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The Pre-FOMC Announcement Drift

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ABSTRACT

We document large average excess returns on U.S. equities in anticipation of monetary policy decisions made at scheduled meetings of the Federal Open Market Committee (FOMC) in the past few decades. These pre-FOMC returns have increased over time and account for sizable fractions of total annual realized stock returns. While other major international equity indices experienced similar pre-FOMC returns, we find no such effect in U.S. Treasury securities and money market futures. Other major U.S. macroeconomic news announcements also do not give rise to preannouncement excess equity returns. We discuss challenges in explaining these returns with standard asset pricing theory.

IN THE PAST FEW decades stocks in the United States and several other major economies have experienced large excess returns in anticipation of U.S. monetary policy decisions made at scheduled policy meetings. This phenomenon, which we refer to as the pre-FOMC (Federal Open Market Committee) announcement drift, is difficult to explain with standard asset pricing theory.

Members of the FOMC—the Federal Reserve's monetary policy-making body—regularly convene at scheduled meetings to make monetary policy decisions. These FOMC meetings have taken place eight times per year since the early 1980s, and were scheduled much more frequently before then. Since 1994 the decisions of scheduled meetings have been announced to the public within a few minutes of 2:15 pm Eastern Time (ET). Prior to 1994 monetary policy decisions were not announced, and investors had to infer policy actions through

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the size and type of open market operations (OMOs) in the days following each meeting.

We show that, since 1994, the S&P500 index (SPX henceforth) has on average increased 49 basis points in the 24 hours before scheduled FOMC announcements. These returns do not revert in subsequent trading days and are orders of magnitude larger than those outside the 24-hour pre-FOMC window. As a result, about 80% of annual realized excess stock returns since 1994 are accounted for by the pre-FOMC announcement drift. The statistical significance of the pre-FOMC return is very high: a simple trading strategy of holding the index only in the 24 hours leading up to an FOMC announcement would have yielded an annualized Sharpe ratio of 1.1 or higher. Other major foreign stock markets exhibit similarly large and significant pre-FOMC returns. For the pre-1994 period, we study excess returns on days of scheduled FOMC meetings, as these days represent the last trading session before investors could observe signals about policy decisions. We find statistically significant average pre-FOMC returns on the SPX of 20 basis points between 1980 and 1993, while returns on other days are an order of magnitude smaller. Combining the samples before and after 1994, we find that about half of the realized excess stock market returns are earned during the pre-FOMC window between January 1980 and March 2011. We find no evidence of pre-FOMC returns before 1980.

The pre-FOMC returns are not explained by outliers, and they remain highly statistically significant when we account for potential data-snooping or small-sample effects. The returns are also broad-based across U.S. industry and size portfolios. A single market factor model captures a significant fraction of the cross-sectional variation of these returns. Fixed income assets do not feature pre-FOMC effects, and other major U.S. macroeconomic news announcements do not give rise to preannouncement equity returns.

Based on one-year rolling averages, we find the pre-FOMC drift to be positive for the vast majority of the 1980 to 2011 sample. Pre-FOMC returns tend to be higher in periods when the slope of the Treasury yield curve is low and when implied equity market volatility, as measured by the VIX index, is high. Even after accounting for these factors, pre-FOMC returns feature substantial serial correlation. The pre-FOMC drift is not significantly different in monetary policy easing versus tightening cycles and is uncorrelated with the unexpected component of the yet-to-be-realized policy decision, as measured by the surprise component of federal funds rate futures (Kuttner (2001)) or by the conditional response of the SPX to the actual announcement.

Finally, we find that realized volatility and trading volume are lower in the hours before FOMC announcements compared to other days. These indicators then jump at the announcement, as the new information is incorporated into prices. Yet the average return on the SPX from right before the announcement until the market close is essentially zero.

What explains these findings? One possible explanation is that pre-FOMC returns reflect a premium required by equity investors for bearing nondiversifiable risk. FOMC decisions provide information about interest rates and the economic outlook, and therefore systematic risk is likely high on FOMC

announcement days. However, while it is common for FOMC members to provide monetary policy information through speeches and interviews between meetings, they refrain from these discussions in the week before FOMC meetings (a time interval known as the *blackout* period), and, more importantly, in the 24-hour pre-FOMC window over which we document the large returns. Of course, investors may still aggregate other information in the pre-FOMC window, for example, through market commentaries. That said, as evidenced by both the jump in realized volatility and trading volumes and the fact that these measures are proportional to the information flow in a large set of models (see, for example, Ross (1989) and Kim and Verrecchia (1991)), the key monetary policy information on FOMC days is revealed in the announcement. Thus, a key challenge for a risk-based explanation is to jointly explain the large positive mean of pre-FOMC returns and the zero mean of announcement returns.

As an alternative explanation, a reallocation of market risk may result in a higher premium even in the absence of higher systematic risk in the pre-FOMC window. In the paper, we discuss a model by Duffie (2010) that features time-varying market participation due to slow-moving capital that can generate price drifts ahead of scheduled announcements. In this model, a subset of investors may trade out of the market ahead of the announcement, thus leaving the burden of market risk with the remaining investors who seek compensation for holding it. While such a model can give rise to a return ahead of the announcement even in the absence of new information, it is not clear why it would be optimal for the inattentive investors to sell out of their positions. We also point out some additional potential shortcomings of this model as a theory of the pre-FOMC drift.

Another possible explanation for the pre-FOMC drift is that returns were not expected by investors, and thus are not compensation for risk, but instead were the result of unexpectedly good news. Monetary policy news has arguably been positive on average over the sample period as the federal funds rate has trended down since the early 1980s, reaching historically low levels at the end of our sample. That said, it is not clear why the positive news would have been reflected in prices only during the pre-FOMC window rather than at the time of the announcement or on other days when returns have essentially averaged to zero. The same argument applies to a "government put" story (Diamond and Rajan (2011)), according to which the monetary policy response to stock price appreciation or depreciation is asymmetric. In addition, a good news explanation would also require investors to have been systematically surprised over a long sample. Even so, the magnitude of the pre-FOMC returns would be difficult to reconcile with estimates of stock price sensitivity to monetary policy (Bernanke and Kuttner (2005)). We also consider other explanations, including unexpected declines in volatility and liquidity (Campbell and Hentschel (1992) and Amihud (2002)), but do not find strong evidence in their support.

In addition to the work cited thus far, our paper is related to different strands of the literature. We document that since the 1980s a large fraction of realized equity excess returns can be accounted for by returns earned in the 24-hour pre-FOMC window, a finding that may help shed light on alternative

theories trying to explain the equity premium puzzle (see Campbell (2003) for a review). A large literature also studies asset price responses to monetary policy rate decisions (e.g., Kuttner (2001)).[1] For U.S. equities, Bernanke and Kuttner (2005) characterize stock market responses to unexpected federal funds rate shocks. Our results complement these studies as we document the existence of an *unconditional* excess return that is earned *ahead* of the FOMC announcement. These returns are thus likely driven by anticipation, rather than actual realization, of policy decisions. A related literature documents sizable conditional responses of various asset classes to macroeconomic news announcements (Fleming and Remolona (1999) and Andersen et al. (2003)). More closely related to our paper, Jones, Lamont, and Lumsdaine (1998) study unconditional fixed income returns around macroeconomic releases (inflation and labor market), and Savor and Wilson (2013) find positive excess equity returns on days of inflation, labor market, and FOMC releases from 1958 to 2009. Our paper differs from the latter study because we examine returns *ahead* of scheduled announcements while they look at unconditional returns on announcement days. For the post-1994 sample, when FOMC announcements have been made around 2:15 pm, our results indicate that the unconditional FOMC announcement-day returns are due to the pre-FOMC drift rather than returns earned at the announcement.[2]

The title of our paper is inspired by the earnings announcement literature, which finds evidence of positive excess returns for single stocks at the earnings release (see, for example, Beaver (1968)) as well as postannouncement (Bernard and Thomas (1989)) and preannouncement drifts. In particular, Lamont and Frazzini (2007) document an upward drift of individual firms' stock prices prior to their scheduled earnings announcements. While these authors focus on a behavioral "attention grabbing" effect as a potential explanation, we mainly consider theories based on rational expectations or unexpected news. Nonetheless, we stress that, due to the lack of significant new public information ahead of scheduled FOMC announcements, informational frictions may play an important role in explaining the drift. For example, Tetlock (2011) shows that stale news can affect stock prices.

The remainder of the paper is organized as follows. Section I provides a brief discussion of the monetary policy decision-making process in the United States, and Section II reviews the data. In Section III we present our main empirical findings. Section IV analyzes a number of possible explanations for our findings, and Section V provides a concluding discussion.

[1] A more recent literature also focuses on financial asset responses to communications about future monetary policy actions, rather than the actual realization of current monetary policy actions (Gürkaynak, Sack, and Swanson (2005), Lucca and Trebbi (2009)).

[2] Because there are no FOMC announcements prior to 1994, our samples do not overlap in this period because we study close-to-close returns on days of scheduled FOMC meetings. On the other hand, Savor and Wilson (2013) focus on returns earned on the day after, which is generally when investors would have learned about the policy actions. We characterize excess returns in the 10-day window centered around FOMC meeting days in Section III.C.

I. Federal Reserve Policy and FOMC Meetings

The FOMC is the monetary policy-making body of the U.S. Federal Reserve System. The FOMC makes policy decisions under the statutory dual mandate of maximum employment and stable prices at FOMC meetings.[3] The FOMC convenes regularly at scheduled meetings, and much less frequently at unscheduled meetings, which are typically conducted via teleconference calls. Only the occurrence of scheduled meetings is known to investors in advance. Because we study returns ahead of monetary policy news, we exclusively consider these meetings in this paper.[4] The FOMC sets its policy in terms of intermediate targets. Since the early 1960s, which is when our analysis starts, these targets have gradually shifted from the level of nonborrowed reserves (banks' balances at the Fed not resulting from borrowing at the discount window) to the federal funds rate, with the important exception of the period from 1979 to 1982, when, under Chairman Volcker, the intermediate target was set in terms of monetary aggregates (see Meulendyke (1998) for a more detailed discussion).

In terms of policy instruments, the FOMC has mainly relied on daily OMOs, which are purchases and sales of Treasury and Agency securities in the open market by the Federal Reserve Bank of New York's trading desk (the "Desk"), and much less frequently on changes in the discount window rate or the level of required reserves. Daily OMOs are typically in the form of temporary repurchase agreements, with important exceptions such as permanent OMOs under the post-2008 Large Scale Asset Purchase programs.

Monetary policy in the United States underwent other major changes in the last few decades related to the communication of monetary policy decisions to investors, the frequency of meetings, and their timing. Prior to 1994, the FOMC did not disclose policy actions and market participants had to infer these actions from the size and type of OMOs. For this period, we study excess returns on days of scheduled FOMC meetings. These days mark the last trading session before investors could observe signals about the likely policy action. While investors could generally infer changes in policy targets from OMOs on the day following the meeting, at times volatility in banks' demand for reserve balances made this inference difficult (see Kuttner (2003) and Gürkaynak, Sack, and Swanson (2005)).

[3] The FOMC is composed of 12 members: the 7 members of the Board of Governors and 5 of the 12 Reserve Bank presidents. The Federal Reserve Board Chairman also serves as the FOMC's chairman. With the exception of the president of the Federal Reserve Bank of New York, who is a permanent voting member and FOMC vice-chair, presidents of all other Banks take voting positions on a rotating basis that last one year. Policy decisions are made under a majority rule at FOMC meetings.

[4] Before September 11, 2001, the Public Affairs Division at the Board of Governors provided information sheets to the press with the dates of scheduled meetings; since then schedules have been posted on the Board's public website. The calendar of past FOMC meetings and those scheduled for the next year can be found at http://www.federalreserve.gov/monetarypolicy/fomccalendars.htm. The website clearly marks conference calls, which are always unscheduled. We distinguish the very infrequent unscheduled meetings not conducted via teleconference from scheduled ones based on whether staff material for FOMC members (the "Greenbook") had been prepared in advance of each meeting.

On a few occasions before 1994, the Board of Governors of the Federal Reserve coincidentally released statements about discount rate changes on days of scheduled FOMC meetings. From these announcements market participants could have correctly inferred a change in the Fed's targets on the day of the meeting. Kuttner (2003) identifies one such event between 1989 and 1992. We expand his analysis to the full 1960 to 1994 sample, using discount rate press releases that we obtain from the Federal Reserve's historical archive. We exclude days of coincidental discount window releases from our regression analysis to ensure that the pre-FOMC windows that we consider do not include policy announcements.[5]

Finally, as discussed in Bernanke and Kuttner (2005), on a few occasions before 1994 the Desk appeared to let the federal funds rate drift in the direction of the new target level ahead of the meeting and investors interpreted this inaction as signaling a policy change. Analyzing the "Credit Markets" columns of the *Wall Street Journal*, Kuttner (2003) identifies five such likely "tacit" policy moves over the 1989 to 1992 period, all of which occurred ahead of unscheduled FOMC meetings that are not included in our analysis. Using the same approach, we find three instances in which investors possibly inferred policy changes on the day of scheduled meetings in the post-1980 sample. As the identification of these dates through newspaper articles involves our judgment and investors' and journalists' interpretation of daily conditions in the often volatile federal funds market, we do not exclude these dates from our analysis. However, we verify that our results are unaffected by their exclusion.

Starting in February 1994, the FOMC began to announce its decisions and publish accompanying statements (FOMC statements) after pre-scheduled meetings.[6] Between September 1994 and May 1999, statements were released only when a change to the current policy was made; otherwise, the FOMC announced that no statement would be released, indicating to investors that no policy action had been taken. Starting in May 1999, statements were released after every scheduled meeting irrespective of whether a policy change occurred. From September 1994 to March 2011, FOMC statements were regularly released at or a few minutes after 2:15 pm following each scheduled meeting.[7] Since April 2011, the time of the release has varied between 12:30 pm and 2:00 pm on days of FOMC meetings on which a press conference by the FOMC chairman is held at 2:15 pm.

Our intraday analysis focuses on the sample from September 1994 through March 2011, when FOMC releases were known to be consistently made at or

[5] The meeting dates that we exclude are December 17, 1968, September 18, 1979, October 6, 1979, and December 18, 1990. The last is the day identified by Kuttner (2003).

[6] The FOMC publishes a more detailed discussion of the policy meeting with the release of the minutes several weeks after the meeting, and publishes the full verbatim transcripts five years after the meeting.

[7] The only exception to the time of the announcement is the statement of March 26, 1996, which was released in the morning because the chairman was scheduled to testify in Congress later that day. The timing of the release was preannounced to investors. We exclude that day from our analysis.

within a few minutes of 2:15 pm. We report the times of each FOMC announcement since 1994 in the Internet Appendix, based on an analysis of time-stamps of Bloomberg and Dow Jones newswires as in Fleming and Piazzesi (2005).[8] Based on this analysis, no announcement was ever made before 2:10 pm. Hence, the 2 pm-to-2 pm pre-FOMC window that we study in the post-1994 sample does not contain any announcement information.

Beyond FOMC announcements, since the early 1990s members of the FOMC have increasingly employed speeches, testimonies to Congress, and other means to communicate to market participants the likely path of monetary policy. Importantly for the analysis in this paper, however, FOMC participants refrain from any policy discussion in the week leading up to each FOMC meeting (the "purdah" or "blackout" period; see Ehrmann and Fratzscher (2009)), meaning that no such information is communicated in the pre-FOMC time window.

In addition to changes in the communication of monetary policy decisions, the meetings' frequency and timing of policy actions have also changed over time. Scheduled FOMC meetings occurred up to 18 times per year in the 1960s and up to 14 times per year in the 1970s. From 1981 to the end of our sample, scheduled meetings have instead always occurred eight times per year. Similarly, the number of unscheduled meetings or conference calls has also declined significantly since the early 1980s.[9] In addition to the lower frequency of meetings, the timing of policy decisions has become much more explicit since 1994 with a significant fraction of policy actions taken at scheduled meetings rather than at other times. For example, based on data from Thornton (2006) and Bonfim and Reinhart (2000), only 22 out of 92 target changes were taken at scheduled meetings in the 10 years ending in 1994. In contrast, 54 out of 60 federal funds rate target changes were made at scheduled meetings between 1994 and 2011. In sum, monetary policy decisions in the United States have become more "lumpy" starting in the 1980s, and both their timing and communication have become much more transparent since 1994.

II. Data

Our analysis focuses on financial asset returns around scheduled FOMC meetings between January 1960 and March 2011 with a special emphasis on the post-1980 and post-1994 samples. Most of the evidence on the latter subsample is based on intraday data and focuses on the 24-hour period from

[8] The Internet Appendix may be found in the online version of this article.

[9] We show this evolution in the Internet Appendix. Since 1994, which is the sample used in our intraday analysis, unscheduled meetings have occurred on the following dates: April 18, 1994, October 15, 1998, January 3, 2001, September 17, 2001, January 21, 2008, and October 7, 2008. In addition, intermeeting statements related to "liquidity facilities" were released on August 10–16, 2008 and May 9, 2010. Over the same sample period, 24 other unscheduled meetings took place without any immediate release of a statement. These meetings were made public only with the release of the minutes of the subsequent scheduled meeting (about one to two months after the original meeting took place).

2 pm on the day before a scheduled FOMC announcement until 2 pm on the day of a scheduled FOMC announcement, or about 15 minutes before the announcement release time. Hence, by construction, returns computed over this time interval do not contain meeting outcomes, which allows us to exclusively study anticipatory effects associated with FOMC announcements.[10] The evidence prior to 1994 is based on daily data. Over that period we consider as pre-FOMC returns those earned on days of scheduled FOMC meetings, which mark the last trading session before investors could observe signals about the likely policy action. Throughout the entire 1960 to 2011 sample, we use as the risk-free rate the daily rate on a one-month Treasury bill locked as of the beginning of each month.

We use several data sources: Thomson Reuters TickHistory and Tickdata.com for intraday data, Bloomberg for dividend data as well as international stock returns and foreign central bank announcements, and Ken French's website for daily returns on size- and industry-sorted U.S. stock portfolios as well as the risk-free rate. We obtain historical newspaper coverage of the *Wall Street Journal* and the *Financial Times* from ProQuest and Factiva. Table I provides summary statistics on pre-FOMC windows and at other times for the main variables used in our empirical analysis. Since most of our analysis refers to mean returns in these two subsamples, we omit a detailed discussion here and instead refer interested readers to the table.

III. Empirical Results

In this section, we present the empirical findings of the paper. We first document excess returns on the SPX in anticipation of U.S. monetary policy decisions. We then look at the persistence of these returns and the robustness of their statistical significance. We then report some cross-sectional and international evidence. Finally, we study returns on other asset classes and on the SPX before other major macroeconomic data releases.

A. The Pre-FOMC Announcement Drift since 1994

Figure 1 shows a striking pattern of U.S. stock returns around FOMC announcements. The black solid line in the chart represents the mean pointwise cumulative intraday percentage return of the SPX over a three-day window from the market open of the day ahead of scheduled FOMC meetings to the day after. The mean is taken over the 131 scheduled FOMC meetings from September 1994 to March 2011.[11]

As seen in the figure, the SPX displays a strong upward drift in the hours ahead of FOMC announcements. First, the SPX rises slightly on the afternoon

[10] Due to limited availability of intraday data, the cross-sectional analysis of pre-FOMC returns is based on daily data.

[11] Relative to the dates reported in the Internet Appendix, we lose one observation (July 1, 1998) because of missing intraday data. The close-to-close return on that day was 1.3%.

Table I
Summary Statistics

This table reports summary statistics for pre-FOMC 24-hour windows and for all other times. The sample period is September 1994 to March 2011 in the top panel and January 1980 to March 2011 in the bottom panel. SPX-2 pm is the cum-dividend log excess return on the S&P500 index from 2 pm on date $t-1$ to 2 pm on date t. SPX denotes the close-to-close log excess return on the S&P500 index. DAX, FTSE100, CAC40, IBEX, SMI, TSX, and NIKKEI denote close-to-close ex-dividend log returns on the German, British, French, Spanish, Swiss, Canadian, and Japanese benchmark stock indices, respectively. FF and ED4 are daily rate changes implied by the first (and second) federal funds futures contract in the first two-thirds (last third) of the month as well as the fourth euro contract. TSY-3M, . . . ,TSY-10Y are daily rate changes for the on-the-run Treasury bills and 2-, 5-, and 10-year notes. VOLUME denotes the trading volume (number of shares traded) for the SPY relative to its past 21-day moving average. lVIX is the level of the VIX at 2 pm on the previous day. SPX-pre and all other rate changes in the bottom panel are based on 2 pm-to-2 pm windows in the post-1994 sample, and are close-to-close on the day of the FOMC meeting (day before FOMC news) in the 1980 to 1993 sample.

	pre-FOMC					Other				
	Mean	St. Dev.	Max	Min	No. Obs.	Mean	St. Dev.	Max	Min	No. Obs.
Post-1994 Sample										
SPX-2 pm	0.488	1.215	9.531	−2.927	131	0.004	1.218	12.064	−13.962	4,010
SPX	0.338	1.144	5.006	−2.571	132	0.009	1.261	10.953	−9.464	4,043
DAX	0.449	1.222	4.418	−3.241	131	0.014	1.571	10.797	−9.791	3,965
FTSE100	0.347	1.204	7.744	−3.492	132	0.004	1.222	9.384	−9.266	3,968
CAC40	0.517	1.422	8.833	−2.538	132	−0.001	1.49	10.595	−9.472	3,970
IBEX	0.491	1.369	9.002	−3.449	132	0.013	1.489	13.484	−9.586	3,939
SMI	0.301	1.141	5.992	−3.016	132	0.012	1.258	10.788	−8.108	3,942
TSX	0.231	0.981	3.752	−2.06	131	0.022	1.156	9.37	−9.788	3,956
NKY	0.006	1.806	7.456	−11.153	125	−0.02	1.579	13.235	−12.111	3,818
FF	−0.005	0.034	0.125	−0.155	132	−0.001	0.026	0.355	−0.52	4,032
ED4	0.006	0.07	0.37	−0.26	132	−0.001	0.08	0.83	−0.435	4,193
TSY-3M	0.000	0.043	0.144	−0.15	132	−0.001	0.06	0.84	−0.78	4,078
TSY-2Y	0.005	0.047	0.185	−0.192	132	−0.002	0.064	0.585	−0.607	4,193
TSY-5Y	−0.001	0.047	0.142	−0.166	132	−0.001	0.067	0.517	−0.382	4,193
TSY-10Y	−0.003	0.044	0.124	−0.175	132	−0.001	0.062	0.349	−0.37	4,193
VOLUME	0.825	0.351	2.675	0.294	120	1.041	0.419	5.283	0.129	3,686
lVIX−2 pm	23.612	9.501	75.52	11.04	121	23.108	9.092	80.69	9.69	3,855
Post-1980 Sample										
SPX-pre	0.366	1.124	9.531	−2.927	244	0.011	1.123	12.064	−22.911	7,598
FF	−0.004	0.031	0.125	−0.155	171	−0.002	0.03	0.38	−0.52	5,431
ED4	0.007	0.082	0.46	−0.26	193	−0.001	0.085	0.83	−1.18	6,261
TSY-3M	−0.011	0.106	0.54	−0.68	245	−0.001	0.109	1.69	−1.13	7,622
TSY-2Y	−0.005	0.08	0.37	−0.52	245	−0.001	0.092	0.89	−0.84	7,741
TSY-5Y	−0.006	0.074	0.42	−0.37	245	−0.001	0.086	0.72	−0.77	7,741
TSY-10Y	−0.009	0.07	0.33	−0.33	245	−0.001	0.08	0.65	−0.75	7,741

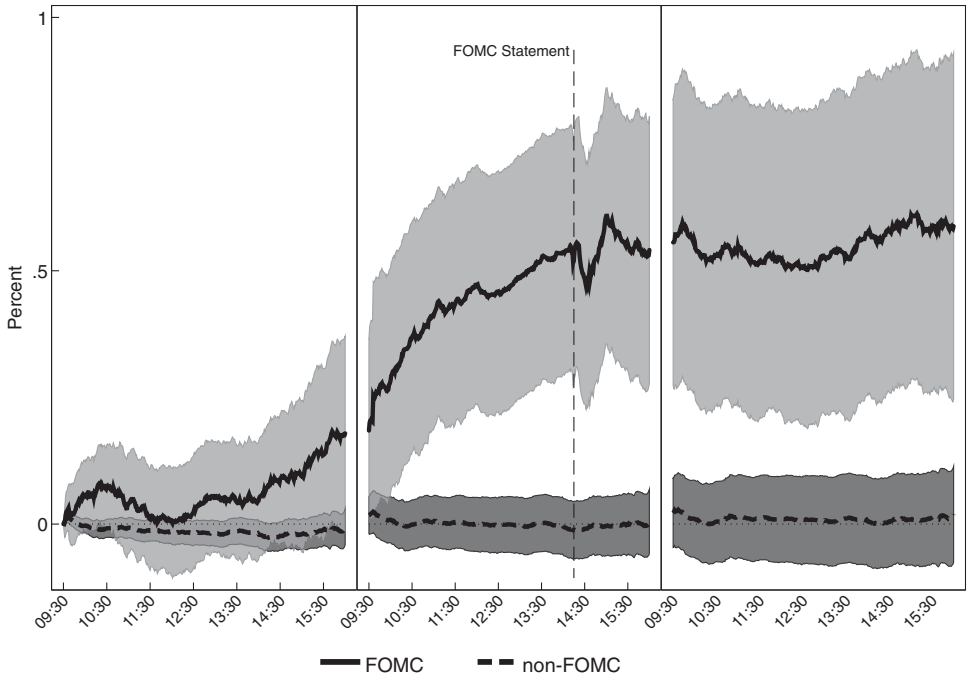

Figure 1. Cumulative returns on the S&P500 index. This figure shows the average cumulative return on the S&P500 index on three-day windows. The solid black line is the average cumulative return on the SPX from 9:30 am ET on days prior to scheduled FOMC announcements to 4:00 pm ET on days after scheduled FOMC announcements. The dashed black line shows average cumulative returns on the SPX on all other three-day windows that do not include FOMC announcements. The gray shaded areas are pointwise 95% confidence bands around the average returns. The sample period is from September 1994 through March 2011. The dashed vertical line is set at 2:15 pm ET, when FOMC announcements are typically released in this sample period.

of the day before the scheduled FOMC meetings (left panel), and then drifts sharply higher in the morning of scheduled FOMC announcements (middle panel). Right before the time of the announcement (vertical dashed line), the SPX reaches a level about 50 basis points higher than on the previous day's open. Following the announcement at 2:15 pm, the SPX is on average flat, both in the hours immediately after the announcement and on the following day (right panel). As evidenced by the pointwise 95% confidence interval for the mean return (light gray area), the cumulative return earned prior to scheduled FOMC announcements is strongly significantly different from zero.

To put the economic magnitude of this pre-FOMC drift in perspective, the dashed black line in Figure 1 shows the average cumulative returns on all other three-day windows in the sample excluding day triplets centered around FOMC announcements, along with the pointwise 95% confidence bands (dark gray

shaded area).[12] On average, cumulative returns on these days are essentially zero in the sample period.

The mean intraday returns in the figure do not include dividend payments and do not account for the level of the risk-free rate. To more formally assess the magnitudes of excess stock market returns prior to scheduled FOMC announcements, we run the simple dummy variable regression model

$$rx_t = \beta_0 + \beta_1 1_t(\text{pre-FOMC}) + \beta_x X_t + \epsilon_t, \tag{1}$$

where rx_t denotes the cum-dividend log excess return on the SPX over the risk-free rate in percentage points. In the main specification, the explanatory variable is a dummy variable that is equal to one on scheduled pre-FOMC announcement windows and zero otherwise. In alternative specifications in Section IV we also include additional control variables denoted by the vector X_t.

In the regression excluding the vector of other controls X_t, the coefficient β_1 is the mean return on pre-FOMC windows when the constant β_0 is omitted, and it is the mean excess return differential on pre-FOMC windows versus other days when the constant is present. The constant β_0 measures the unconditional mean excess return earned on all time periods outside of the pre-FOMC window.

Table II reports coefficient estimates for these two parameters over different return windows. The dependent variable in the first two columns is the 2 pm-to-2 pm SPX excess return. By construction, this 24-hour return ending at 2 pm on the day of scheduled FOMC announcements does not include the realized policy decision, which is yet to be announced. As seen in the first column, for the 131 FOMC observations in the sample, the 24-hour return right before the FOMC meeting is on average 49 basis points, with a t-statistic of more than 4.5 based on Huber-White standard errors (square brackets). As shown in the second column, this excess return is orders of magnitude larger than the mean excess return on all other 2 pm-to-2 pm windows in the sample (less than 0.5 basis points). Yet there are only eight scheduled FOMC meetings each year. To gauge the impact of this return difference on the total annual realized stock returns in the sample, the middle panel of Table II presents annualized returns earned in the pre-FOMC window and on all non-FOMC days. While the excess return on the SPX over the 24 hours prior to the FOMC announcement is on average 3.89% per year, it is only 0.88% on all remaining trading days. These point estimates thus imply that since 1994 about 80% of realized excess stock returns in the United States have been earned in the 24 hours before scheduled monetary policy announcements. The simple strategy that consists of buying the SPX at 2 pm the day before a scheduled FOMC announcement, selling 15

[12] Because we consider returns on all other days, we use Newey-West standard errors when computing confidence intervals of the mean returns to account for the cumulative returns' one- and two-day overlaps when computing means in the second and third day, respectively, of the figure.

Table II
Returns on the S&P500 Index

This table shows results for the (pre-)FOMC dummy variable regression (1) based on returns on the S&P500 computed over different windows. The dependent variables are: (1 and 2) the cum-dividend log excess return on the S&P500 from 2 pm on date $t-1$ to 2 pm on date t, (3) the ex-dividend log return on the S&P500 for the same-day 2 pm to 4 pm time window, (4) the cum-dividend log excess return on the S&P500 from the close (4 pm) on date $t-1$ to the date t close, (5) the cum-dividend log excess return on the S&P500 from the close on date $t-1$ to 2 pm on date t, and (6) the log excess return on the S&P500 from the close on date $t-2$ to 2 pm on date t. "pre-FOMC dummy" is equal to one when a scheduled FOMC announcement has been released in the following 24-hour interval and zero otherwise. "FOMC dummy" is equal to one when a scheduled FOMC announcement has been released in the return window. "Annual ex-return FOMC" is the cumulative annual excess return earned in the 24-hour pre-FOMC trading window and "Annual ex-return non-FOMC" is the cumulative annual excess return earned on all other days in the year. "Sharpe ratio" is the annualized Sharpe ratio on pre-FOMC returns. The sample period is from September 1, 1994 to March 30, 2011. ***Significant at 1%, **significant at 5%, *significant at 10%. Robust standard errors are shown in brackets.

Return Window	2 pm-to-2 pm		2 pm-to-Close	Close-to-close	Close-to-2 pm	Close(t − 2)-to-2 pm
pre-FOMC dummy	0.488 [0.11]***	0.485 [0.11]***			0.335 [0.06]***	0.544 [0.14]***
FOMC dummy			0.002 [0.09]	0.330 [0.10]***		
Const.		0.004 [0.02]		0.009 [0.02]		
Annual ex-return FOMC		3.89		2.70		
Annual ex-return non-FOMC		0.88		2.08		
Sharpe ratio	1.14	1.14	0.01	0.84	1.43	0.98
Obs.	131	4,141	131	4,175	131	131
No. of FOMC	131	131	131	132	131	131

minutes before the announcement, and holding cash on all other days would have earned a large annualized Sharpe ratio of 1.14 as reported in the table.[13]

Consistent with Figure 1, the excess SPX return between 2 pm and the market close on the day of the announcement has instead been zero (column (3)). In other words, while the SPX has displayed a large positive drift in the 24 hours leading up to the announcement, stock returns have on average been zero at or following the announcement. This implies that, while equity market investors have at times been surprised by the FOMC decision (Bernanke and Kuttner (2005)), these surprises average out to zero in our sample period.

[13] Since there are eight scheduled FOMC meetings per year, we compute the annualized Sharpe ratio as $\sqrt{8}$ times the per-meeting Sharpe ratio (sample mean of pre-FOMC return divided by its sample standard deviation).

Table III
Summary Statistics on 2 pm-to-2 pm S&P500 Index Excess Returns

This table reports summary statistics for the 2 pm–2 pm cum-dividend log excess returns on the S&P500 on the pre-FOMC window and at other times. The right panel excludes the top 1% and bottom 1% of returns. Standard errors for the mean are reported in square brackets. "Obs." is the number of observations in each subset of days. The sample period is September 1, 1994 to March 31, 2011.

	All Observations		Excl. Top/Bottom 1%	
	Pre-FOMC	Other	Pre-FOMC	Other
Mean	0.488	0.004	0.445	0.008
	[0.11]	[0.02]	[0.08]	[0.02]
St. Dev.	1.22	1.22	0.88	0.99
Skew	3.18	−0.24	0.61	−0.16
Kurtosis	25.61	15.91	5.22	3.71
Max	9.53	12.06	3.69	3.08
Min	−2.93	−13.96	−2.18	−3.25
Obs.	131	4,010	129	3,930

Looking at the close-to-close excess returns on the SPX (column (4)), which include the afternoon following the announcement rather than the afternoon before, the FOMC return differential is somewhat lower at about 33 basis points in the sample period. However, the average close-to-close return on all other days is less than one basis point, and the annualized FOMC-day return on a close-to-close basis still accounts for more than half of realized excess stock returns (2.7% compared to 2.08% on all other days) in the sample. Moreover, the close-to-close FOMC-day return still remains highly significant and yields a considerable annualized Sharpe ratio of 0.84 as reported in the table.

One may worry that the properties of the pre-FOMC returns crucially depend on the exact 24-hour time window that we consider. This is not the case. Indeed, in the last two columns we consider a close-to-2 pm and a close two days prior to 2 pm window. In both cases the pre-FOMC return remains highly significant, with a Sharpe ratio of 1.43 for the close-to-2 pm window and a pre-FOMC drift of 54 basis points with associated Sharpe ratio of about one in the close two days prior to 2 pm window.

A further concern is the sensitivity of these results to potential outliers. Table III provides summary statistics of the 2 pm-to-2 pm return on the SPX on FOMC days versus all other days in the post-1994 sample. The mean excess returns (and their standard errors) are the same as in Table II. The standard deviation of the excess returns is about 1.2% both on FOMC days and on other days, implying that, in terms of variance, stocks do not appear to be riskier on FOMC days (we discuss the relation between volatility and returns in Section IV.B). The skewness of the two return distributions, however, displays a notable difference. While equity returns exhibit a strong positive skew ahead of FOMC announcements, they are slightly negatively skewed on all other days. Indeed, 98 of the 131 pre-FOMC announcement returns are positive in our sample—or

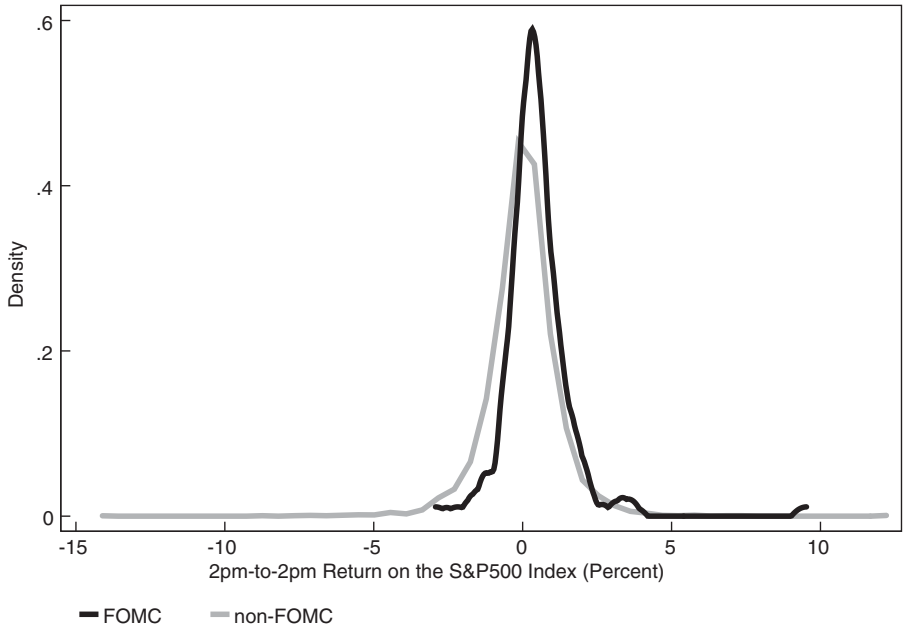

Figure 2. Empirical densities of 2 pm-to-2 pm S&P500 index returns. This figure plots empirical densities of the 2 pm-to-2 pm cum-dividend excess returns on the S&P500 index. The solid black line is the return distribution in the pre-FOMC window and the gray line is the return distribution at other times. The sample period is from September 1994 through March 2011.

three-quarters of the total—but only 33 are negative (not reported in the table). On the other hand, positive and negative excess returns are roughly equally split on non-FOMC days in the sample.

The distributional differences in the empirical densities are shown in Figure 2. The 2 pm-to-2 pm FOMC return density (black line) is similar to that on non-FOMC days (gray), but importantly omits a left tail, with most of the corresponding density mass instead concentrated in positive returns. While at this point it is clear that outliers do not dominate the results so far, Table III shows that the kurtosis of pre-FOMC returns is slightly higher than on regular days, suggesting a somewhat more fat-tailed distribution on FOMC days. As a final check we drop the top and bottom percentiles and compare the resulting moments of the FOMC- and non-FOMC-day distributions in the last two columns of Table III.[14] None of the summary measures are qualitatively affected when we exclude outliers. Dropping the top and bottom 1% of all

[14] The top and bottom 1% of pre-FOMC returns amount to only two observations. The largest positive outlier is a 9.5% return on October 29, 2008. News reports on that day partly attributed the surge in equity prices to speculation that the FOMC may cut interest rates the next day. Moreover, talk of a federal rescue for General Motors and Chrysler may have also contributed to the price action. The largest negative outlier is a −2.9% return on June 26, 2002, driven mainly by news of accounting fraud at phone company WorldCom.

observations, the mean pre-FOMC announcement return is still very large at 45 basis points while the mean return on all other days is one basis point (as evidenced in the second row, the statistical significance increases). The standard deviation of returns remains very similar. While the skewness of pre-FOMC announcement returns falls somewhat when excluding the tails of the distribution, it is still positive, in contrast with the skewness on other days, which remains negative. Finally, the kurtosis is now similar in both trimmed samples.

B. Pre-FOMC Returns before 1994

Thus far we have focused on the 1994 to 2011 sample, when FOMC decisions have been explicitly announced to investors at known times. As discussed in Section I, before 1994 market participants inferred policy decisions through the size and type of OMOs in the days after FOMC meetings. Following the convention in Kuttner (2001) and Bernanke and Kuttner (2005), we therefore set the preannouncement window to be the day of scheduled FOMC meetings in the pre-1994 sample.[15]

Table IV presents the parameter estimates of the dummy variable regression (1) of pre-FOMC returns for different sample periods. In these regressions, we splice together the daily SPX excess return series prior to 1994 and the 2 pm-to-2 pm excess return series after 1994. The first column provides the regression results for the sample from 1960 to 2011, covering more than 50 years of daily data and a total of 524 scheduled FOMC meetings. Over that period, the average excess return earned on non-FOMC days is estimated to be a statistically insignificant 0.9 basis points. In contrast, the return differential earned in the pre-FOMC window is estimated to be 16.7 basis points, which is statistically significant at the 1% level.

While it is still highly statistically significant, the average pre-FOMC return is considerably smaller in magnitude relative to the 49 basis points that we find in the post-1994 sample. It is therefore interesting to ask how much of the average pre-FOMC return from 1960 to 2011 is accounted for by different subsamples. To this end, we split the period prior to 1994 into two subperiods. Columns (2) and (3) in Table IV show estimates for the periods from 1960 to 1979 and 1980 to 1993, respectively. Prior to 1980, pre-FOMC returns are essentially zero while between 1980 and 1993 they average to a statistically significant 20 basis points in excess of the two basis points earned on all non-FOMC days. As shown in column (4), average excess pre-FOMC returns on the SPX amount to 36 basis points in the 1980 to 2011 sample with a t-statistic of 4.86. Moreover, pre-FOMC returns account for more than half of the realized excess stock returns over this 30-year period, and the simple strategy of holding

[15] As discussed before, we exclude from the sample four days on which the Federal Reserve Board of Governors released discount rate decisions on days of scheduled FOMC meetings. The average excess return on the SPX on those five days is −0.5 basis points.

Table IV
S&P500 Index Returns on Alternative Samples

This table reports pre-FOMC dummy variable regression results for different samples as reported in the bottom row. From September 1994 onwards, the dependent variable is the cum-dividend log excess return on the S&P500 from 2 pm on date $t-1$ to 2 pm on date t, while before 1994 the dependent variable is a close-to-close (4 pm-to-4 pm) excess return. "pre-FOMC dummy" is equal to one when FOMC news (an announcement post-1994 or OMOs on the day following FOMC scheduled meetings) is scheduled to take place in the following time interval, and zero otherwise. "Annual ex-return FOMC" is the cumulative annual excess return earned in the 24-hour pre-FOMC trading window and "Annual ex-return non-FOMC" is the cumulative annual excess return earned on all other days in the year. "Sharpe ratio" is the annualized Sharpe ratio on pre-FOMC returns. ***Significant at 1%, **significant at 5%, *significant at 10%. Robust standard errors are shown in brackets.

Dependent Variable: %Log Excess Return on S&P500 Stock Market Index				
Sample Period	1960:01–2011:03	1960:01–1979:12	1980:01–1993:12	1980:01–2011:03
pre-FOMC dummy	0.167	0.005	0.204	0.355
	[0.04]***	[0.04]	[0.09]**	[0.07]***
Const.	0.009	0.006	0.020	0.011
	[0.01]	[0.01]	[0.02]	[0.01]
Annual ex-return FOMC	1.81	0.16	1.81	2.87
Annual ex-return non-FOMC	2.27	1.45	4.98	2.80
Sharpe ratio	0.53	0.04	0.64	0.92
Obs.	12,854	5,012	3,539	7,842
No. of FOMC	524	280	113	244

stocks right ahead of FOMC announcements and cash otherwise would have delivered an annualized Sharpe ratio of 0.92.[16]

Based on the results in this section, pre-FOMC returns started to be prevalent in the 1980s and have increased in magnitude and significance over time, accounting for a large fraction of realized U.S. excess stock returns in the three decades spanning 1980 to 2011.

C. Persistence

Above we show that pre-FOMC returns have accounted for large fractions of total realized excess stock returns over the last few decades. Such a decomposition assumes that pre-FOMC returns are not reversed on subsequent days and are not associated with offsetting negative returns in prior days. We verify whether this assumption holds by estimating the pre-FOMC regression (1) for the five days before and after FOMC announcements. Table V summarizes results from these regressions for the sample periods 1994 to 2011 and 1980 to 2011. In both samples, we find that only the pre-FOMC dummy is significant. While the SPX features a few small negative returns in the five-day windows

[16] In the Internet Appendix, we report the empirical distributions of pre-FOMC returns and the returns on all other days from 1980 to 2011.

Table V

S&P500 Index Returns before, on, or after FOMC News

This table reports results for dummy variable regressions for average excess returns on the S&P500 index on days prior to, on, and after scheduled FOMC announcements. The sample in the left panel is September 1, 1994 to March 30, 2011, and on the right panel is January 2, 1980 to March 30, 2011. Refer to Table IV for the dependent variable definition. FOMC news on $t+i$ $(t-i)$ denotes a dummy that is equal to one for the ith trading session before (after) a scheduled FOMC meeting day. $\sum_{i=2}^{6} 1(FOMC_{t+i})$ denotes the sum of the coefficients on the dummy variables for the five days before while $\sum_{i=0}^{4} 1(FOMC_{t-i})$ denotes the sum of coefficients on the dummy variables for the five days after FOMC news became available. ***Significant at 1%, **significant at 5%, *significant at 10%. Robust standard errors are shown in brackets.

	Post-1994 Sample		Post-1980 Sample	
+6	−0.02	[0.09]	0.04	[0.06]
+5	−0.10	[0.10]	−0.07	[0.06]
+4	0.09	[0.09]	0.03	[0.06]
+3	−0.06	[0.09]	0.04	[0.07]
+2	0.06	[0.08]	−0.02	[0.06]
+1 (pre-FOMC)	0.49***	[0.11]	0.37***	[0.07]
	0.04	[0.12]	0.06	[0.07]
−1	−0.02	[0.10]	0.05	[0.07]
−2	0.08	[0.11]	0.09	[0.07]
−3	−0.03	[0.10]	−0.08	[0.07]
−4	−0.08	[0.08]	0.03	[0.06]
$\sum_{i=2}^{6}$ (FOMC at $t+i$)	−0.041		0.027	
p-value	0.842		0.853	
$\sum_{i=0}^{4}$ (FOMC at $t-i$)	−0.018		0.147	
p-value	0.939		0.335	

before and after the pre-FOMC window in the post-1994 sample, they are statistically insignificantly different from zero, and only add up to a few basis points. Moreover, cumulative returns on the five days before and the five days after pre-FOMC news windows are also economically and statistically insignificantly different from zero in the 1994 to 2011 sample (bottom panel of the table). Interestingly, in the 1980 to 2011 sample, which includes the pre-1994 period when investors learned policy actions from daily OMOs rather than from a single-day public announcement, we find an economically meaningful (15 basis points) but statistically insignificant positive cumulative return over the five days following the pre-FOMC trading session. Most importantly for decomposing historical S&P500 returns in pre-FOMC and other time windows, we do not find evidence of pre-FOMC return reversals in either sample.

D. Inference

In the regression tables above, we rely on asymptotic normality to gauge the statistical significance of the estimated coefficients. However, one may be concerned that the asymptotic distribution provides a poor approximation to the small-sample distribution of the estimated coefficients given the relatively

small number of observations and fat tails of the empirical distribution of pre-FOMC returns. In this section, we address this concern through different bootstrap exercises. As we will see, the results show that the statistical significance based on asymptotic inference is in fact not due to small-sample issues or data-snooping. We provide a qualitative summary of these results here and give a more detailed account in the Internet Appendix.

We first compute small-sample standard errors for the point estimates of the dummy variable coefficients reported in the previous sections using a simple bootstrap procedure. More precisely, we draw with replacement from the observed distribution of pre-FOMC returns a series of length equal to the number of FOMC dates and from the observed distribution of non-FOMC returns another series of length equal to the number of non-FOMC days. With the two series at hand, we reestimate the dummy variable regression (1) and record the estimated coefficients. For both the 1994 to 2011 and the 1980 to 2011 samples, we find the empirical distribution of the estimated pre-FOMC dummy coefficients across bootstrap replications to have a mean and standard deviation that are very close to those in Table II.

As a second bootstrap exercise, we assess how likely it would be to observe an average return as large as the pre-FOMC drift in a sample drawn from the return distribution on all other days. To that end we draw with replacement from the empirical distribution of non-FOMC returns a time-series of length equal to the number of scheduled FOMC announcement days. For both estimation samples, the probability of obtaining a series with an average greater than the sample mean of pre-FOMC returns is zero. Hence, it is essentially impossible to have observed such a large mean had one drawn from the distribution of returns outside the pre-FOMC window.

In a similar vein, one might be concerned that it is not unlikely to observe a sample mean as large as the pre-FOMC return in a short sample drawn from a distribution with a population mean of zero but with the higher moments observed on the pre-FOMC windows.[17] We assess this possibility by constructing pseudo zero-mean pre-FOMC return distributions for the 1994 to 2011 and 1980 to 2011 samples. More precisely, we subtract the sample means of pre-FOMC returns from all observations so that, by construction, the resulting distributions have a sample mean of zero but higher moments identical to the distribution of pre-FOMC returns. We then randomly draw with replacement from the pseudo pre-FOMC distributions series of length equal to the number of FOMC days. For both estimation samples, we find that the probability of observing a sample mean greater than or equal to the average pre-FOMC return is essentially zero.

Finally, one might also worry that the significance of our finding (and thus the Sharpe ratios) could be the artificial outcome of an extensive search across the universe of economic news announcements for the highest t-statistic. Of course, such a search would not bias the large economic magnitude of the return. We address this concern by conducting a reality check à la White (2000). We

[17] We thank an anonymous referee for raising this point.

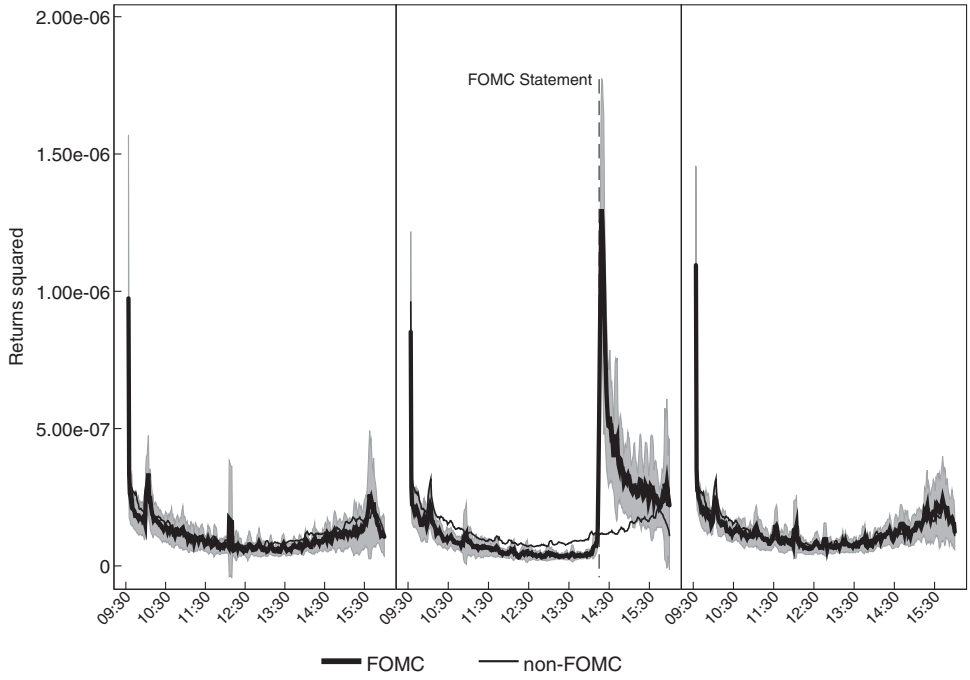

Figure 3. Intraday realized volatility of S&P500 index returns. This figure shows intraday realized volatility over three-day windows. The thick line is the average five-minute rolling sum of squared tick-by-tick returns on the S&P500 from 9:30 am ET on days prior to scheduled FOMC announcements to 4:00 pm ET on days after scheduled FOMC announcements. The sample period is from September 1994 through March 2011. The thin line is the result of the same calculation on all other three-day windows that do not contain FOMC announcements. Shaded areas represent pointwise 95% confidence bands around FOMC means.

draw with replacement from the empirical distribution of 24-hour returns and record the largest absolute t-statistic among 10 dummy variable regressions that include as individual regressors dummies for FOMC announcements as well as nine other economic news announcements considered in Table VII. For both the 1994 to 2011 and the 1980 to 2011 samples, we find that the probability of finding a t-statistic as large as the ones we document for the average pre-FOMC returns is smaller than 0.02%. Hence, the statistical significance of our finding is extremely unlikely to be the result of data-snooping.

E. Realized Volatility and Liquidity in the Pre-FOMC Window

In this subsection, we briefly document intraday realized volatility and liquidity patterns on the SPX around FOMC announcements. Figure 3 plots the five-minute moving sums of squared tick-by-tick returns on the SPX (available about every 15 seconds) in the three-day window around the FOMC announcement (thick line). For comparison, we superimpose intraday average realized

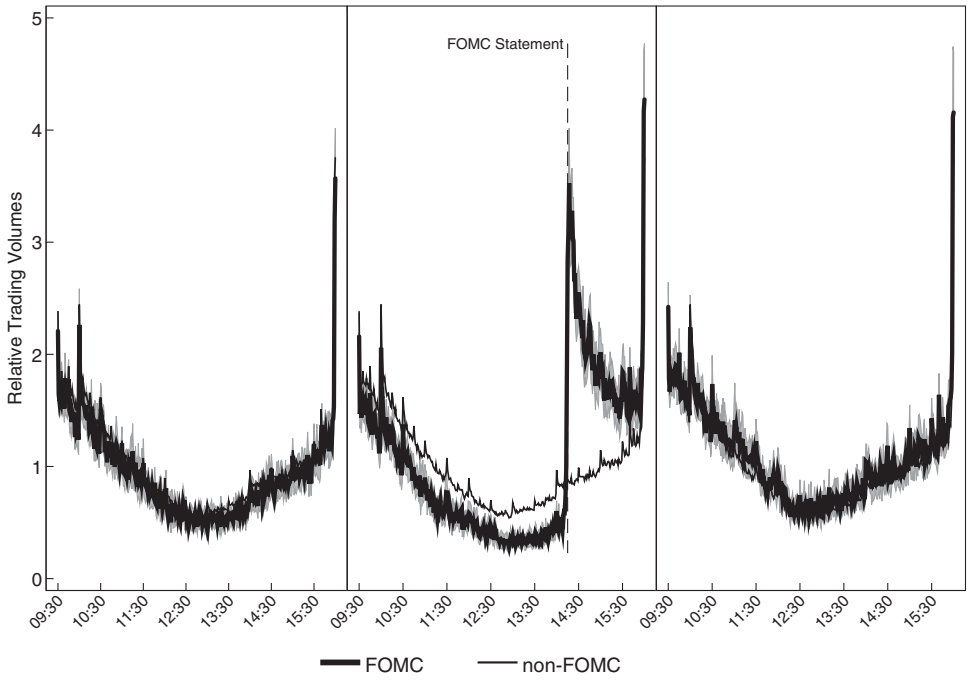

Figure 4. Intraday trading volumes for the E-mini S&P500 future. This figure shows intraday trading volume of E-mini S&P500 futures over three-day windows. The thick line is the average five-minute (scaled) rolling average number of contracts traded from 9:30 am ET on the days before scheduled FOMC announcements until 4:00 pm ET on days after scheduled FOMC announcements. For each minute, the rescaling is relative to the 21-day prior average trading volume. The thin line is the result of the same calculation on all other three-day windows that do not contain FOMC announcements. Shaded areas represent pointwise 95% confidence bands around FOMC means.

volatility on non-FOMC days (thin line). Volatility on the day prior (and after) FOMC announcements follows the typical U-shaped pattern observed on other days. On FOMC days, prior to the announcement, realized volatility is somewhat lower, and, as discussed below in Section III.H, the same holds for implied volatility (as measured by the VIX). As one may suspect, realized volatility jumps at 2:15 pm on scheduled FOMC days when the FOMC statement is released.

While we do not observe trades or bid-ask spreads for all SPX constituents on an intraday basis, we proxy for liquidity measures of the cash index using tick-by-tick measures based on the S&P500 E-mini futures, which started trading in September 1997. The E-mini tracks the SPX very closely and exhibits almost identical pre-FOMC announcement returns as the cash index itself.[18] Figure 4 shows five-minute average trading volumes on the most

[18] The patterns described below are similar when using the SPDR S&P500 exchange traded fund rather than the E-mini future.

traded (either first- or next-to-front) S&P500 E-mini futures contract over the same three-day window as above. Because trading volume has a low frequency trend in our sample period, we display volume levels relative to their prior 21-day mean. The liquidity patterns match those for realized volatility: both are lower in the pre-FOMC drift time window but spike at the announcement.[19]

F. International and U.S. Cross-Sectional Evidence

In this subsection, we document the pre-FOMC drift in major international equity indices and show that FOMC announcement-day returns are widespread across U.S. portfolios sorted by size and industry.

Previous research (see, for example, Karolyi and Stulz (1996)) finds ample evidence of international stock return comovement. This evidence suggests that international equity indices may also feature an FOMC equity return differential. To address this question, we reestimate model (1) with a constant and a pre-FOMC dummy on daily close-to-close (local currency and ex-dividend) returns of major OECD stock indices for the sample period from September 1994 to March 2011. The results of these regressions are documented in the upper panel of Table VI.[20] The first five columns report estimates based on returns on the German DAX, the British FTSE 100, the French CAC40, the Spanish IBEX, as well as the Swiss SMI. Importantly, because of the time offset, the close-to-close returns on these European stock indices never include scheduled FOMC announcements and thus provide estimates of pre-FOMC announcement returns.[21] The pre-FOMC dummy variables are highly statistically significant and economically large in all five countries, with pre-FOMC estimates ranging from 29 basis points in Switzerland to 52 basis points in France. In all five countries the Sharpe ratios of an FOMC-only investment strategy range between 0.75 and 1.04. Results for the Canadian TSX index and the Japanese NIKKEI 225 are reported in the last two columns of Table VI. The TSX shows a statistically significant albeit lower FOMC announcement-day return than the European indices.[22] Interestingly, the NIKKEI index is the only major stock market index that does not feature a significant FOMC announcement-day return. In the bottom panel of the table we repeat the same regressions in the post-1980 sample, and also find evidence of large pre-FOMC returns on major international stock indices in this longer sample. We also

[19] These results are consistent with a "quiet-before-the-storm" effect found by Jones, Lamont, and Lumsdaine (1998) for inflation and labor market releases, and by Bomfim (2003) for FOMC announcements between 1994 and 2001.

[20] Due to a lack of comparable dividend and risk-free rate data, these regressions are based on ex-dividend gross returns rather than cum-dividend excess returns as in the analysis of the SPX above.

[21] In the Internet Appendix, we compare intraday cumulative returns on these international stock indices in their respective trading hours to the SPX cumulative return on day triplets around FOMC announcements.

[22] Note that the TSX is computed from close prices taken after the FOMC announcement and therefore contains both a preannouncement and a postannouncement component.

Table VI

Returns on International Stock Market Indices

This table reports estimates of pre-FOMC dummy coefficients for daily close-to-close returns on the German DAX, British FTSE 100, French CAC40, Spanish IBEX, Swiss SMI, Canadian TSX index, and Japanese NIKKEI 225. The sample in the upper panel is September 1, 1994 to March 31, 2011. Samples in the lower panel differ across indices depending on data availability and are reported in the bottom row. ***Significant at 1%, **significant at 5%, *significant at 10%. Robust standard errors are shown in brackets.

	Dependent Variable %Log Return of Stock Market Indices						
	DAX	FTSE100	CAC40	IBEX	SMI	TSX	NIKKEI
				Post-1994 Sample			
pre-FOMC dummy	0.43	0.34	0.52	0.48	0.29	0.21	0.03
	[0.11]***	[0.11]***	[0.13]***	[0.12]***	[0.10]***	[0.09]**	[0.16]
Const.	0.01	0.00	−0.00	0.01	0.01	0.02	−0.02
	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]
Sharpe ratio	1.04	0.81	1.03	1.01	0.75	0.67	0.01
Obs.	4,096	4,100	4,102	4,071	4,074	4,087	3,943
No. of FOMC	131	132	132	132	132	131	125
				Post-1980 Sample			
pre-FOMC dummy	0.16	0.21	0.38	0.38	0.20	0.14	0.03
	[0.08]**	[0.08]***	[0.10]***	[0.10]***	[0.09]**	[0.06]**	[0.11]
Const.	0.03	0.02	0.01	0.01	0.02	0.02	0.00
	[0.02]*	[0.01]	[0.02]	[0.02]	[0.02]	[0.01]*	[0.02]
Sharpe ratio	0.44	0.57	0.78	0.79	0.55	0.54	0.05
Observations	7,686	6,753	5,842	5,930	5,585	7,716	7,453
No. of FOMC	244	211	182	185	175	241	235
Sample period	1980:01–2011:03	1984:01–2011:03	1987:07–2011:03	1987:01–2011:03	1988:07–2011:03	1980:01–2011:03	1980:01–2011:03

investigate whether the European, British, and Japanese stock indices feature similar return patterns before their corresponding central banks' monetary policy announcements, but we do not find such effects. While a global phenomenon, the preannouncement return is thus specific to U.S. monetary policy decisions.

Having established that U.S. and international stock market indices exhibit economically large and statistically highly significant pre-FOMC returns, we next analyze the cross-sectional variation of U.S. equity portfolio returns on days of scheduled FOMC announcements. Because of more limited availability of intraday data at the disaggregated level, this analysis is based on daily close-to-close returns. To the extent that individual stocks mirror the pre-FOMC drift that we document for the market as a whole, the close-to-close returns should be good proxies for the pre-FOMC drift of disaggregated portfolios.

We estimate the dummy variable regression (1) including a constant and an FOMC dummy using as dependent variables the daily excess returns on the value- and equal-weighted market index from the Center for Research in Security Prices (CRSP), 10 value-weighted portfolios sorted by firm size, and 49 value-weighted industry portfolios. We summarize the results of these regressions here and report detailed regression tables in the Internet Appendix. We find evidence of large and statistically significant FOMC-day returns across stock portfolios of firms with different market caps and from different industries, and results are similar for both the 1994 to 2011 and the 1980 to 2011 samples. Firms in the second to tenth size deciles have similar FOMC announcement-day returns while small firms feature somewhat lower returns on these days. Moreover, the majority but not all of the 49 industry portfolios feature statistically significant excess returns on FOMC days. Financials and banks show the largest FOMC-day returns while industries typically considered to be less volatile such as agriculture and food feature smaller and insignificant FOMC-day returns.

It is natural to ask whether the average excess returns on FOMC announcement days in different industries and size deciles are in line with their typical comovement with the market portfolio, as would be implied by the capital asset pricing model (CAPM). To address this question, we estimate portfolio betas from a regression of each portfolio's excess return on the excess return of the CRSP value-weighted market portfolio.[23] We then estimate a cross-sectional regression of average excess returns on the 59 industry and size portfolios on the estimated betas. Figure 5 shows a scatter plot of observed average FOMC announcement-day returns against the fitted values from this regression. We superimpose the estimated regression line (dashed) as well as the 45-degree line (solid). The figure shows that the single market factor model provides a good description of the cross-section of FOMC-day returns. Indeed, the slope coefficient λ, which represents the price of market risk, is estimated to be 47

[23] We run this regression using daily data including FOMC announcement days. Dropping these days from the sample barely affects the β estimates.

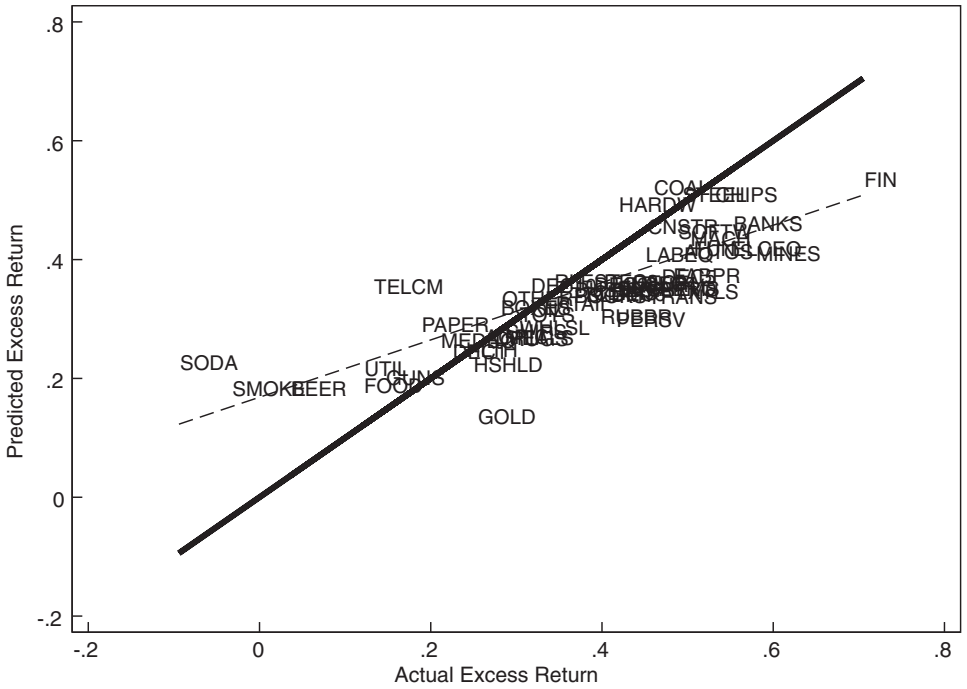

Figure 5. CAPM for industry and size portfolios on FOMC announcement days. This figure shows the fit of the CAPM for the 49 Fama-French industry portfolios and the 10 size decile portfolios on FOMC announcement days. For each portfolio, the horizontal axis shows the average excess return earned on scheduled FOMC announcement days (in percent) whereas the vertical axis shows the excess return implied by the CAPM. The sample period is from September 1994 through December 2010. The betas are estimated from a regression of the portfolio's excess return on the excess return of the market portfolio at a daily frequency (using all days in the sample). The result from the second-stage cross-sectional regression is $\bar{R}_{\text{FOMC}} = -0.099_{[0.10]} + 0.468_{[0.149]}\hat{\beta}$, where the standard errors are adjusted for the estimation error in betas following Shanken (1992). The R^2 of the regression is 65. The dashed line shows the estimated regression line and the solid black line shows the 45-degree line.

basis points and highly statistically significant. By contrast, the constant α in the regression is not statistically different from zero. Moreover, the adjusted R^2 of the CAPM regression on FOMC announcement days is 65%. These results indicate that the observed cross-sectional variation of FOMC announcement-day returns is well captured by exposure to aggregate market risk.[24] This finding is in contrast to the well-documented failure of the CAPM to explain the

[24] At the announcement, Bernanke and Kuttner (2005) also find that the CAPM does a good job at explaining the cross-sectional variation of the response of different industry portfolio returns to monetary policy shocks. Moreover, in a recent paper Savor and Wilson (2012) find that, on days when news about inflation, unemployment, or FOMC decisions is announced, stock market beta is significantly related to returns on individual stocks, equity portfolios, as well as other asset classes.

cross-sectional variation of average excess returns on equities. Many authors (see, for example, Fama and French (1993)) have argued that additional risk factors beyond the return on the market portfolio are needed to explain the cross-section of stock returns. To the extent that risk exposures are not different on FOMC announcement days and that the additional risk factors do not earn differential excess returns on these days in contrast to the market portfolio, it may not be surprising that the CAPM explains average excess equity returns better on FOMC days than on other days.

G. Other Macroeconomic Announcements and Other Assets

In this section, we first document that the SPX does not feature abnormal excess returns ahead of other major macroeconomic announcements. We then show that fixed income assets do not exhibit abnormal pre-FOMC announcement returns.

We consider a set of nine major U.S. economic releases: total nonfarm payroll employment (NFPAY) published monthly by the Bureau of Labor Statistics (BLS), weekly initial claims for unemployment insurance (INCLM) released by the U.S. Department of Labor, the advance GDP (GDPADV) estimate released quarterly by the Bureau of Economic Analysis (BEA), the monthly Institute for Supply Management's (ISM) manufacturing index, industrial production (IP) released monthly by the Federal Reserve Board, housing starts (HS) published monthly by the Census Bureau, producer price index (PPI), and consumer price index (CPI) data published monthly by the BLS, as well as personal income (PI) released monthly by the BEA. Except for IP, which is released at 9:15 am ET, and the ISM, which is released at 10:00 am ET, all these data releases occur at 8:30 am ET. To assess whether there are preannouncement returns for these macroeconomic data releases, we run a dummy variable regression where the dummy variable equals one on the day prior to the release.

As shown in the upper panel of Table VII, none of the other macroeconomic releases feature statistically significant preannouncement returns in the 1994 to 2011 sample. The largest coefficient is the one for housing starts, which implies a 13 basis point excess return on the SPX on days prior to that announcement. However, the standard deviation of that return is also quite large at nine basis points. We repeat these regressions for the 1980 to 2011 sample (lower panel of Table VII), and find qualitatively similar results. In this longer sample, the PPI release is the only macroeconomic news that exhibits a preannouncement return that is significant at the 10% level. However, the estimated coefficient is negative. As we document in the data-snooping exercise in Section III.D, one is bound to find coefficients that are significant at marginal levels if one runs enough dummy variable regressions. We thus conclude that no other major macroeconomic announcement is associated with large and statistically significant preannouncement returns.

Table VII

S&P500 Index Returns Ahead of Other Economic News

This table reports preannouncement dummy variable regressions for various macroeconomic news announcements as discussed in Section III.G. The dependent variable is the daily close-to-close cum-dividend log excess return on the S&P500. The sample in the top panel starts on September 1, 1994 and ends on March 30, 2011. The sample in the bottom panel starts on January 2, 1980 and ends on March 30, 2011. The table does not report the coefficient on a constant, which is always included. The macroeconomic releases are: employment report (NFPAY), initial claims (INCLM), advance GDP (GDPADV), ISM manufacturing index (ISM), industrial production (IP), housing starts (HS), producer price index (PPI), consumer price index (CPI), personal income (PI), and all economic releases (ALL).***Significant at 1%, **significant at 5%, *significant at 10%. Robust standard errors are shown in brackets.

Dependent Variable: %Log Return of SP&500 Stock Market Index										
	NFPAY	INCLM	GDPADV	ISM	IP	HSTART	PPI	CPI	PI	ALL
Post-1994 Sample										
Pre-news dummy	−0.08	−0.01	0.07	−0.09	0.01	0.13	−0.10	−0.09	−0.01	−0.04
	[0.09]	[0.05]	[0.14]	[0.08]	[0.09]	[0.09]	[0.08]	[0.10]	[0.08]	[0.04]
No. of events	198	861	66	199	211	197	204	206	201	1,866
Post-1980 Sample										
Pre-news dummy	−0.08	0.04	0.02	0.04	0.01	−0.02	−0.11	−0.08	0.04	−0.00
	[0.06]	[0.03]	[0.10]	[0.05]	[0.06]	[0.08]	[0.06]*	[0.07]	[0.05]	[0.03]
No. of events	369	1,627	125	375	386	372	375	381	374	3,561

We next study the pre-FOMC announcement effects on Treasury securities of different maturities as well as interest rate futures.[25] The short-term rate derivatives that we consider are standard market-implied measures of monetary policy expectations: the front-month fed funds futures contract (or the second-month contract if the FOMC falls in the last third of the month to address data-noise issues) and the fourth euro contract. These interest rate futures measure policy expectations for one month and one year out, respectively. FOMC dummy regression results for these securities for the sample periods 1994 to 2011 and 1980 to 2011 are provided in Table VIII. For the 1994 to 2011 sample, none of the coefficients are statistically significant at conventional confidence levels. For the 1980 to 2011 sample, the on-the-run 10-year Treasury is significant at the 10% level with a coefficient of less than one basis point.[26] In sum, the results in this section show that the preannouncement drift that we report is specific to equities ahead of FOMC announcements. It does not exist ahead of other macroeconomic announcements or in fixed income securities ahead of FOMC announcements.

H. The Time-Series of Pre-FOMC Returns

Before turning to potential explanations for our empirical findings, in this section we study the correlation over time of pre-FOMC returns with a number of observable variables. Figure 6 shows the time-series of pre-FOMC returns (dashed line) along with their one-year moving average (solid line) from 1980 to 2011.[27] One-year average pre-FOMC returns remain positive for the majority of the sample and turn negative only for brief periods of time. Moreover, it appears that pre-FOMC returns are somewhat higher around recessions and in periods of financial turbulence such as the 1987 stock market crash or the 1998 Long-Term Capital Management (LTCM) crisis. To study potential determinants of pre-FOMC returns more formally, we next regress the time-series of these returns on explanatory variables capturing business cycles, monetary policy cycles, market expectations of future Fed policy, market uncertainty, and the surprise component of monetary policy decisions.

The results of these regressions are reported in Table IX for the 1994 to 2011 sample and in Table X for the 1980 to 2011 sample. All explanatory variables except for dummy regressors are standardized to have zero mean and unit variance in each of the two samples to facilitate interpretation of the coefficients.

[25] See Kuttner (2001) and Bernanke and Kuttner (2005) for asset responses to policy rate decisions, and Gürkaynak, Sack, and Swanson (2005) and Lucca and Trebbi (2009) for responses to the content of the statements.

[26] A closer inspection of this result reveals that it is entirely driven by a few outlier observations in 1980, a year in which money supply numbers were sometimes coincidentally released on days of FOMC meetings. When we start the sample in 1981, the FOMC dummy becomes insignificant for the 10-year Treasury.

[27] The large right-tailed observation (October 29, 2008) that we exclude in Table III is excluded from the pre-FOMC moving average and marked with an "X." We also exclude this observation from the regressions discussed next.

Table VIII

Fixed Income Instruments

The sample in the top panel is September 1, 1994 to March 30, 2011 and the dependent variables are percent yield changes from 2 pm on date $t-1$ to 2 pm on date t. "pre-FOMC dummy" is a variable that takes the value of one if the next 24-hour trading interval comprises a scheduled FOMC announcement, and zero otherwise. Samples in the bottom panel differ depending on data availability as reported in the bottom row and start no earlier than January 2, 1980 and end on March 30, 2011. The dependent variables in this sample are close-to-close yield changes in percent prior to 1994, and yield changes in percent from 2 pm on the day before a scheduled FOMC announcement to 2 pm on the announcement day after 1994. "FF" are rates implied by the front (next month) in the first two-thirds (last third) of each month. "ED-4" is the fourth euro implied rate. Variables denoted "TREAS" refer to yields on the 3 months, 2 years, 5 years, and 10 years benchmark Treasury issues. ***Significant at 1%, **significant at 5%, *significant at 10%. Robust standard errors are shown in brackets.

	FF	ED-4	TREAS-3M	TREAS-2Y	TREAS-5Y	TREAS-10Y
			Post-1994 Sample			
pre-FOMC dummy	0.001	0.007	0.001	0.006	0.001	−0.002
	[0.001]	[0.006]	[0.004]	[0.004]	[0.004]	[0.004]
Const.	−0.002	−0.001	−0.001	−0.002	−0.001	−0.001
	[0.0004]***	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Obs.	4,322	4,325	4,210	4,325	4,325	4,325
No. of FOMC	131	132	132	132	132	132
			Post-1980 Sample			
pre-FOMC dummy	0.002	0.008	−0.010	−0.004	−0.006	−0.009
	[0.001]	[0.006]	[0.007]	[0.005]	[0.005]	[0.005]*
Const.	−0.002	−0.001	−0.001	−0.001	−0.001	−0.001
	[0.0004]***	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Obs.	5,765	6,454	7,867	7,986	7,986	7,986
No. of FOMC	170	193	245	245	245	245
Sample period	1988:12–2011:03	1986:04–2011:03	1980:01–2011:03	1980:01–2011:03	1980:01–2011:03	1980:01–2011:03

Table IX

S&P500 Index Return Time-Series Regressions (Post-1994)

This table reports results time-series regressions of pre-FOMC announcement returns on various explanatory variables, discussed in Section III.H. The sample starts on September 1, 1994 and ends on March 30, 2011. The dependent variable is a time-series of cum-dividend log excess returns on the S&P500 from 2 pm on days before to 2 pm on days of scheduled FOMC announcements. "NBER dummy" is a (daily) recession dummy indicator. "Δ^{12} Log(IP)" is the 12-month log change of the real-time industrial production index, "Δ^{12} Log(CPI)" is the 12-month log change of the real-time consumer price index. "Easing cycle" and "Tightening cycle" are dummy variables that are equal to one if the corresponding observation can be classified as falling into a period of monetary loosening or tightening, respectively. "Level" and "Slope" are the first two principal components from the cross-section of daily one through five year zero-coupon Treasury yields from Gürkaynak, Sack, and Wright (2007), lagged two days with respect to the FOMC announcement day. "VIX" is the level of the VIX index at the market close two days before the scheduled meeting. "Kuttner surprise" is a monetary policy surprise measure constructed as in Bernanke and Kuttner (2005) and Gürkaynak, Sack, and Swanson (2005) on a 2 pm-to-3 pm window around FOMC announcements. "SPX surprise" is the 2 pm-to-3 pm FOMC announcement return on the SPX. "pre-FOMC(MA8)" is the moving average of pre-FOMC returns over the past eight meetings. ***Significant at 1%, **significant at 5%, *significant at 10%. Robust standard errors are shown in brackets.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
NBER dummy	0.62							
	[0.33]*							
Δ^{12} Log(IP)		−0.13						
		[0.12]						
Δ^{12} Log(CPI)		−0.03						
		[0.13]						
Tightening cycle			0.06					
			[0.14]					
Easing cycle			0.48					
			[0.32]					
Level				−0.04				
				[0.11]				
Slope				−0.19				−0.23
				[0.10]*				[0.08]***
VIX					0.31			0.26
					[0.08]***			[0.10]***
SPX surprise						−0.12		
						[0.10]		
Kuttner surprise						0.04		
						[0.10]		
pre-FOMC(MA8)							0.28	0.17
							[0.08]***	[0.08]**
Const.	0.33	0.42	0.33	0.42	0.42	0.42	0.42	0.42
	[0.08]***	[0.08]***	[0.10]***	[0.08]***	[0.08]***	[0.08]***	[0.08]***	[0.07]***
Adjusted R^2	0.05	0.01	0.02	0.02	0.10	0.01	0.08	0.18
Obs.	130	130	130	130	130	130	130	130

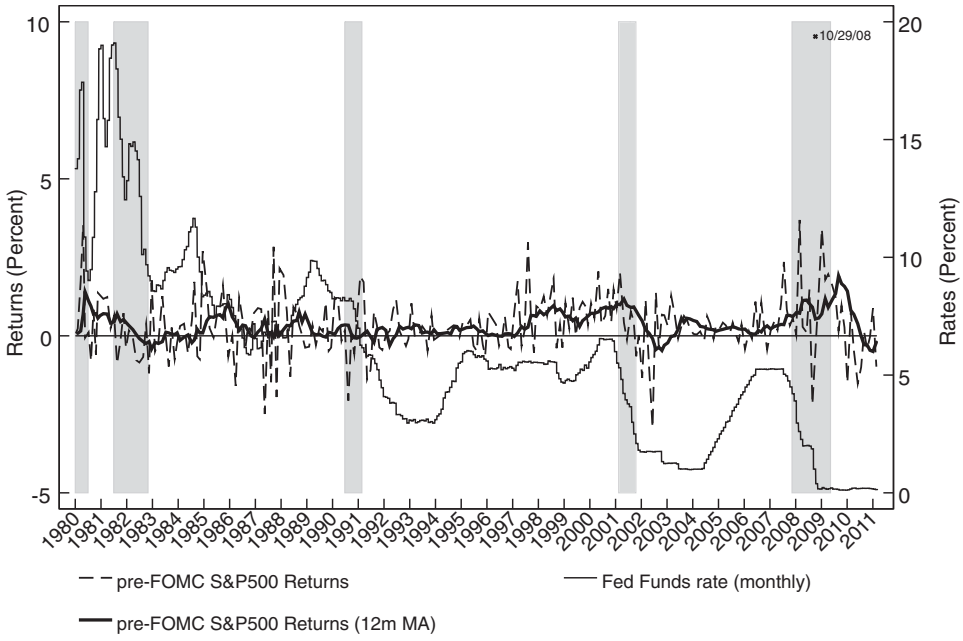

Figure 6. Time-series of pre-FOMC announcement returns on the S&P500 index. The dashed line is the time-series of pre-FOMC announcement returns from January 1980 through March 2011 (post-1994, cum-dividend log excess return on the S&P500 from 2 pm on the day prior to a scheduled FOMC announcement to 2 pm on that day; pre-1994, daily close-to-close cum-dividend log excess return on the SPX on days of scheduled FOMC meetings). The solid thick line shows the one-year moving average of these returns. The thin solid line is the monthly average of the effective federal funds rate.

The first column in the tables shows a regression of pre-FOMC returns on a NBER recession dummy. In the 1994–2011 sample the point estimate on the dummy is positive and significant at the 10% level. However, while still positive, the coefficient is not statistically different from zero in the longer 1980–2011 sample. We therefore find only weak evidence that pre-FOMC returns are countercyclical based on NBER recessions. Of course, a recession dummy is only a coarse measure of economic activity, and only known to market participants ex-post. We therefore consider annual growth rates of IP as well as annual inflation as measured by the CPI as regressors (column (2)). Both series are computed using real-time data that we obtain from the ALFRED St. Louis Fed database. The two coefficients are slightly negative but statistically insignificant in the two samples, confirming that pre-FOMC returns are not strongly countercyclical.[28] Regressing pre-FOMC returns on dummy variables for periods of monetary policy easing and tightening (column (3)), we see that

[28] Similarly, we also do not find a significant link with the annual growth of nonfarm payroll employment as well as a simple measure of the output gap constructed from detrended IP as in Cooper and Priestley (2009).

Table X

S&P500 Index Return Time-Series Regressions (Post-1980)

This table reports results for regressions of the time-series of pre-FOMC announcement returns on various explanatory variables for the sample period 1980 to 2011, discussed in Section III.H. The dependent variable is a time-series of cum-dividend log excess returns on the S&P500 from 2 pm on days before to 2 pm on days of scheduled FOMC announcements starting in 1994, and of close-to-close cum-dividend log excess returns on the S&P500 on days of scheduled FOMC meetings before 1994. For other variable definitions refer to Table IX. Depending on data availability, the sample start may differ across the various explanatory variables, as indicated by the top row. ***Significant at 1%, **significant at 5%, *significant at 10%. Robust standard errors are shown in brackets.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sample Start	1980:01	1980:01	1980:01	1980:01	1990:02	1988:11	1980:01	1990:02
NBER dummy	0.20							
	[0.21]							
Δ^{12} Log(IP)		−0.05						
		[0.07]						
Δ^{12} Log(CPI)		−0.01						
		[0.08]						
Tightening cycle			0.00					
			[0.14]					
Easing cycle			0.02					
			[0.15]					
Level				−0.05				
				[0.07]				
Slope				−0.15				−0.16
				[0.06]**				[0.06]**
VIX					0.26			0.19
					[0.08]***			[0.09]**
SPX surprise						−0.06		
						[0.09]		
Kuttner surprise						0.02		
						[0.07]		
pre-FOMC(MA8)							0.18	0.15
							[0.06]***	[0.08]**
Const.	0.29	0.33	0.32	0.33	0.37	0.35	0.33	0.37
	[0.06]***	[0.06]***	[0.09]***	[0.06]***	[0.07]***	[0.07]***	[0.06]***	[0.07]***
Adjusted R^2	0.00	−0.01	−0.01	0.02	0.08	−0.01	0.03	0.12
Obs.	243	243	243	243	161	169	243	161
No. of FOMC	243	243	243	243	161	169	243	161

the pre-FOMC returns are considerably larger in periods of monetary policy easing (which to a good extent overlap with recessions) in the shorter 1994 to 2011 sample, but the coefficients are not significant.[29] The coefficients on

[29] We define tightening cycles as periods between local troughs and peaks of the target federal funds rate and easing cycles as periods between local peaks and troughs of the target rate or when the Federal Reserve conducted large-scale asset purchase programs. The chronology that we obtain with this simple dating approach is very similar to the one in Adrian and Estrella (2008). The constant in the regression measures the average pre-FOMC returns in the third regime, in which the Federal Reserve is neither tightening nor easing.

both the easing and the tightening dummies are economically and statistically insignificantly different from zero in the longer sample from 1980 to 2011.

We next assess whether pre-FOMC equity returns are related to market participants' expectations about the future path of monetary policy, as measured by the first two principal components (level and slope) from the cross-section of Treasury yields. We use daily zero-coupon yields from Gürkaynak, Sack, and Wright (2007) for maturities from one through five years. As we do not have access to intraday yield curve data, we lag the principal components by two days with respect to the FOMC announcement day to get an ex-ante, albeit approximate, snapshot of the yield-curve information available to market participants before the pre-FOMC window. The slope enters with a negative coefficient that is significant at the 10% (5%) level (column (4)). The point estimates imply that a one-standard-deviation increase in the slope lowers the pre-FOMC drift by about 19 (15) basis points in the post-1994 (post-1980) sample. Thus, up to term premia, the pre-FOMC drift is lower when investors expect the Fed to tighten policy.

We next assess whether pre-FOMC returns are related to equity market uncertainty as measured by the VIX at the market close two days before scheduled meetings. As shown in column (5), the VIX is strongly significant with a coefficient of 0.31 in the 1994 to 2011 sample. In other words, a one-standard-deviation increase in the VIX is associated with pre-FOMC returns that are 31 basis points higher in that sample. In the longer sample (the VIX is only available starting in 1990), the coefficient on the two-day lagged level of the VIX drops slightly, but remains strongly statistically significant.

We also consider whether pre-FOMC returns are related to ex-post monetary policy surprises as measured by federal funds rate futures and stock market responses to FOMC announcements (column (6)). In the post-1994 sample, fed funds (and SPX) surprises are constructed as in Bernanke and Kuttner (2005) and Gürkaynak, Sack, and Swanson (2005), using the 2 pm to 3 pm time window around FOMC announcements.[30] The coefficients on the futures-implied policy surprise are statistically and economically zero in both samples. The coefficient on the stock market surprise is estimated to be negative 12 basis points in the post-1994 sample, but is also statistically insignificant. Thus, not surprisingly, the magnitude of ex-ante returns is not associated with the ex-post policy surprise.

As evidenced by the one-year moving average of pre-FOMC returns in Figure 6, there seems to be some persistence in the pre-FOMC return. To assess whether there is some time-series predictability of pre-FOMC returns at low frequencies, we regress them on their average over the past eight FOMC meetings (a variable that we label MA8). We find that the backward-looking

[30] From 1994 to 2011 we follow Gürkaynak, Sack, and Swanson (2005) and take the change from 2 pm to 3 pm as the surprise measure. Before 1994, we follow Bernanke and Kuttner (2005) and use the daily change in the contract. The return on the SPX is from 2 pm to 3 pm on FOMC announcement days from 1994 onwards, and we use the daily return of the SPX on the day after the FOMC meeting before 1994 as our equity-based measure of monetary policy surprises.

moving average is a highly statistically significant explanatory variable for future pre-FOMC returns with a large positive sign in both samples (column (7)). Above, we document that the slope of the Treasury yield curve and the level of the VIX also predict some of the time-series variation in pre-FOMC returns. To gauge whether there is serial correlation in pre-FOMC returns beyond the variation explained by these two variables, we run a regression that includes the slope, the VIX, as well as the past moving average of pre-FOMC returns as regressors. The results show that all three variables retain their significance in the joint regression in both samples and explain a sizable fraction (18%) of the time-series variation in pre-FOMC returns (column (8)).

In sum, pre-FOMC returns tend to be higher when investors expect the Fed to ease its monetary policy stance, when implied equity market volatility is high, and when past pre-FOMC returns have been positive.

IV. Potential Explanations

In this section, we attempt to rationalize the pre-FOMC drift with a number of alternative explanations. We first discuss risk-based explanations and then consider other potential explanations.

A. Risk-Based Explanations

In standard asset pricing theory, excess returns are earned as compensation for undiversifiable risk. For example, in consumption-based models, investors demand compensation for holding assets whose payoffs are negatively correlated with their marginal utility of consumption. FOMC announcements provide investors with information about policy actions, the likely path of interest rates, and the macro-economic outlook. Therefore, systematic and political risk (in the sense of Pástor and Veronesi (2013)) are high on FOMC-announcement days as investors receive signals about future consumption growth and asset payoffs. Yet, while FOMC members often discuss monetary policy in speeches and interviews between meetings, they do not do so in the blackout period that starts one week before FOMC meetings. Of course, investors may learn about monetary policy indirectly through other economic releases or market commentaries in the pre-FOMC window. That said, as discussed in Section III.E, both realized volatility and trading volume are low in the hours before the announcement but then jump when the statement is released. These patterns indicate that the flow of new information is significantly lower in the pre-FOMC window as compared to the time of the announcement or on other days. Indeed, in a large set of asset pricing models, an absence of arbitrage implies that price volatility is proportional to the rate of information flow (Ross (1989)). In terms of trading volumes, market microstructure models such as Kim and Verrecchia (1991) predict that volumes increase around public announcements with the precision of the announcement and decrease with the precision of preannouncement information. Combined, these models and our evidence support the view that the key information on FOMC days is received

by investors not surprisingly at the announcement and not in the preannouncement window. In contrast, returns are high in the pre-FOMC window but have averaged to zero at the announcement. The main challenge for explanations based on higher systematic risk is precisely this disconnect between the time when the returns are earned and when the news is revealed.[31]

Even if systematic risk is not higher ahead of the announcement, a reallocation of that risk may result in a higher premium. Duffie (2010) presents a model in which inattentive investors trade only infrequently while specialists trade frequently. In his model, prices decline ahead of scheduled bond issuance as specialists temporarily hold a larger share of total market risk. In the case of pre-FOMC returns, when the supply of assets does not change, one could assume that inattentive investors may sell out of their positions ahead of the announcement for fear of trading with better-informed specialists. As a result, a larger share of the market risk would be borne by the specialists, and in the mean-variance setup of Duffie (2010), they would demand compensation in the form of higher expected returns ahead of the announcement. While this framework would have the attractive feature of not requiring higher aggregate risk in the pre-FOMC window to generate a premium, it is not immediately clear why it would be optimal for the inattentive investors to sell out of their positions. Indeed, in the informational disadvantage story just discussed, simply not trading in the pre-FOMC window would protect nonspecialist investors against an informed trade but would earn them a premium and not require them to trade out of their (presumably preferred) original position. That said, while a complete characterization of this framework is beyond the scope of this section, we note that such a time-varying limited participation model seems to fit some but not all of the empirical evidence.[32]

B. Other Explanations

In this section, we consider a few alternative explanations including a good news story, an information leakage story, as well as explanations related to volatility and liquidity shocks.

Under a good news explanation, one may presume that pre-FOMC returns were not expected by investors and thus did not reflect risk compensation, but were rather earned as a result of news that positively surprised investors.

[31] In addition, a standard risk-based explanation appears difficult to reconcile with the absence of the pre-FOMC drift in fixed income instruments or of preannouncement returns on equities ahead of other major economic releases. Finally, we do not find the pre-FOMC drift to be substantially higher in economic downturns when equity risk premia tend to be high.

[32] For example, the volatility and volume patterns are consistent with a reallocation of market risk among investors. Assuming that the fraction of monetary policy specialists is larger in fixed income markets, this story could potentially also match the fact that the returns are present in equity but not in fixed income markets. However, within the confines of this story it is not immediately clear why there are no preannouncement equity returns ahead of other key macroeconomic releases. Finally, it remains an open question whether such a model implies that pre-FOMC returns persist on subsequent trading sessions (Section III.C) as risk gets reallocated to all investors following the announcement.

Consistent with this view, one may argue that monetary policy news has on average been positive for stocks since the 1980s, as the federal funds rate has trended down over the past 30 years, reaching historically low levels at the end of our sample while inflation remained contained. In addition, under a government put view (see, for example, Diamond and Rajan (2011)), monetary policy has an asymmetric impact on stocks as financial conditions are eased in times of trouble but not tightened correspondingly in good times. Potentially consistent with such a story, the pre-FOMC drift is larger in periods of financial stress when the VIX is high (Section III.H). That said, it is not clear why the positive news or the notion of a put should be incorporated into prices only during the pre-FOMC window, and not at the announcement (or on other days) when the flow of monetary policy news is significantly larger but when returns average to zero.

One possible way to rationalize the timing of returns would be to assume that investors have restricted information sets or short investment horizons due to myopic preferences. For example, investors may be slow at updating their information sets in models of inattention such as Sims (2003) because they face constraints as to how much information they can process. For example, in Kacperczyk, Nieuwerburgh, and Veldkamp (2009), investors allocate their attention between signals about aggregate and idiosyncratic components of cash flows, and at each point in time they optimally focus on shocks that have the largest impact on returns. Along these lines, one could interpret the pre-FOMC window as a time when investors focus on monetary policy news because of the upcoming announcement, even if the news may have been available before.[33]

That said, explanations based on informational frictions may conflict with rational expectations as investors should not be systematically surprised over long samples such as ours. Even relaxing this assumption, it nonetheless seems that the economic magnitude of the average pre-FOMC return is difficult to square with a good news story. For example, based on estimates from Bernanke and Kuttner (2005) and Gürkaynak, Sack, and Swanson (2005), an unexpected decline in the federal funds rate of one basis point implies an increase in the SPX of two to four basis points (depending on the specification). Based on these estimates, to account for the 49 (37) basis point average pre-FOMC return in the post-1994 (post-1980) sample, equity investors would have had to be surprised by at least 12 (9) basis points per scheduled FOMC meeting. To put these implied surprises in perspective, the revision in federal funds rate expectations based on fed funds futures since 1989 averages to only about -1 basis point both in a one-hour window around the announcement and in the

[33] Consistent with this view, media coverage of the Federal Reserve picks up markedly before the meeting as measured by the number of articles about the Fed in the print issues of the *Wall Street Journal* and the *Financial Times* as shown in the Internet Appendix. Related to this interpretation, Tetlock (2011) provides evidence that stale firm-specific news predicts future returns, indicating that investors trade based on media articles that contain old information. Huberman and Regev (2001) and Carvalho, Klagge, and Moench (2011) discuss specific examples where media reports containing stale or false news have large effects on individual companies' stock prices.

24-hour pre-FOMC window. Thus, the magnitude of the implied surprises that a good news story would require appears unrealistically large.

Instead of informational frictions, an alternative explanation for the mismatch between the time of the announcement and when the returns are earned could be that monetary policy information somehow leaks into the market before the release of the statement. Aside from the fact that these information leaks are unrealistic from an institutional viewpoint, we argue that they would also be an implausible explanation for the pre-FOMC drift for a number of reasons. First, because the pre-FOMC drift is an average return, such a story could only explain our findings if the information were somehow consistently positive or created risk. We discuss evidence against both types of explanations above. Second, assuming that the hypothetical leaks were informative for some investors but not others, one would expect pre-FOMC returns to be correlated with announcement returns. However, as we discuss in Section III.H, we find the two returns to be uncorrelated. Third, if, instead, the hypothetical leaks are informative to all investors and thus do not predict a correlation between pre- and postannouncement returns, it is not clear why we would observe pre-FOMC returns on equities worldwide but not in U.S. fixed income assets such as Treasuries and money market futures, which are very sensitive to monetary policy news.

We finally consider two explanations that are motivated by lower levels of liquidity and volatility in the pre-FOMC window as discussed in Section III.E. Among others, Campbell and Hentschel (1992) find evidence of a negative contemporaneous correlation between volatility and returns, which they explain through a "volatility feedback" effect: because of its persistence, an unexpected decline in volatility leads to a downward revision in future expected volatility, and thus to lower risk and higher contemporaneous returns. A large literature also documents a negative correlation between equity returns and trading liquidity.[34]

We assess the role of liquidity and volatility by including them as controls X_t in our main regression (1). Since their expected and unexpected components may play different roles depending on the theory, we first decompose all measures of volatility and liquidity into an innovation and a $t-1$ measurable component using simple univariate AR(1) models. Because we do not have intraday measures of liquidity for the market as a whole, we use trading volumes on the front-month E-mini futures contract (or second contract if more highly traded on a given day) as a market-wide liquidity proxy. Data on the E-mini futures contract are available starting in September 1997.[35]

[34] While most of the work focuses on the cross-section of returns, a few papers study the impact of liquidity on market-wide returns. Amihud (2002), for instance, constructs a simple measure of illiquidity and documents a positive relationship between illiquidity and future excess returns as well as a negative relationship between contemporaneous unexpected illiquidity and excess returns on U.S. equities.

[35] Regression results using trading volumes on the SPDR ETF are very similar. We also run similar analyses using bid-ask spreads and the Amihud price impact measure on these instruments

Table XI
Liquidity and Volatility Risk

This table reports results for the pre-FOMC regressions in Table I when controlling for measures of liquidity and volatility. The dependent variable is the cum-dividend 2 pm-to-2 pm log excess return on the S&P500. The sample period starts at September 12, 1997 (introduction of E-mini futures) and ends at March 30, 2011. "pre-FOMC dummy" is a dummy variable that is equal to one if there is a scheduled FOMC announcement in the next 24-hour trading interval. "Trade Vol (innov.)" is the residual from an AR(1) regression of the relative trading volume on the front-month E-mini S&P500 stock market index futures contract as of 2 pm on a constant and its previous 2 pm level. "Trade vols (lag)" denotes the prior day 2 pm level. "VIX (innov.)" denotes the residual from an AR(1) regression of the VIX index at 2 pm on a constant and its previous day 2 pm level. "VIX (lag)" denotes day 2 pm level of the VIX index on the previous trading day. "Trade vols. (FOMC-innov.)" and "VIX (FOMC-innov.)" denote residuals from the same AR(1) regressions but augmented with the pre-FOMC dummy. ***Significant at 1%, **significant at 5%, *significant at 10%. Robust standard errors are shown in brackets.

	(1)	(2)	(3)	(4)	(5)
pre-FOMC dummy	0.54	0.48	0.36	0.32	0.53
	[0.13]***	[0.13]***	[0.07]***	[0.07]***	[0.07]***
Trade Vol (innov.)		−0.61		−0.14	
		[0.06]***		[0.03]***	
Trade Vols (lag)		0.02		−0.08	−0.08
		[0.05]		[0.03]***	[0.03]***
VIX (innovat.)			−0.60	−0.60	
			[0.02]***	[0.02]***	
VIX (lag)			0.004	0.004	0.004
			[0.003]	[0.003]	[0.003]
Trade Vols. (FOMC-innov.)					−0.14
					[0.03]***
VIX (FOMC-innov.)					−0.60
					[0.02]***
Const.	−0.01	−0.01	−0.09	0.00	−0.01
	[0.02]	[0.06]	[0.06]	[0.07]	[0.07]
Adjusted R^2	0.01	0.04	0.69	0.69	0.69
Obs.					3,363
No. of FOMC					107

As a benchmark, the pre-FOMC drift is larger at 54 basis points and highly statistically significant in this shorter sample (column (1) in Table XI). When including the 24-hour lagged trading volume on the 2 pm-to-2 pm window and its contemporaneous innovation, we find only the coefficient on the innovation to be strongly statistically significant with a negative sign (column (2)). The pre-FOMC dummy coefficient drops to 48 basis points, but remains highly statistically significant. Moving to stock market volatility, we control for the lagged (2 pm on the previous day) level and the daily innovation of the VIX index, which measures option-implied volatility on SPX. While the lagged level of the VIX has virtually no impact on contemporaneous returns, consistent with

as measures of liquidity. They provide qualitatively similar results, albeit somewhat weaker in terms of their economic and statistical significance.

Table XII

Out-of-Sample Analysis

This table reports results for regression one estimated over different subsamples and using different weighting schemes for the observations. The dependent variable is the cum-dividend 2 pm-to-2 pm log excess return on the S&P500. "pre-FOMC dummy" is a dummy variable equal to one if there is a scheduled FOMC announcement in the next 24-hour trading interval. The upper panel shows results for regressions using a rolling 5-year (left panel) or 10-year (right panel) rolling window. The samples in these regressions end at the first FOMC meeting of the year indicated in the last row and start 5 or 10 years earlier, respectively. The lower two panels provide results for regressions where past observations (on an expanding window) are discounted with exponentially declining weights. We choose weighting functions with half-lives of 5 years (left panel) and 10 years (right panel). That is, in these regressions a 5- (10-) year lagged observation is given a weight of 0.5 in the estimation. ***Significant at 1%, **significant at 5%, *significant at 10%. Robust standard errors are shown in brackets.

	5-Year Rolling Regression					10-Year Rolling Regression				
Sample Ending in	1990	1995	2000	2005	2010	1990	1995	2000	2005	2010
pre-FOMC dummy	0.26	0.11	0.40	0.39	0.65	0.25	0.19	0.26	0.40	0.52
	[1.5]	[0.8]	[3.1]***	[2.8]***	[3.7]***	[2.1]**	[1.7]*	[2.8]***	[4.1]***	[4.6]***
Const.	0.03	0.02	0.06	−0.03	−0.04	0.02	0.02	0.04	0.02	−0.04
Obs.	1,263	1,257	1,237	1,245	1,257	2,526	2,519	2,493	2,481	2,501
	5-Year Exponential Weight Regression					10-Year Exponential Weight Regression				
Pre-FOMC dummy	0.15	0.14	0.29	0.32	0.51	0.10	0.10	0.19	0.24	0.37
	[1.7]*	[1.9]*	[3.9]***	[4.2]***	[4.7]***	[1.6]	[1.8]*	[3.4]***	[4.4]***	[5.4]***
Const.	0.02	0.02	0.04	0.01	−0.02	0.01	0.02	0.03	0.01	−0.00
Obs.	7,566	8,823	10,060	11,306	12,563	7,566	8,823	10,060	11,306	12,563

Campbell and Hentschel (1992), the innovation is very strongly negatively correlated with returns (column (3)). More importantly, adding the VIX innovation as a control variable reduces the point estimate on the pre-FOMC dummy by 18 basis points, or a third of the average pre-FOMC return in this sample. Even so, the estimated dummy coefficient of 36 basis points is still economically and statistically very significant. When we control for liquidity and volatility in a joint regression (column (4)), we find that the innovations to both the VIX and trading volume remain significant. The coefficient on the pre-FOMC dummy is now 32 basis points but remains highly statistically significant.

According to the volatility feedback effect, we could interpret the link between volatility and returns in a causal sense if the estimated innovations in the VIX were true surprises; these innovations may have been temporary if market prices quickly incorporated new information (see Jones, Lamont, and Lumsdaine (1998)). To better gauge if these innovations could have been surprises, we decompose the VIX and trading volume using an alternative AR(1) model that also includes a pre-FOMC dummy as a control. When we estimate the pre-FOMC regression controlling for the estimated innovations from these regressions (column (5)), we find that, while the coefficient on the VIX and the volume innovation are unaffected (as compared to column (4)), the level of the pre-FOMC dummy is almost exactly equal to the benchmark (column (1)). In conclusion, a fraction of the pre-FOMC returns could be accounted for by lower market volatility and liquidity immediately ahead of FOMC announcements if these declines were truly unexpected by investors. However, one would still have to rationalize the declines in volatility and liquidity to explain the pre-FOMC drift in a fundamental way, and even so, a large component of the return remains unexplained.

V. Concluding Remarks

In this paper, we document that U.S. equities have experienced large average excess returns in anticipation of U.S. monetary policy actions taken at scheduled FOMC meetings since the 1980s. Pre-FOMC returns have been increasing over time and have accounted for large fractions of total realized returns in the past few decades. A key challenge when explaining these returns is the timing disconnect between monetary policy news and when these returns are earned. We discuss a number of potential driving forces behind pre-FOMC returns ranging from higher systematic risk and its reallocation among investors to unexpected positive news, liquidity, or volatility. We argue that it is difficult to square these explanations with all of the empirical evidence.

We find evidence of pre-FOMC returns since the 1980s, but not before. Moreover, the magnitude of these returns has been greatest in the post-1994 sample. One might speculate that these patterns could be related to changes in the conduct of U.S. monetary policy. First, the appointment of Chairman Volcker in 1979 represents a key shift in the Fed's policy vis-a-vis inflation (see, for example, Bernanke, Blinder, and McCallum (2005)), suggesting that monetary policy may have been perceived by investors as more active and consequential

after that date. Consistent with this view, Clarida, Gali, and Gertler (2000) find a significant shift in the parameters of estimated monetary policy reaction functions in the third quarter of 1979.

Furthermore, the frequency of scheduled meetings declined significantly in the early 1980s, resulting in a more discrete conduct of monetary policy. Another key monetary policy shift occurred in 1994 when the FOMC began announcing its actual policy decisions. Although prior to 1994 investors could have learned about policy actions indirectly through open market operations, such inference was at times complex (Kuttner (2003)) and relied on each investor's information-updating process rather than on a public signal. In conjunction with the introduction of policy announcements in 1994, the timing of policy decisions also shifted substantially with policy actions becoming much more concentrated at scheduled meetings. Related to these changes, Bomfim (2003) finds evidence of a "quiet-before-the-storm" effect in realized volatility ahead of FOMC announcements, an effect that had been previously documented by Jones, Lamont, and Lumbsdaine (1998) on Treasury securities ahead of important macroeconomic announcements. In sum, the increasing magnitude of the pre-FOMC drift may potentially be related to the increased importance and clarity of the information collected by investors at scheduled FOMC meetings.

Understanding how asset prices incorporate payoff-relevant information is a key question in finance. We note that one can potentially reconcile the puzzling fact that returns are earned at a time when information flow is limited by assuming that investors are subject to more complex information structures than in standard theory, for example, due to constraints in information processing. Under models such as Kacperczyk, Nieuwerburgh, and Veldkamp (2009), investors optimally choose what signals to pay attention to, and accordingly pre-FOMC windows may be a time when equity investors process monetary policy information that might have been publicly available before. This would be qualitatively consistent with Tetlock (2011), who finds evidence of stale news affecting asset prices. Under an alternative explanation along the lines of Duffie (2010), information flow may in fact be very limited in the pre-FOMC window, but premia could arise due to a reallocation of risk toward a smaller number of investors before the upcoming announcement.

Financial asset returns are often decomposed into expected and unexpected components, with the first generally being ascribed to risk compensation and the latter to news. As in most analyses, pre-FOMC returns in this paper do not represent news from an econometrician's perspective, because the returns are explained by a statistical model. Yet one may wonder how quickly investors could have been able to learn about the magnitude and statistical significance of the pre-FOMC drift in real time. Aside from the importance of this question in its own right, this distinction may also help guide future work aimed at explaining the source of the pre-FOMC drift. To that end we reestimate the main specification model (1) for different subsamples and weights assigned to past observations. We use 5- and 10-year rolling windows as well as schemes that exponentially down-weight past observations with half-lives of 5 and 10 years. By giving a smaller weight to older observations, we proxy for investors

guarding against the various structural changes in monetary policy that we discuss above.

For each of the different regression specifications, we estimate the pre-FOMC dummy for samples ending at five-year increments from 1990 through 2010 (see Table XII). For example, the rolling five-year regression for the sample ending in 1990 uses data from 1985 to 1990, and the regression with exponential down-weighting uses data from 1960 to 1990 but discounts older observations. Across all specifications and sample periods considered, the magnitude of pre-FOMC returns is always economically large, although greater in the latter part of the sample, consistent with our previous findings. More importantly, based on the *t*-statistics, pre-FOMC returns are significant as early as 1990 in some specifications and as of 2000 across all specifications. These results indicate that pre-FOMC returns have been detectable not only ex-post to an econometrician, but also in real time to an investor that had run a similar analysis. While this evidence points toward explanations that characterize the pre-FOMC announcement drift as an expected return, none of the off-the-shelf risk-based theories that we discuss match our empirical evidence. Thus, as of this paper's writing, the pre-FOMC announcement drift is a puzzle.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Appendix S1: Internet Appendix.