry Meyer discusses the Fed's "signal corps":

"The use of reporters as part of the Fed's signal corps is not official Board or FOMC doctrine. The public affairs staff and the Chairman like to pretend it doesn't happen. I expect that the Chairman generally expects reporters to read between the lines or somehow sense the signal in his body language. He generally relies on a small group of reporters for this purpose. John Berry, longtime reporter for *The Washington Post* and now at Bloomberg is the more widely recognized in this role. But *The Wall Street Journal* reporter covering the Fed – it was David Wessel, then Jake Schlesinger, and most recently Greg Ip during my term – was also a regular member of the signal corp."

Meyer (2004), page 98

``I was surprised, then, one Monday before an FOMC meeting, to pass John Berry coming out of the Chairman's office.''

Meyer (2004), page 99

Beyond intentional releases of information: Private parties on occasion obtain insights from the information aggregation process inside the Fed. Some examples (from Appendix B part 2):

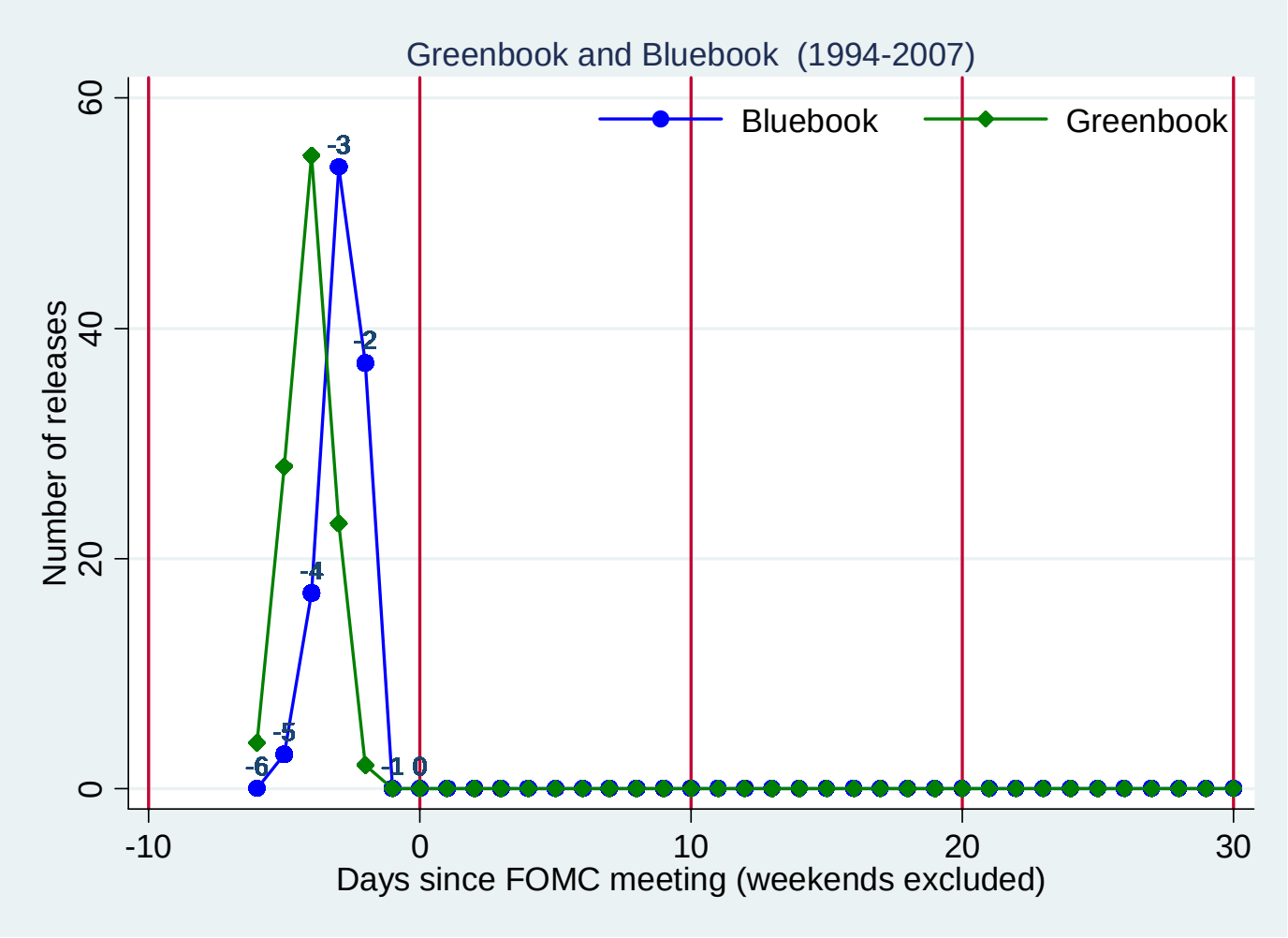
- Robert Rough, a N.Y. Fed director convicted in 1989 for insider trading on regional fed discount rate votes and on the information coming back to the N.Y. Fed from Board of Governors discount rate meetings concerning discount rate policy.

- Larry Meyer's book (2004) states that the Greenbook is rather "leaky," and thus there has been resistance to include the update from the trading desk in the written copy. Timing lines up with week 0 if leaks take a couple of days.

  An example of PIMCO's Bill Gross knowing the Greenbook content on a day 0 (before the FOMC announcement) is at:

  http://www.zerohedge.com/article/did-bill-gross-just-confirm-live-tv-he-has-advance-look-non-public-fed-data

Figure 14, Panel B. Releases of documents internally within the Federal Reserve



- A Reuters report by Cooke, da Costa and Flitter (2010) discusses how Larry Meyer and other former employees have access to the Fed Board facilities.

  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.

- The famous Geithner Leak, from the FOMC transcript of August 2007:

  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.”

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. But this remains the key unresolved issue.

WHY SUCH A HIGH RISK PREMIUM FOR FED NEWS POST-1994?

Either there is:

1) A risk premium for macro news revealed by the Fed which is larger post-1994, or
2) A risk premium for monetary policy news that is larger post-1994.

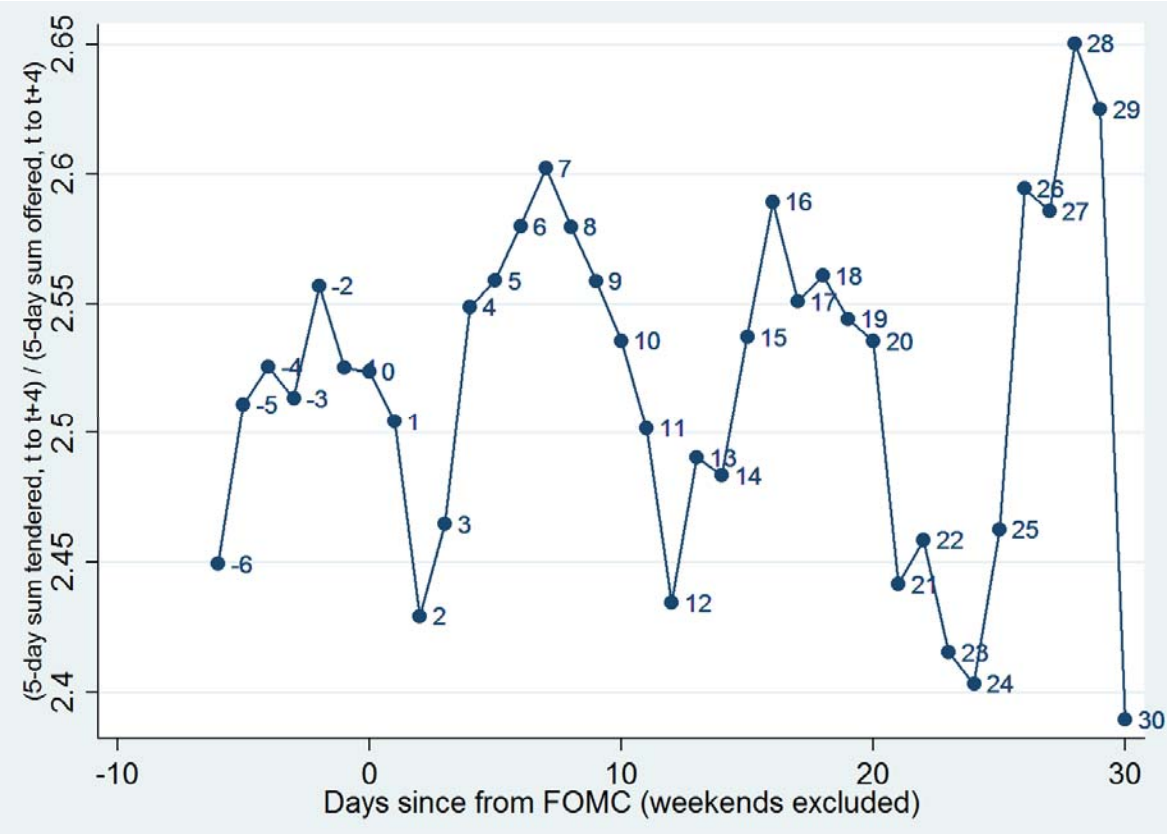
1) seems unlikely: Why would Fed's informational advantage have increased post-1994?

Possible argument for 2):

- Increased importance of leverage and highly levered intermediaries for determining risk premia. Hedge funds? Broker-dealers?

- Their borrowing cost is closely related to Fed funds rate so they likely worry a lot about monetary policy news.

- Evidence:
  - Using data on net stock buying by individuals over the FOMC cycle, individuals have fantastic market timing (likely because institutions are less willing to buy). I don't have legal clearance to show this graph yet. Sorry!!!
  - Primary dealers bid more heavily in Treasury auctions just prior to the high-return weeks, possibly because they would like more Treasury collateral which has lower haircuts in repo contracts. Using data for 1994-2008:06.



CONCLUSION:

- *Since 1994 the US equity premium is earned entirely in weeks 0, 2, 4 and 6 in FOMC cycle time*

- Likely to reflect a risk premium for news (about monetary policy or the macro economy) coming from the Federal Reserve

- How the information gets from the Fed to asset markets remains the main unresolved issue:

  - Not signaling via OMOs and (except week 4) even weeks do not systematically line up with official information releases from the Fed or with frequency of speeches by Fed officials.

  - Possible role for quiet policy communication and unintended information flows.