Coordinating Attention: The Unintended Consequences of FOMC Press Conferences

Oliver Boguth, Vincent Grégoire, and Charles Martineau*

April 16, 2016

ABSTRACT

In an effort to increase transparency, the Chair of the Federal Reserve now holds a press conference following some, but not all, Federal Open Market Committee announcements. Press conferences are scheduled independently of economic conditions and communicate little additional information relative to the announcements. Using media coverage and Google searches, we show that investors shift attention away from announcements without press conferences. This inattention hinders the Fed's attempts to coordinate market expectations and therefore prevents effective monetary policy. Consequently, evidence from equity and derivative markets demonstrates that investors lower their expectations of major policy actions on days without press conferences.

JEL Classification: E58, E52, G14.
Keywords: Federal Reserve, Press Conferences, Attention, Transparency.

*We thank Bruce Carlin, Murray Carlson, Silvio Contessi, Adlai Fisher, Neal Galpin, Thomas Gilbert, Bruce Grundy, Brian Kelly, Ali Lazrak, Spencer Martin, Masahiro Watanabe, Jun Yang (discussant), and seminar participants at Arizona State University and the 2015 Financial Institutions, Regulation and Corporate Governance Conference for helpful comments and suggestions, Frank Hatheway of NASDAQ OMX for providing access to the TotalView-ITCH data, Jeremy Lao and Agha Mirza of CME Group for providing FedWatch support and data, and Compute Canada (WestGrid) for high-performance computing support. Martineau gratefully acknowledges financial support from the Social Sciences and Humanities Research Council (SSHRC) of Canada, the Montreal Exchange, and the NASDAQ OMX Educational Foundation. Boguth: W. P. Carey School of Business, Arizona State University, PO Box 873906, Tempe, AZ 85287-3906 (oliver.boguth@asu.edu). Grégoire: Department of Finance, University of Melbourne, Level 12, 198 Berkeley Street, Carlton VIC, 3068, Australia (vincent.gregoire@unimelb.edu.au). Martineau: Sauder School of Business, University of British Columbia, 2053 Main Mall, Vancouver BC, Canada, V6T 1Z2 (charles.martineau@sauder.ubc.ca).

The Federal Open Market Committee (FOMC), the monetary policy-making body of the U.S. Federal Reserve System (Fed), meets regularly to discuss the state of the economy and set monetary policy. Because asset prices are intimately linked to macroeconomic conditions, great care is given not just to the decisions made, but also to how they are communicated to financial markets after the meetings. While it was left to market participants to infer decisions from the Fed's open market operations until 1994, policy decisions are now announced in a press statement. Since April 2011, in an effort to *"provide additional transparency and accountability"* (Bernanke, 2011), the Chair of the Board of Governors additionally holds a press conference (PC) following half of the announcements. Importantly, the decision to hold a PC does not depend on macroeconomic conditions, as the schedule for both announcements and PCs is released at least six months in advance.[1]

In this paper, we study the role and consequences of having press conferences following some meetings. We first show that PCs seem to convey little new information to markets. While the realized volatility of equities during the PC is elevated, it is not significantly higher than after FOMC announcements without PC. Virtually no changes in option implied volatility indicate that PCs do not reduce uncertainty.[2]

Having established that PCs communicate little new information, we argue that they can serve as a powerful coordination device. Duffie and Sun (1990) and Abel, Eberly, and Panageas (2007, 2013) show that investors optimally remain inattentive to some information if they face information acquisition costs. Similarly, in Kacperczyk, van Nieuwerburgh, and Veldkamp (2016) investors allocate scarce attention between two kinds of information and optimally focus on information that has the largest impact on prices. In both types of models, with indistinguishable FOMC announcements investors will on average pay equal attention

[1]The schedule for a year is typically released in June of the previous year. The new communication policy was first announced on March 24, 2011, which is 5 weeks before the first meeting with a press conference.

[2]These tests measure information content only by the reaction of equity and option markets. Information that does not immediately affect market prices, either because it is not price relevant or takes longer to process, could still be revealed during press conferences.

to each. However, PCs designate some events to be more important than others, and they coordinate investors to pay more attention to FOMC announcements with PCs.

Consistent with this hypothesis, we show that media coverage before FOMC announcements with PCs is significantly higher than before announcements without. The effect is large and holds both for a low-frequency measure based on articles in the print editions of major newspapers as well as for intraday newswire articles. Simply allowing conditional means to vary between PC and non-PC events explains up to one third of the variation in our media attention measures. A similar picture emerges for a broader attention measure based on Google search volume in the week prior to FOMC announcements, where the number of searches for "FOMC" and related terms is significantly higher before announcements with PCs than without.[3] Investor attention thus concentrates around FOMC announcement days with press conferences.

We next ask if these attention shifts have any consequences for the Fed and monetary policy. It has long been recognized that market expectations are critical to the transmission of monetary policy (Stein, 1989; Blinder, Goodhart, Hildebrand, Lipton, and Wyplosz, 2001), and therefore "monetary policy is more effective if it is more effective in coordinating market expectations" (Amato, Morris, and Shin, 2002, p. 496).[4] Clearly, if investors pay little attention to its communication, the Fed cannot coordinate market expectations and might find it optimal to delay important announcements.

Unfortunately, it is difficult to quantify the gravity of the Fed's decisions. Instead, we rely on financial markets to gauge the expectations of important monetary policy announcements. Using evidence spanning multiple asset classes, we document striking differences in both markets' expectations of and reactions to FOMC announcements with and without PCs. We

[3] A Google search for "FOMC" should be not be interpreted as an attempt to learn about the FOMC, but as a starting point to acquire details or news about the upcoming announcements.

[4] Highlighting this importance further, Blinder (1998, p.70) states: "central banks generally control only the overnight interest rate, an interest rate that is relevant to virtually no economically interesting transactions. Monetary policy has important macroeconomic effects only to the extent that it moves financial market prices that really matter – like long-term interest rates, stock market values and exchange rates."

first show that average returns of the S&P 500 in the 30 minutes immediately following the FOMC announcement are large and positive on days with PCs, averaging 0.30%. This estimate is highly statistically significant and robust to possible outliers and bootstrapped small-sample statistics. In contrast, announcement returns are on average negative on days without PCs. The difference in announcement returns between PC and non-PC days is highly significant at 0.55%. This finding is robust to controlling for inflation and changes to the unemployment rate, the two variables the FOMC is mandated to manage, as well as growth of gross domestic product (GDP) and past market returns.

We argue that this ex-post reaction to FOMC announcements can be used to proxy for the ex-ante market expectation of the Fed's decisions. The reasoning relies on the observation that throughout our sample similar information was revealed at both types of announcements. In particular, the Federal funds target rate, one of the main drivers of equity prices in FOMC announcements, remained unchanged at 0 to 0.25%. Since 2011, the FOMC has therefore repeatedly surprised markets positively, with the magnitude of the surprise directly proportional to ex-ante expectations of target rate increases. The large market returns following announcements with PCs then correspond to large ex-ante market expectations of rate increases.[5]

Two aspects about our analysis are important to emphasize. First, these findings are about the market reaction to FOMC announcements. They are not returns in anticipation of announcements, as in Lucca and Moench (2015), nor do they necessarily present profitable trading opportunities. Second, we analyze announcement returns conditional on press conferences taking place, but the returns we study do not include information revealed during the press conferences.

[5]Target rate announcements are of first-order importance for equity prices (Kuttner, 2001). For example, Bernanke and Kuttner (2005) and Ozdagli and Weber (2015) estimate that a surprise decrease in the Federal funds rate of 0.25% increase stock prices by 1%, whereas the analysis in Bjornland and Leitemo (2009) suggests an even bigger impact. Gürkaynak, Sack, and Swanson (2005) confirm that rate announcements are important, but argue that the future path of policy also plays a role.

We then confirm these findings in option markets, where we use the option-implied volatility of the S&P 500, as measured by the VIX index, to proxy for uncertainty associated with monetary policy. The VIX drops sharply by more than 4% at FOMC announcements if a PC is scheduled, suggesting that the Fed provides valuable information to reduce uncertainty about monetary policy on these days. In contrast, on days without PCs, the VIX remains virtually unchanged after the announcement, and monetary policy uncertainty is not reduced.

Both changes in stock prices and volatility in response to FOMC announcements are only indirect measures of true ex-ante expectations of changes to monetary policy. To overcome this limitation, we directly measure expected target rate changes implied by Federal Fund Futures. On days with PCs, the probability of a rate change is on average 2.8 percentage points higher than on days without. This estimate represents an increase of a staggering 76% relative to the unconditional mean. In other words, markets expect more important decisions on days with press conferences.

Taken together, our findings suggests that investors shift attention away from FOMC announcement days without PCs. These attention shifts have consequences for the Fed, as investors paying attention is crucial for effective monetary policy. Consequently, FOMC announcements convey less price-relevant information on days without press conferences. Markets understand that, and expectations of relevant changes to monetary policy are lower on those days. In other words, in the markets' view, the introduction of PCs separated FOMC announcements into important and lesser ones.

Alternatively, it is conceivable that the Fed actively decided to defer important decisions for meetings when it has the opportunity to provide explanations and context in a PC, rather than passively reacting to changes in investor attention. This does not seem to be the case. First, it was not mentioned when a possible introduction of press conferences was originally discussed during a FOMC conference call on October 15, 2010. Rather, the discussion talks about what other central banks do, about providing "a little more clarity", and that it

"dovetails with some of the concerns about interpretations" (Bernanke, 2010).[6] Second, the official position of the Fed is that all meetings and announcements are equally important, irrespective of press conferences. When asked if it is good *"that the market expects big news to come when you have a press conference and no news to come when you don't have one,"* Chairwoman Yellen replied that she *"would really like to strongly discourage the expectation that policy moves can only occur when there's a scheduled press conference"* (Yellen, 2014).[7] Lastly, we confirm in untabulated results that meetings with and without PCs are on average equally long, both in real time and based on the word count of the published minutes.

Even if the Fed wanted to make big decisions on days without press conferences, it now faces two obstacles. First, markets pay little attention, and policy would therefore be less effective. Second, markets do not expect significant policy changes, and any such announcement would therefore be a surprise. However, the Fed is frequently believed to be averse to surprising markets.[8] This aversion imposes an additional constraint on the Fed's actions, and market expectations can therefore become self-fulfilling. This tension also increases the Fed's incentives for the kind of informal communication studied in Cieslak, Morse, and Vissing-Jorgensen (2015).

Press conferences were introduced with the intention to increase transparency. Our analysis raises strong doubts about whether this goal is achieved. As we show, PCs convey little new information to markets. At the same time, our evidence suggests that the reduced information revealed at non-PC announcements decreases transparency at these intermediate times. Taken together, it seems that overall transparency probably decreased as a result of

[6] During the same discussion, it is also acknowledged that "communicating what we are doing will be challenging", that PCs "would probably become obligatory on a regular basis", and that it "would be quite a commitment".

[7] A similar exchange again occurred nine months later (Yellen, 2015b).

[8] For example, in a recent paper co-authored by Jeremy Stein, a former member of the Board of Governors, the authors assume that the central bank is averse to bond-market volatility (Stein and Sunderam (2015)). See also Cieslak, Morse, and Vissing-Jorgensen (2015) for a detailed discussion. In the press, a survey by the Wall Street Journal *"underscores just how much work it would take for the Fed to create expectations of a rate increase at a meeting without a news conference"* (Zumbrun, 2015).

having PCs after only some FOMC announcements.

The implications of this new FOMC communication policy are difficult to gauge. While transparency is frequently viewed as positive, it is less clear whether increased transparency really results in lower price volatility or in prices that better reflect fundamental values. See, for example, Amato, Morris, and Shin (2002) and Banerjee, Davis, and Gondhi (2015).

Taken to the extreme, our evidence raises the question why the FOMC meets and makes policy announcements on days without scheduled press conferences. If the objective of the FOMC is to increase transparency while simultaneously limiting market surprises and maintaining flexibility of action, it should consider following the practice of holding press conferences after every meeting, as adopted by the European Central Bank, the Bank of Japan, Sweden's Riksbank and Norway's Norges Bank.

I. The Federal Open Market Committee

The FOMC is the monetary policy-making body of the U.S. Federal Reserve System. It oversees the nation's open market operations, i.e., purchases and sales of U.S. Treasury and Federal Agency Securities, which affect the cost and availability of money and credit in the economy, under the statutory dual mandate of maximum employment and stable prices. The FOMC is composed of the seven members of the Board of Governors and five of the twelve Reserve Bank presidents. While the president of the Federal Reserve Bank of New York serves on a continuous basis, the presidents of the other Reserve Banks serve one-year terms on a rotating basis. By law, the FOMC must meet at least four times a year. Since 1981, however, eight regularly scheduled meetings have been held each year at intervals of five to eight weeks. Members may also be called on to participate in special meetings if circumstances require consultation or consideration of an action between these regular meetings. For the purpose of this paper, we are not interested in these special meetings. Prior to 1994, changes to the Federal funds rate were not announced and market participants had to infer them by

observing the size and type of open market operations. In 1994, the FOMC began announcing their policy decisions in a press statement, with the announcement dates and times released to the public in June of the previous year.

Since April 2011, the Chair of the Board of Governors holds a press conference following half of the FOMC announcements. Importantly, just like the announcements themselves, PCs are also scheduled at least six months in advance, and the decision to hold a PC therefore does not depend on economic or market conditions. Press conferences last on average close to one hour and consist of an opening statement by the Chair of the Board of Governors followed by a question and answer session with financial journalists. Between April 2011 and January 2013, FOMC announcements with PCs were made at 12:30 pm, followed by PCs beginning at 2:15 pm. Announcements without PCs were made at 2:15 pm. Since March 2013, FOMC announcements always occur at 2:00 pm, and press conferences begin at 2:30 pm.

Table I provides an overview of the FOMC announcements, their times, and the starting time of the associated press conferences. In total, our sample is comprised of 37 announcements, 19 with and 18 without press conferences. After some initial irregularities, since June 2012 press conferences have followed every other FOMC announcement.

Throughout our sample, the Federal funds target range remained constant at 0 to 0.25%. Nevertheless, our sample contains some changes in monetary policy by means of quantitative easing (QE) to help revive the U.S. economy following the financial crisis. We now list some of the key FOMC announcements since 2011.

June 22, 2011 (PC): the Fed announces the end of QE2.

September 21, 2011 (no PC): the Fed announces Operation Twist, which consists of purchasing $400 billion of Treasuries with long maturities and selling an equal amount with shorter-term maturities.

June 20, 2012 (PC): the Fed announces that it will continue Operation Twist.

September 13, 2012 (PC): the Fed announces QE3.

December 12, 2012 (PC): the Fed announces the expansion of QE3.

June 19, 2013 (PC): During the PC, Chairman Bernanke suggests a gradual moderation of the pace of bond purchases could begin in the months to come.[9]

September 18, 2013 (PC): the Fed decides to hold off on "tapering".

October 29, 2014 (no PC): the Fed announces the halt of bond purchases.

June 17th, 2015 (PC): Chairwoman Yellen specifies three possible dates for a first raise in interest rates, all of which have a scheduled PC (Yellen, 2015a).

II. The Information Content of Press Conferences

In this section, we argue that press conferences reveal little new information to equity markets. While realized market volatility is generally high during PCs, this is due to the preceding FOMC announcements. In particular, we show that realized volatility is not significantly higher during actual PCs than during the same time frame following FOMC announcements without PCs. Similarly, the VIX index is largely unchanged during PCs, suggesting that the revealed information does not reduce monetary policy uncertainty.

In efficient markets, the release of price relevant new information induces prices to move instantly. Consequently, in a large class of models, information flow is equivalent to volatility (e.g., Ross, 1989). We estimate high-frequency measures of realized volatility during PCs to proxy for the information revealed. While monetary policy decisions affect many asset classes, we focus on the liquid and mostly efficient equity market, in particular the SPDR S&P 500 exchange traded fund (SPY).

[9]Equity and fixed income markets reacted strongly to this information. Interestingly, on May 22, 2013, one month before this press conference, Chairman Bernanke made a statement using similar language in a testimony to Congress.

We retrieve intraday data for SPY from the NASDAQ TotalView-ITCH database. TotalView-ITCH tracks all orders that are submitted, canceled, or executed on NASDAQ, which allows us to construct the entire limit order book.[10] We define the SPY price as the midpoint of the best outstanding bid and ask quotes, and convert this time-series of prices into one-second midquote returns. We further restrict our sample to regular trading hours, i.e., 9:30 am to 4:00 pm EST.

We define realized volatility during PCs as the square root of mean squared one-minute returns, expressed in percent per year, in the 60-minute window starting with the press conference. Panel A of Table II shows that realized volatility during PCs is around 15.66%, or about 2.33 times as high as the benchmark volatility estimated between 180 minutes and 5 minutes before the announcement.[11] Crucially, the point estimate for average realized volatility is not larger than the one for the control sample, the times when PCs would take place on non-PC days. To the contrary, volatility in the control sample is slightly larger at 17.11%.

While the difference is not statistically significant based on the asymptotic standard errors in parentheses, natural concerns about the sample distribution of the test statistic arise when working with small samples. We therefore also provide bootstrapped standard errors (in brackets) and p-values (in italics) for the test that the difference is less than or equal to zero. All bootstrapped results are based on 1,000,000 samples. The bootstrapped standard errors closely resemble the asymptotic ones, and the p-values confirm the findings. Overall, there is no indication that volatility during actual press conferences might be higher

[10] Importantly, this data is not limited to NASDAQ listed securities. According to Fidessa Fragmentation Index (2015), between 20 and 25% of the total market turnover of SPY during our sample occurs on NASDAQ. The average bid-ask spread of SPY in our data is 1.1 cents, or less than 0.01%. Clearly, the quoting and trading activity we observe is sufficient to obtain meaningful prices.

[11] The benchmark volatility estimate of around 7% per year is small relative to common measures of annual return standard deviations. The discrepancy arises mainly because our estimates are obtained during trading hours only and do not contain overnight returns, but also reflects the reduced liquidity in the market before FOMC announcements (Lucca and Moench, 2015).

than at the same time on days without PCs.

Basing conclusions of this test on the entire sample induces a possible bias. In 2011 and 2012, FOMC announcements with PC were held earlier in the day than those without (see Table I), and PCs started 1.75 hours after announcements. This implies that the time window for hypothetical PCs in the control group comprises of the first trading hour of the next trading day, and volatility is known to vary throughout the day.

Panel B shows the results for the reduced, but unaffected sample from 2013 to 2015. The realized volatility during PCs is 17.4%, higher than the 13.3% in the control sample. The difference is significant with a p-value of 0.06, apparently suggesting that PCs convey important information. However, this conclusion changes again when we control for the information content of FOMC announcements. Volatility estimates during both actual PCs and in the control group are nearly identical relative to those estimated between one minute before and 30 minutes after FOMC announcements. Since realized volatility spikes immediately after announcements and then declines slowly, our evidence indicates that high volatility during PCs is driven by news revealed at the FOMC announcement, and not the press conferences themselves.[12]

Overall, the evidence based on realized volatility does not suggest that important price-relevant information is revealed during press conferences. We also perform an alternative test that uses changes in the option implied volatility index, VIX. The test follows Beber and Brandt (2009), who empirically show a strong link between the resolution of macroeconomic uncertainty and changes in VIX.[13] If part of the VIX reflects uncertainty associated with monetary policy, it should on average decrease with the arrival of new information.

We obtain intraday VIX data from Thomson Reuters Tick History (TRTH) as supplied by

[12]Persistence in realized volatility following macroeconomic news is well documented in Andersen, Bollerslev, Diebold, and Vega (2003), and investigating its causes is beyond the scope of our paper.

[13]Amengual and Xiu (2015) use a similar reasoning, but are specifically interested in large downward jumps in the VIX at FOMC announcements. They argue that in addition to resolving uncertainty, the Fed usually intervenes in hard times, effectively providing a put option to markets.

the Securities Industry Research Centre of Asia-Pacific (SIRCA), and confirm in untabulated results that the average change in VIX from the beginning to the end of the PC is zero, corroborating our conclusion that press conferences provide little additional information to markets.

III. Attention Shifts to Announcements with Press Conferences

In this section, we present the first main empirical findings of the paper. Using different measures of attention, in particular media coverage spanning multiple frequencies and Google search volume, we show that interest in the FOMC is higher prior to announcements with press conferences.

A. Media Attention

We begin our analysis with a measure of media attention that is based on low-frequency printed news in the Wall Street Journal (WSJ) and the New York Times (NYT) around FOMC announcements. To measure daily news intensity, we follow Fisher, Martineau, and Sheng (2016) and divide the number of articles related to the FOMC or monetary policy by the total number of articles published in the morning edition of each newspaper.[14] We then average daily intensity over windows that start three business days before the announcement and end with the morning edition on the announcement day. Fisher, Martineau, and Sheng (2016) provide a detailed overview over the construction of macroeconomic media attention indices and their statistical properties.

Our findings are summarized in Table III. We first present two groups of results where the dependent variables are the meeting-to-meeting changes in news intensity for WSJ and NYT.

[14]In particular, we search FACTIVA for the following key words: ((federal reserve OR federal open market committee OR fomc) AND (interest rate OR monetary OR inflation OR economy OR economic OR unemployment)).

Performing our test on changes rather than levels avoids concerns that variables might be non-stationary in-sample. The first specification within each group only contains an intercept and changes in the PC indicator variable, ΔPC, which can take one of three values: one if the announcement has a PC while the previous did not, minus one for the opposite case, and zero if both the current and prior announcement were followed by or not followed by PCs. It shows that, on average, media intensity in the WSJ is 0.66% higher on days with PCs than on days without.

This estimate is highly statistically significant based on both the asymptotic standard errors in parentheses, and the bootstrapped results. In particular, the p-value of 0.01 confirms that media attention significantly increases before announcement days with PCs and decreases on non-PC days. Economically, the estimate suggests that the variation associated with press conferences represents around 23% of the unconditional mean of our WSJ news intensity measure (2.9%, untabulated). The indicator variable alone explains 12.4% of the total variation in media coverage.

In the second specification, we add monthly log-changes in seasonally adjusted consumer price index (ΔCPI) and unemployment (ΔUE) to control for the economic environment. These variables are the most natural candidates to influence expected monetary policy, as they correspond to the FOMC's target measures under its dual mandate. Data are obtained from the U.S. Bureau of Labor Statistics, and we always use the most recently announced data. We complement these with GDP growth (ΔGDP) from the U.S. Bureau of Economic Analysis. In the third specification, we further control for the cumulative log return of the S&P 500 Total Return Index over the 21 trading days ending three days before the event, $R_{\text{S\&P}}$, from TRTH. The specific window is chosen to avoid overlap with both the current and the previous FOMC meetings.

Of the control variables, only the S&P 500 return is significant. The negative coefficient suggests that interest in the Fed is higher after bad stock market realizations, consistent

with well documented investor behavior, for example under prospect theory (Kahneman and Tversky, 1979). Importantly, none of the control variables affects the coefficient of interest. ΔPC remains economically large and statistically significant in all specifications.

A similar picture emerges for our media attention measure for the NYT. While the estimated coefficient is much smaller (0.20%), it is important to keep in mind that the NYT is a general news media outlet that is less focused on economic and financial coverage than the WSJ. Accordingly, the average proportion of relevant articles is also lower at 1.10%, and the estimated coefficient is therefore again sizable relative to the mean.

We next move to a high-frequency measure of media attention that is based on intraday newswires (INW) in the hours before FOMC announcements. From RavenPack's global macroeconomic news database, we collect a comprehensive sample of news stories from the Dow Jones News Wire. We keep only intraday news that are classified as full-article, and are timestamped in the 24 hours preceeding FOMC announcements. To capture the predominance of the entities mentioned, RavenPack further assigns to each news a relevance score between 0 and 100. We select news articles with a minimum relevance score of 90 for either the Federal Reserve or the Federal Open Market Committee.

Our findings are summarized in the last three columns of Table III. As with the the printed news, the coefficient estimate on ΔPC is positive, highly significant, and unaffected by control variables. We find that on days with PC the raw article count increases by more than 71, which again is very large compared to the unconditional mean of 156. 34% of the variation in the number of intraday newswire articles on FOMC announcement days can be attributed to PCs taking place. These results confirm the ones obtained from the printed news and represent further evidence in support of more attention and importance attached to FOMC announcements followed by PCs.

B. Google Search Volume

We conclude the attention analysis with the search volume index (SVI) from Google Trends, which measures the frequency of searches in Google for given keywords. Data obtained from Google Trends have previously been used in connection with financial markets, for example to study the effects of investor attention (Da, Engelberg, and Gao, 2011) and to obtain broad sentiment measures (Da, Engelberg, and Gao, 2015). In particular, the weekly SVI is calculated by dividing the number of searches for specific keywords ("FOMC" and related term), by the total number of searches in a geographic area ("global"), and rescaling the resulting series so that the maximum is 100.

In contrast to our previous measures, the search volume index proxies for the overall level of interest among Google's users. Google is often used as a universal shortcut to websites. We posit that the SVI is a proxy for web traffic to the FOMC and other related websites, and therefore quantifies investor attention. We use the SVI in the last full week prior to each FOMC meeting, and again analyze meeting-to-meeting changes.[15]

The findings mirror the previous ones. Search volume for "FOMC" is higher by more than three points prior to announcements with PC than without. The coefficient is large and robust to control variables. Economically, the estimate suggests that the variation associated with PCs represents around 17% of the unconditional mean of SVI (17.9, untabulated). Overall, there is strong evidence that both media and investors attention is higher prior to FOMC announcements with PCs. This represents a shift from equally spreading their attention over all eight FOMC announcements per year before PCs were introduced in 2011, to now putting more emphasis on the four announcements that are accompanied by press conferences.

[15]Given that the SVI is based on calendar weeks, concerns might arise if some FOMC announcements are later in the week than others. In our sample, the vast majority of announcements fall on a Wednesday, only three on a Tuesday and two on a Thursday. Since the two Thursday announcements are followed by PCs while the three Tuesday announcements are not, a possible bias would work against our findings.

IV. The Role of Press Conferences for Market Expectations

In this section, we investigate whether the shift of attention away from FOMC announcements without press conferences has any consequences for the Fed and monetary policy. Rather than attempting to measure the gravity of monetary policy decisions, we use evidence from equity and derivative markets to show that there has been a significant shift in the perceived importance of FOMC announcements since the introduction of PCs. Only events with PCs are associated with large expectations of important monetary policy decisions and a significant resolution of uncertainty at the time of the announcement.

A. Stock Market Announcement Returns

We begin our analysis by showing that stock market reactions to FOMC announcements differ across days with and without press conferences. If markets are efficient, these returns measure the unexpected component of the announcements. We argue that, specific to our sample, these surprises can also be used to proxy for the expected part of the announcements. Our identification relies on the observation that there is little variation in the total information content, expected and unexpected, of announcements in our sample. In particular, the Federal funds target rate, the single most closely watched number associated with FOMC announcements, has remained at its lower bound of 0 to 0.25%. Any decisions regarding this rate can therefore be thought of as binary: rates can either remain unchanged or increase.[16]

Since unexpected rate increases typically lead to a drop in equity prices (Kuttner, 2001, Bernanke and Kuttner, 2005), in this scenario prices should rise when the Fed announces that rates remain low. The magnitude of the rise, however, depends on the markets' ex-ante expectations that rates would increase. For example, if markets are certain that rates will

[16] In practice, unconventional monetary policies such as large-scale asset purchases can be used to effectively overcome the zero lower bound (Swanson, 2015). On the other end, target rates could increase by more than 0.25%.

not change, an announcement of no increase should not affect prices. If on the other hand markets have a large expectation of a rate increase, any announcement of constant rates should be considered a large positive surprise, and stock prices should therefore increase significantly.

Figure 1 plots the average cumulative return of SPY around FOMC announcements, starting 3 hours before and ending 1.75 hours after the announcement. Returns are normalized to zero at the time of the announcement. The time interval is chosen to avoid potential effects from overnight returns. As shown in Table I, prior to 2013 announcements with PCs were made at 12:30 pm, or 3 hours after market open, and between August 2011 and January 2013 announcements without PCs were made at 2:15 pm, or 1.75 hours before market close.

Panel A groups all FOMC announcements from April 2011 to October 2015. Consistent with the conjecture that FOMC announcements throughout our sample contained good news for equity markets, there is a small return of about 0.10% immediately following the announcement, or up to 0.20% in the hour after the announcement. The 95% confidence interval, plotted in gray, suggests that this effect is not statistically significant.

A striking pattern emerges in Panel B, where we separate FOMC announcements into ones with and without press conferences. When there is a PC (blue solid line), prices increase by economically large and statistically significant 0.40% after the announcement. In contrast, FOMC announcements without PCs (red dashed line) are accompanied by a drop in prices of about 0.10% during a volatile period following the announcement.

In Table V, we formally test the main insights from Figure 1. The table provides estimates of moments and associated statistical tests of announcement returns, which we define as the cumulative return of SPY in the 31 minute event window starting one minute before the announcement. We begin our announcement window one minute prior to the event to ensure that our findings are not affected by either information leakage before the announcement or possible data errors with regard to the exact FOMC announcement time. The choice of end

time follows Ozdagli and Weber (2015), and further ensures that announcement returns are not affected by information released during the press conferences.

The full sample results in Panel A show an average announcement return of 0.04%. On days with PCs, this figure rises to 0.31%, while it is -0.24% on days without. Based on the asymptotic distribution, the mean return for all announcements is insignificant. Announcement returns with PCs are both significantly positive and significantly larger than those without. On days with PCs, they range from -0.38% to 1.19%, with only 4 out of 19 observations (21%) negative.

Our evidence is based on a rather small sample containing only 19 (18) observations for PC (non-PC) events. We address concerns about the sample distribution of the test statistic and the effect of possible outliers in two ways. First, we again provide bootstrapped standard errors and p-values for the test that mean announcement returns are less than or equal to zero. The bootstrapped results confirm the previous findings.

Second, to investigate the potential impact of outliers, Panel B repeats the analysis on a trimmed sample that excludes both the largest and smallest announcement return observations in each group. Point estimates for the means are, with one exception, little affected. Only on non-PC days, average returns rise from -0.24% to -0.15%, the minimum increases from -2.37% to -0.72%, and the standard deviation declines from 0.62% to 0.32%. This implies that the sample was affected by one very large negative observation. Crucially, even in the trimmed sample, the statistical inference remains unchanged. Announcement returns on days with PCs are significantly positive, and larger than those on days without.

Since prices of exchange traded funds can deviate from their net asset value, we repeat these tests using announcement returns on the shortest maturity E-mini S&P 500 Futures, obtained from TRTH. The results are nearly identical.

We test whether the announcement return differences between PC and non-PC days can be explained by different economic environments in Table VI. The first two specifications

regress announcement returns on indicator variables for PC and non-PC days. These two tests confirm the results from Table V under the additional assumptions ordinary least square regressions impose on the error distribution. Just allowing for differences in averages between PC and non-PC days explains 20% of the variation in announcement returns.

In the third and fourth specifications, we add control variables. Of these, changes in the unemployment rate are significantly negatively and the prior 21-day S&P 500 returns significantly positively related to announcement returns. The signs are consistent with our interpretation of the dependent variable. Following improvements in the state of the economy, such as a decrease in the unemployment rate or rising stock prices, markets increase their expectation of a tightening in monetary policy. Announcements to keep policy unchanged therefore result in large positive surprises. Importantly, none of the control variables have any impact on the coefficient on the PC indicator. The marginal impact of PCs on announcement returns is very stable across specifications, ranging from 0.55% to 0.60%, and highly statistically significant.

B. Revelation of Uncertainty at FOMC Announcements

The use of ex-post stock market announcement returns to proxy for ex-ante expectations relies on the key assumption that the total information content of all FOMC announcements in our sample is comparable. We now provide more direct evidence by showing that FOMC announcements reduce uncertainty about monetary policy on days with press conferences, but not on other days.

We follow Beber and Brandt (2009) and Amengual and Xiu (2015) and use the option implied volatility index, VIX, as proxy for uncertainty associated with monetary policy. With the arrival of new information, we generally expect uncertainty to decrease.[17] But volatility

[17]Beber and Brandt (2009) show a general link between resolution of macroeconomic uncertainty and changes in the VIX index. Amengual and Xiu (2015) are specifically interested in large downward jumps in the VIX, and argue that in addition to resolving uncertainty, the Fed usually intervenes in hard times, effectively providing a put option to markets. For our purpose, the distinction between both interpretations

would change little if announcements merely confirm what markets already expected, or if announcements provide little price-relevant information. If on the other hand uncertainty in markets was large, and the announcement resolves this uncertainty, we expect large declines in the VIX.

Figure 2 shows cumulative changes in the VIX around the FOMC announcement, starting 3 hours prior and ending 1.75 hours after. The intraday VIX data is provided by TRTH. Across all FOMC announcements (Panel A), the VIX exhibits the expected pattern. There is little time-series variation prior to the announcement, but the VIX drops sharply by about 2% when the new information arrives. The release of the Fed's monetary policy decisions clearly reduces uncertainty.

A striking contrast emerges in Panel B, which separates FOMC announcements into ones that are followed by a PC (blue solid line) and ones that are not (red dashed line). While announcements with PCs see an average drop of over 4% in the volatility index, uncertainty remains virtually unaffected by FOMC announcements without PCs.

Table VII formally tests this finding. We first regress log changes in VIX from one minute prior to 30 minutes after the announcement on indicator variables for PC and non-PC days. Regression (1) shows that the VIX decreases by a statistically and economically highly significant 4.2% on days with PCs, and remains unchanged on days without. Including control variables further increases the economic magnitude and the statistical significance of the impact of press conferences.

The large decrease in option-implied volatility suggests that a significant amount of uncertainty in equity markets is resolved at the time of the announcement on days with PCs. In contrast, when there is no PC, uncertainty does not change around FOMC announcements. In turn, this implies that FOMC announcements communicate price-relevant information only on PC days, and markets correctly expect no relevant monetary policy changes on days without

is secondary.

PCs.

A potential confounding effect stems from the release of economic projection materials at the same time as the announcement starting in 2013.[18] While the relevance of these materials is often debated in the media, they nonetheless represent an additional source of information that can potentially reduce uncertainty. We address this issue by introducing an indicator variable T equal to one for events from 2013 to 2015, and zero otherwise. Regressions (5)-(7) extend regressions (2)-(4) by interacting PC with T. The interaction term is not significant in any of the specifications, suggesting that our results are not driven by this simultaneous release of economic projection materials.

The argument that important monetary policy decisions should reduce uncertainty in the market is general and, in contrast to the evidence using stock market announcement returns, does not rely on the specific sample. This allows us to investigate if the segregation of FOMC announcements is a new effect caused by press conferences, or if historically some announcements have always implicitly carried a higher weight. Most press conferences (15 out of 19) are scheduled following the second FOMC meeting in each calendar quarter, and we therefore test if FOMC announcements at quarter ends have always had a larger impact on uncertainty.

Figure 3 shows changes in the VIX around FOMC announcements from January 2006 to March 2011, separately for the first (solid blue line) and second (dashed red line) announcements in each calendar quarter. In short, there is no difference. Therefore, there is no evidence to suggest that the timing of press conferences simply reflects a previously existing pattern. Instead, the separation into important and less important FOMC announcements seems to be caused by the advent of press conferences.

[18]The Fed releases economic projection materials only on days with PCs. These materials contain the economic projections of Federal Reserve Board members and the Federal Reserve Bank presidents about growth, unemployment, inflation, and future policy.

C. Ex-Ante Implied Probabilities of Target Rate Changes

Both announcement returns and changes in volatility are ex-post measures that might be affected by the content of the announcement. We now validate these results using a pure ex-ante measure from derivative markets that directly captures the expected gravity of FOMC announcements.

We measure the ex-ante expectations of target rate changes using the 30-day Federal Funds Futures (FF), for which we obtain settlement prices from TRTH. These contracts are listed for the first 36 calendar months and derive their price from the realized Federal funds overnight rate. Specifically, the settlement price is 100 minus the average daily transaction-volume-weighted Federal funds overnight rate for the delivery month. Futures prices thus reflect market expectations of the average daily Federal Funds Effective Rate (FFER), which is published by the Federal Reserve Bank of New York each day.

To extract probabilities of rate movements from FF prices, we follow the methodology used by the CME Group.[19] The expected target rate change in month m is computed as

$$\mathbb{E}(\Delta r_m) = \widehat{FFER}_m - \widehat{FFER}_{m-1}, \tag{1}$$

where $\widehat{FFER}_m$ is the futures-implied FFER at the end of month m. It is important to note that these expected target rate changes can be negative even though the Federal funds target rate is at its zero lower bound. This is because rates are targeted to stay within an interval, in our case 0 to 0.25%, rather than at a specific number, whereas the FF settlement price is based on realized market rates.

[19]CME Group introduced the FedWatch Tool in August 2015. We apply their methodology to our whole sample period and validate our calculations in the post-August 2015 period with historical probabilities provided to us by CME Group. For more details, see http://www.cmegroup.com/trading/interest-rates/countdown-to-fomc.html. Alternatively, it is possible to use these contracts to estimate the announcement surprise following Kuttner (2001). However, to obtain surprises and therefore expectations, Kuttner's approach requires the use of FF prices from the end of the announcement day. This is not suitable for our purposes, as the end-of-day prices contain information revealed during the press conference. Similarly, Sinha (2015) uses option and future contracts written on U.S. treasuries to extract state price densities and show that that ex-ante investor beliefs respond to forward guidance provided by the FOMC.

To convert expected rate changes to probabilities, we assume that target rates can only change by 0.25% at any given meeting and compute

$$P(Change) = |\mathbb{E}(\Delta r_m)| \,/0.25, \tag{2}$$

$$P(Increase) = \max\left[\mathbb{E}(\Delta r_m), 0\right]/0.25. \tag{3}$$

The calculation of $\widehat{FFER}_m$ depends on whether there is another FOMC meeting scheduled in month $m+1$. If there is, we estimate

$$\widehat{FFER}_{m-1} = 100 - FF_{m-1} \tag{4}$$

$$\widehat{FFER}_m = \frac{1}{N-M}\left[N(100 - FF_m) - M(100 - FF_{m-1})\right] \tag{5}$$

where FF_m is the price of the future expiring in month m, N is the number of calendar days in month m, and M is the calendar day of the FOMC meeting minus 1. If there is no meeting scheduled in the following month, we instead estimate

$$\widehat{FFER}_{m-1} = \frac{1}{M}\left[N(100 - FF_m) - (N-M)(100 - FF_{m+1})\right] \tag{6}$$

$$\widehat{FFER}_m = 100 - FF_{m+1}. \tag{7}$$

We first compute the probability of a rate change for each FOMC meeting from 2011 to 2016 using FF settlement prices at the end of the first trading day of each calendar year. Results are presented in Figure 4. Full circles identify meetings with PCs while hollow dots identify those without.

In the plot for 2011, the probabilities of rate changes are smoothly increasing over the next eight FOMC announcements. The plot is based on data from January 3, 2011, and the introduction of press conferences had not yet been announced. Therefore, not surprisingly, press conferences do not affect the probabilities. In the following years, we see a clear separation between meetings with PCs and those without. Probabilities of interest rate changes are consistently higher for meetings associated with PCs.

Next, we formally test the main insights from Figure 4. For each FOMC meeting, we obtain the FF implied probability computed on the previous day. To test whether press conferences affect the probability of rate changes, we regress changes in the FF implied probability onto changes in an indicator variable for press conferences and control variables.

Our findings are summarized in Table VIII. In the first three columns, the dependent variable is based on the probability of changes in interest rates. The first specification only contains an intercept and changes in the PC indicator variable, ΔPC. It shows that, on average, the probability of rate changes is 2.8 percentage points higher on days with press conferences than on those without. The estimate is statistically significant and economically large compared to the sample average of the probability of rate changes of 5.1%. The estimate thus suggests that meetings with press conferences are associated with a $(5.1+2.8/2)/(5.1-2.8/2)-1 = 76\%$ increased probability of a change in target rates relative to those without.

When adding control variables in specifications (2) and (3), the coefficient on ΔPC is unaffected, and press conferences remain associated with a higher probability of rate changes. Of the control variables, only the past S&P 500 return is significant. The negative coefficient suggests that changes in market prices reflect the altered probabilities of interest rate changes.

Since the target rate has been at its zero lower bound throughout our sample, we also perform the tests on the narrower probability of target rate increases. The results, shown in columns (4)-(6) of Table VIII, confirm the previous findings. On days with press conferences, the probability of a rate increase is 3.3 percentage points higher than on days without press conferences. Relative to the unconditional average of a rate increase of 3.3% in our sample, this corresponds to a three-fold increase in probability on press conference days relative to non-PC days.

To show robustness, we repeat the same exercise using a measure of ex-ante expectations of rate changes using the Overnight Index Swap (OIS) Implied Probability provided by Bloomberg. These probabilities are estimated by stripping the OIS term structure into

forward rates, which in turn are used to compute the expected Federal Funds Effective Rate before and after the next FOMC meeting. Results confirm those obtained using FF.

Overall, the prices of both Federal Fund Futures and Overnight Index Swaps, combined with the reactions of equity and option markets to FOMC announcements, paint a clear picture that markets expect big changes in monetary policy only following FOMC meetings with press conferences, and view the remaining announcements as less important.

V. Conclusion

In an effort to increase transparency, the Chair of the Board of Governors now holds a press conference following half of the scheduled FOMC announcements. We first show that press conferences do not add significant information relative to the preceding announcement. More importantly, we document that this information practice has unintended consequences: it curtails the range of actions the Fed can take and counteracts the declared transparency goal.

Holding press conferences after some, but not all, FOMC meetings coordinates media and investor attention towards those meetings. Since managing market expectations is central to monetary policy, it is optimal for the Fed to focus their policy efforts on times when markets pay close attention.

Markets understand this and expect important monetary policy decisions only on announcement days with press conferences. As a result, the Fed, generally believed to be averse to surprising markets, now faces two obstacles to make important monetary policy decisions at meetings without press conferences: markets pay little attention, and do not expect big decisions. This constrains the possible monetary policy decisions. Naturally, these constraints diminish information flow and reduce transparency.

Taken to the extreme, our evidence raises the question why the FOMC meets and makes policy announcements when there are no press conferences. Resolving the constraints on

actions and the associated reduced transparency requires that markets perceive all FOMC announcements equal. While this could be achieved by removing press conferences completely, in order to maintain their goal of increased transparency, the Fed should instead consider holding press conferences after every meeting, as many other central banks do.

References

Abel, Andrew B., Janice C. Eberly, and Stavros Panageas, 2007, Optimal inattention to the stock market, *American Economic Review* 97, 244–249.

——— , 2013, Optimal inattention to the stock market with information costs and transactions costs, *Econometrica* 81, 1455–1481.

Amato, Jeffery D., Stephen Morris, and Hyun Song Shin, 2002, Communication and monetary policy, *Oxford Review of Economic Policy* 18, 495–503.

Amengual, Dante, and Dacheng Xiu, 2015, Resolution of policy uncertainty and sudden declines in volatility, Working Paper, University of Chicago, Chicago, IL.

Andersen, Torben G., Tim Bollerslev, Francis X. Diebold, and Clara Vega, 2003, Micro effects of macro announcements: Real-time price discovery in foreign exchange, *American Economic Review* 93, 38–62.

Banerjee, Snehal, Jesse Davis, and Naveen Gondhi, 2015, When transparency improves, must prices reflect fundamentals better?, Working Paper, Northwestern University, Evanston, IL.

Beber, Alessandro, and Michael W. Brandt, 2009, Resolving macroeconomic uncertainty in stock and bond markets, *Review of Finance* 13, 1–45.

Bernanke, Ben S., 2010, Conference call of the Federal Open Market Committee on October 15, 2010, http://www.federalreserve.gov/monetarypolicy/files/FOMC20101015confcall.pdf, accessed March. 14, 2016.

——— , 2011, Transcript of Chairman Bernanke's press conference, April 27, 2011, http://www.federalreserve.gov/mediacenter/files/FOMCpresconf20110427.pdf, accessed Nov. 18, 2015.

——— , and Kenneth N. Kuttner, 2005, What explains the stock market's reaction to Federal Reserve policy?, *Journal of Finance* 60, 1221–1257.

Bjornland, Hilde C., and Kai Leitemo, 2009, Identifying the interdependence between US monetary policy and the stock market, *Journal of Monetary Economics* 56, 275–282.

Blinder, Alan, 1998, *Central Banking in Theory and Practice* (MIT Press: Cambridge, MA).

——— , Charles Goodhart, Philipp Hildebrand, David Lipton, and Charles Wyplosz, 2001, How do central banks talk?, *Geneva Reports on the World Economy 3* London, Centre for Economic Policy Research.

Cieslak, Anna, Adair Morse, and Annette Vissing-Jorgensen, 2015, Stock returns over the FOMC cycle, Working Paper, University of California at Berkeley, Berkeley, CA.

Da, Zhi, Joseph Engelberg, and Pengjie Gao, 2011, In search of attention, *Journal of Finance* 66, 1461–1499.

——— , 2015, The sum of all FEARS: Investor sentiment and asset prices, *Review of Financial Studies* 28, 1–32.

Duffie, Darrell, and Tong-sheng Sun, 1990, Transactions costs and portfolio choice in a discrete-continuous-time setting, *Journal of Economic Dynamics and Control* 14, 35–51.

Fidessa Fragmentation Index, 2015, http://fragmentation.fidessa.com, accessed Nov. 18, 2015.

Fisher, Adlai J., Charles Martineau, and Jinfei Sheng, 2016, Media attention, macroeconomic fundamentals, and stock market activity, Working Paper, University of British Columbia, Vancouver, Canada.

Gürkaynak, Refet S., Brian Sack, and Eric T. Swanson, 2005, Do actions speak louder than words? The response of asset prices to monetary policy actions and statements, *International Journal of Central Banking* 1, 55–93.

Kacperczyk, Marcin, Stijn G. van Nieuwerburgh, and Laura Veldkamp, 2016, A rational theory of mutual funds attention allocation, *Econometrica* 84, 571–626.

Kahneman, Daniel, and Amos Tversky, 1979, Prospect theory - analysis of decision under risk, *Econometrica* 47, 263–291.

Kuttner, Kenneth N., 2001, Monetary policy surprises and interest rates: evidence from the Fed funds futures market, *Journal of Monetary Economics* 47, 523–544.

Lucca, David O., and Emanuel Moench, 2015, The pre-FOMC announcement drift, *Journal of Finance* 70, 329–371.

Ozdagli, Ali, and Michael Weber, 2015, Monetary policy through production networks: Evidence from the stock market, Working Paper, University of Chicago, Chicago, IL.

Ross, Stephen A., 1989, information and volatility: the no-arbitrage martingale approach to timing and resolution irrelevancy, *Journal of Finance* 44, 1–17.

Sinha, Arunima, 2015, FOMC forward guidance and investor beliefs, *American Economic Review* 105, 656–661.

Stein, Jeremy C., 1989, Cheap talk and the Fed - a theory of imprecise policy announcements, *American Economic Review* 79, 32–42.

——— , and Adi Sunderam, 2015, Gradualism in monetary policy: a time-consistency problem?, Working Paper, Harvard University, Cambridge, MA.

Swanson, Eric T., 2015, Measuring the effects of unconventional monetary policy on asset prices, Working Paper, University of California at Irvine, Irvine, CA.

Yellen, Janet L., 2014, Transcript of Chair Yellen's press conference, December 17, 2014, http://www.federalreserve.gov/mediacenter/files/fomcpresconf20141217.pdf, accessed Nov. 18, 2015.

——— , 2015a, Transcript of Chair Yellen's press conference, June 17, 2015, http://www.federalreserve.gov/mediacenter/files/FOMCpresconf20150617.pdf, accessed Nov. 18, 2015.

——— , 2015b, Transcript of Chair Yellen's press conference, September 17, 2015, http://www.federalreserve.gov/mediacenter/files/fomcpresconf20150917.pdf, accessed Nov. 18, 2015.

Zumbrun, Josh, 2015, WSJ survey: most economists don't see all FOMC meetings as 'live', *The Wall Street Journal,* http://www.wsj.com/articles/wsj-survey-most-economists-dont-see-all-fomc-meetings-as-live-1444312805, accessed Nov. 18, 2015.

Figure 1. Cumulative SPY Return Around FOMC Announcements

This figure shows the average cumulative return of SPY around FOMC announcements. Returns are normalized to zero at the time of the announcement. Panel A shows results for the whole sample, while Panel B separates announcements into those with press conferences (blue solid line) and those without (red dashed line). The shaded areas are pointwise 95% confidence bands around the average returns. The sample period is April 2011 to October 2015.
Intraday SPY data are from NASDAQ TotalView-ITCH.

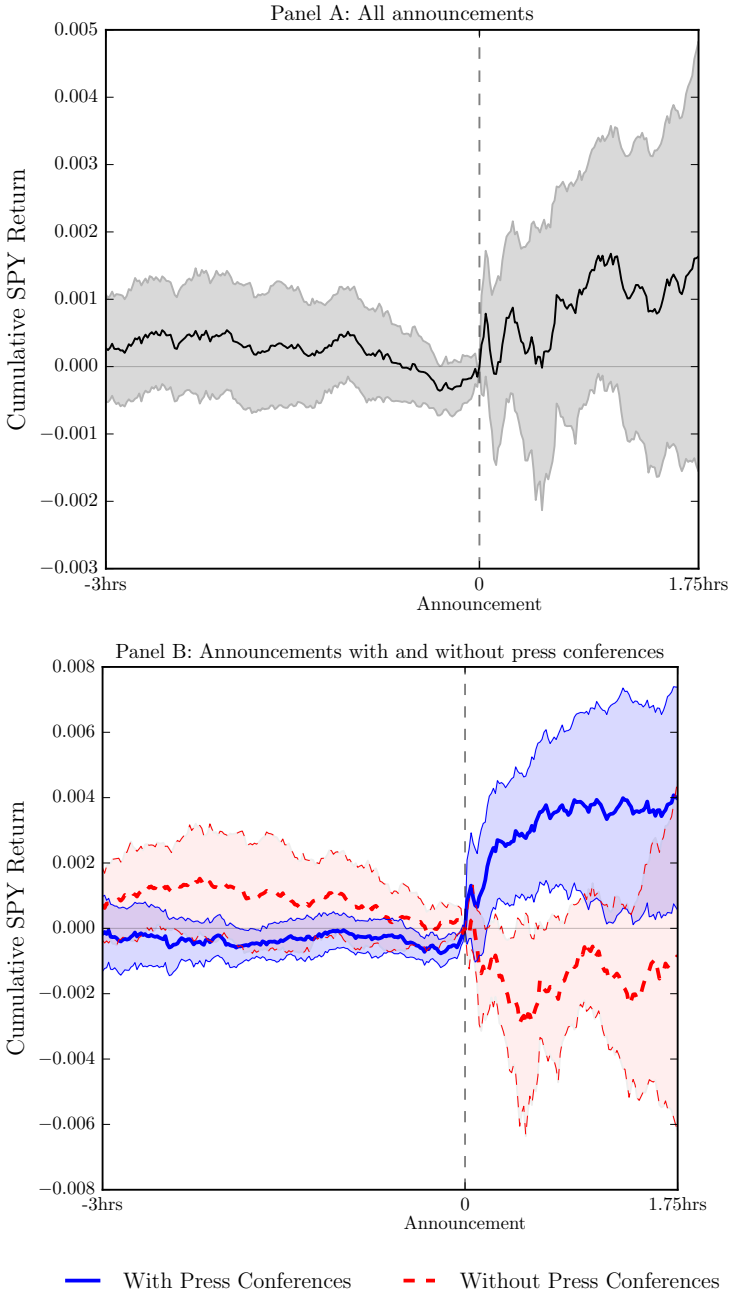

Figure 2. Cumulative VIX Return Around FOMC Announcements

This figure shows the average cumulative return of VIX around FOMC announcements. Returns are normalized to zero at the time of the announcement. Panel A shows results for the whole sample, while Panel B separates announcements into those with press conference (blue solid line) and those without (red dashed line). The shaded areas are pointwise 95% confidence bands around the average returns. The sample period is April 2011 to October 2015.
Intraday VIX data are from Thomson Reuters Tick History.

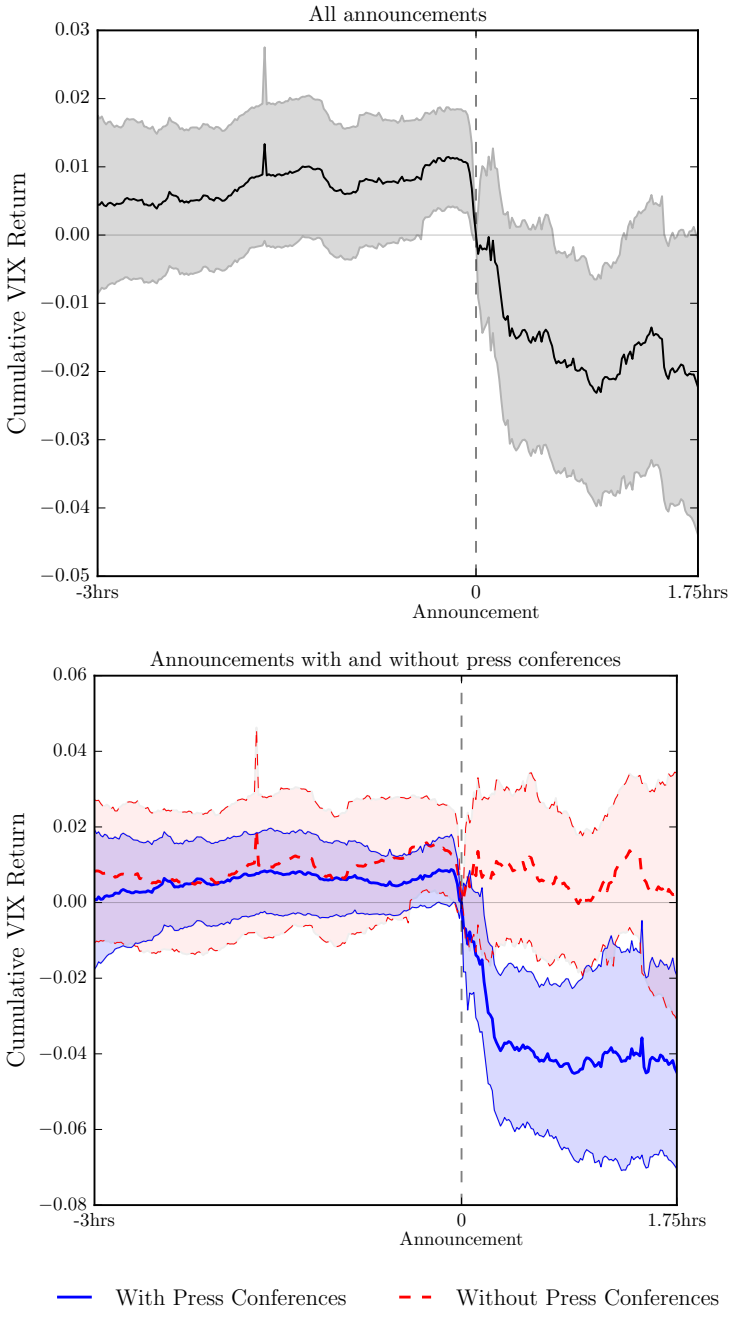

Figure 3. Cumulative VIX Return Around FOMC Announcements (2006-2011)

This figure shows the average cumulative return of VIX around FOMC announcements. VIX returns are normalized to zero at the announcement. Events are separated into the first (red dashed line) and second (blue solid line) announcements in each calendar quarter. The shaded areas are pointwise 95% confidence bands around the average returns. The sample contains 42 events from January 2006 to March 2011.
Intraday VIX data are from Thomson Reuters Tick History.

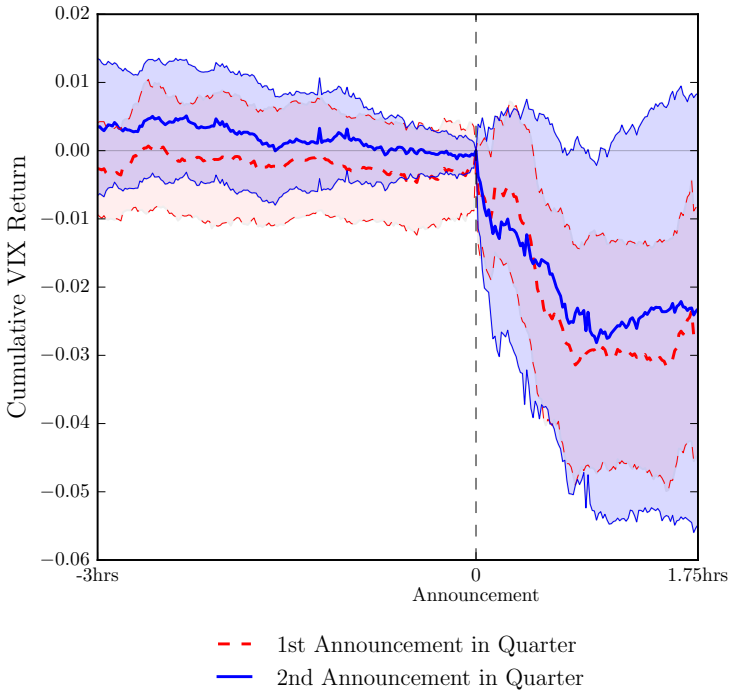

Figure 4. Probability of Target Rate Changes

This figure shows the implied probability of an interest rate change at each of the eight annual FOMC meeting. Implied probabilities are computed from 30 Day Federal Fund Futures as of the first trading day of each year. Full circles identify meetings followed by press conferences while hollow dots identify those without.
Detailed information on the construction of probability measures and data sources is provided in the text.

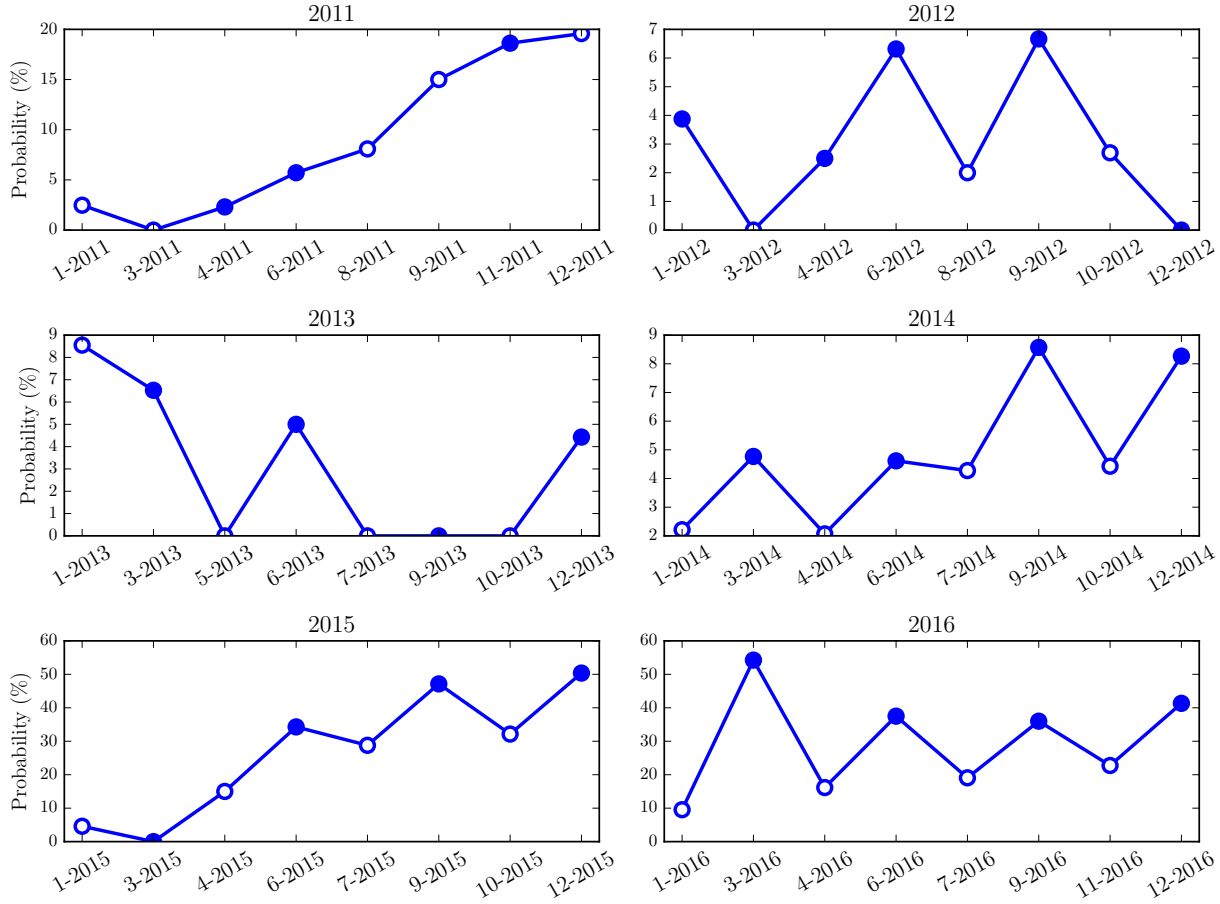

Table I
FOMC Announcement Calendar

This table shows the scheduled time of FOMC announcements and press conferences (PCs) between April 2011 and October 2015.
Source: http://www.federalreserve.gov/monetarypolicy/fomccalendars.htm.

Date	Time	PC	Date	Time	PC
04/27/2011	12:30	14:15	09/18/2013	14:00	14:30
06/22/2011	12:30	14:15	10/30/2013	14:00	
08/09/2011	14:15		12/18/2013	14:00	14:30
09/21/2011	14:15		01/29/2014	14:00	
11/02/2011	12:30	14:15	03/19/2014	14:00	14:30
12/13/2011	14:15		04/30/2014	14:00	
01/25/2012	12:30	14:15	06/18/2014	14:00	14:30
03/13/2012	14:15		07/30/2014	14:00	
04/25/2012	12:30	14:15	09/17/2014	14:00	14:30
06/20/2012	12:30	14:15	10/29/2014	14:00	
08/01/2012	14:15		12/17/2014	14:00	14:30
09/13/2012	12:30	14:15	01/28/2015	14:00	
10/24/2012	14:15		03/18/2015	14:00	14:30
12/12/2012	12:30	14:15	04/29/2015	14:00	
01/30/2013	14:15		06/17/2015	14:00	14:30
03/20/2013	14:00	14:30	07/29/2015	14:00	
05/01/2013	14:00		09/17/2015	14:00	14:30
06/19/2013	14:00	14:30	10/28/2015	14:00	
07/31/2013	14:00				

Table II
Realized Volatility during Press Conferences

This table reports the realized volatility (RV) of SPY returns during FOMC press conferences (PCs). RV is defined as the annualized mean of squared one-minute returns during a 60-minute interval starting at the press conference. The ratios of this RV relative to the benchmark RV, estimated between 180 minutes and 5 minutes before the FOMC announcement, and relative to the announcement RV, estimated between 1 minute prior and 30 minutes after the announcement, are also reported. On days without PC, RV is estimated during the corresponding event-time in which PCs would take place. Asymptotic and bootstrapped standard errors are presented in parenthesis and square brackets, respectively, and bootstrapped p-values for the test that coefficients are less than or equal to zero in italics. N denotes the number of observations. The sample period is April 2011 to October 2015.
Intraday SPY data are from NASDAQ TotalView-ITCH.

	RV			RV relative to Benchmark RV			RV relative to Announcement RV		
	PC	No PC	Difference	PC	No PC	Difference	PC	No PC	Difference
Panel A: Full Sample									
Mean	15.66	17.11	-1.45	2.33	2.12	0.21	0.64	0.66	-0.02
Std. Error (asympt.)			(3.15)			(0.26)			(0.08)
Std. Error (bootstr.)			[3.07]			[0.25]			[0.08]
p-value (bootstr.)			*0.70*			*0.20*			*0.61*
N	19	18		19	18		19	18	
Panel B: March 2013 to October 2015									
Mean	17.41	13.34	4.07	2.94	2.03	0.91	0.62	0.55	0.06
Std. Error (asympt.)			(2.75)			(0.32)			(0.08)
Std. Error (bootstr.)			[2.62]			[0.31]			[0.08]
p-value (bootstr.)			*0.06*			*0.00*			*0.22*
N	11	11		11	11		11	11	

Table III
Media Attention Before FOMC Announcements

This table reports coefficients from regressions of meeting-to-meeting changes in measures of media attention on changes ΔPC of an indicator variable, PC, equal to one if a meeting is followed by a press conference and zero otherwise, and control variables. The measures of media attention are based on articles printed in the Wall Street Journal (WSJ), the New York Times (NYT), and intraday newswires (INW). ΔCPI, ΔUE, and ΔGDP are log changes in, respectively, the consumer price index, the unemployment rate, and the gross domestic product. $R_{\text{S\&P}}$ is the S&P 500 log return over the 21-day interval ending 3 days before the announcement. Asymptotic heteroscedasticity robust and bootstrapped standard errors are presented in parenthesis and square brackets, respectively, and bootstrapped p-values for the test that coefficients are less than or equal to zero in italics. Adjusted R^2 and the number of observations N are also reported. The sample period is April 2011 to October 2015. Detailed information on the construction of media attention measures and data sources is provided in the text.

	ΔWSJ			ΔNYT			ΔINW		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Intercept	-0.001	0.269	0.649	0.017	-0.004	0.093	2.901	24.701	40.114
	(0.25)	(0.49)	(0.40)	(0.10)	(0.19)	(0.17)	(15.36)	(19.82)	(19.39)
	[0.25]	[0.48]	[0.41]	[0.10]	[0.19]	[0.18]	[15.25]	[27.74]	[26.28]
	0.51	*0.29*	*0.05*	*0.43*	*0.51*	*0.30*	*0.42*	*0.19*	*0.06*
ΔPC	0.656	0.675	0.706	0.196	0.206	0.213	71.452	72.889	74.133
	(0.26)	(0.26)	(0.21)	(0.10)	(0.10)	(0.09)	(15.17)	(13.56)	(11.98)
	[0.26]	[0.26]	[0.21]	[0.10]	[0.10]	[0.09]	[15.93]	[14.83]	[13.67]
	0.01	*0.00*	*0.00*	*0.03*	*0.02*	*0.01*	*0.00*	*0.00*	*0.00*
ΔCPI		-119.220	-103.872		-18.172	-14.252		-13557.052	-12933.975
		(85.97)	(77.36)		(28.50)	(24.90)		(5935.90)	(5420.52)
		[105.99]	[88.19]		[41.22]	[38.42]		[6149.88]	[5668.86]
		0.87	*0.88*		*0.67*	*0.65*		*0.98*	*0.99*
ΔUE		-198.682	75.106		-98.866	-28.948		-15081.210	-3965.962
		(173.11)	(157.14)		(83.21)	(82.23)		(11015.85)	(11886.04)
		[217.12]	[193.06]		[84.57]	[84.23]		[12609.70]	[12418.85]
		0.82	*0.35*		*0.88*	*0.63*		*0.88*	*0.63*
ΔGDP		-14.349	-12.450		-2.001	-1.515		-901.085	-823.975
		(17.37)	(14.68)		(6.74)	(6.15)		(866.74)	(885.20)
		[18.17]	[15.12]		[7.08]	[6.59]		[1055.60]	[973.37]
		0.79	*0.79*		*0.61*	*0.59*		*0.80*	*0.80*
$R_{\text{S\&P}}$			-0.222			-0.057			-9.018
			(0.05)			(0.02)			(3.42)
			[0.06]			[0.02]			[3.56]
			1.00			*0.99*			*0.99*
Adjusted R^2	0.124	0.088	0.349	0.068	0.019	0.121	0.340	0.376	0.453
N	36	36	36	36	36	36	36	36	36

Table IV
Google Search Volume Before FOMC Announcements

This table reports coefficients from regressions of meeting-to-meeting changes in the Search Volume Index (SVI) on changes ΔPC of an indicator variable, PC, equal to one if a meeting is followed by a press conference and zero otherwise, and control variables. The weekly SVI is obtained from Google Trends for searches for "FOMC" and related terms. ΔCPI, ΔUE, and ΔGDP are log changes in, respectively, the consumer price index, the unemployment rate, and the gross domestic product. $R_{\text{S\&P}}$ is the S&P 500 log return over the 21-day interval ending 3 days before the announcement. Asymptotic heteroscedasticity robust and bootstrapped standard errors are presented in parenthesis and square brackets, respectively, and bootstrapped p-values for the test that coefficients are less than or equal to zero in italics. Adjusted R^2 and the number of observations N are also reported. The sample period is April 2011 to October 2015.
Detailed information on the SVI and data sources is provided in the text.

	ΔSVI		
	(1)	(2)	(3)
Intercept	-0.247	-1.698	-1.404
	(1.27)	(1.98)	(1.97)
	[1.27]	[2.40]	[2.45]
	0.57	*0.76*	*0.71*
ΔPC	3.114	3.268	3.292
	(1.29)	(1.21)	(1.19)
	[1.32]	[1.28]	[1.28]
	0.01	*0.01*	*0.01*
ΔCPI		114.330	126.232
		(486.63)	(498.96)
		[531.37]	[529.91]
		0.42	*0.42*
ΔUE		-1630.223	-1417.901
		(706.63)	(778.18)
		[1087.94]	[1158.36]
		0.93	*0.89*
ΔGDP		-3.932	-2.459
		(85.95)	(86.98)
		[91.30]	[91.01]
		0.52	*0.51*
$R_{\text{S\&P}}$			-17.225
			(34.02)
			[33.27]
			0.70
Adjusted R^2	0.108	0.087	0.064
N	36	36	36

Table V
The FOMC Announcement Return

This table reports selected moments and percentiles of log returns of SPY and the shortest maturity S&P 500 E-mini Futures, in %, over the 31-minute intervals starting one minute before FOMC announcements. Values are reported for the whole sample, as well as samples split into days with and without press conferences (PCs) and their difference. Asymptotic and bootstrapped standard errors are presented in parenthesis and square brackets, respectively, and bootstrapped p-values for the test that coefficients are less than or equal to zero in italics. N denotes the number of observations. Panel A is based on the whole sample, while Panel B repeats the analysis on trimmed samples that omit the smallest and largest observation. The sample period is April 2011 to October 2015.
Intraday SPY data are obtained from NASDAQ TotalView-ITCH and E-MINI data from Thomson Reuters Tick History.

	SPY				E-MINI			
	All	PC	No PC	Diff.	All	PC	No PC	Diff.
Panel A: Full Sample								
Mean	0.038	0.305	-0.244	0.549	0.012	0.295	-0.287	0.582
Std. Error (asympt.)	(0.10)	(0.10)	(0.15)	(0.18)	(0.11)	(0.10)	(0.17)	(0.20)
Std. Error (bootstr.)	[0.10]	[0.10]	[0.14]	[0.17]	[0.101]	[0.10]	[0.17]	[0.19]
p-value (bootstr.)	*0.36*	*0.00*	*0.94*	*0.00*	*0.48*	*0.00*	*0.94*	*0.00*
Std. Deviation	0.594	0.435	0.619		0.658	0.437	0.728	
Minimum	-2.371	-0.380	-2.371		-2.873	-0.365	-2.873	
25th Percentile	-0.178	0.075	-0.390		-0.178	0.018	-0.378	
Median	0.102	0.251	-0.092		0.080	0.242	-0.101	
75th Percentile	0.269	0.560	0.135		0.279	0.521	0.109	
Maximum	1.185	1.185	0.332		1.238	1.238	0.356	
Proportion <0	0.405	0.211	0.611		0.378	0.211	0.556	
N	37	19	18		37	19	18	
Panel B: Trimmed Sample								
Mean	0.074	0.293	-0.147	0.440	0.060	0.279	-0.165	0.444
Std. Error (asympt.)	(0.07)	(0.09)	(0.08)	(0.12)	(0.07)	(0.09)	(0.08)	(0.12)
Std. Error (bootstr.)	[0.07]	[0.09]	[0.08]	[0.12]	[0.07]	[0.09]	[0.08]	[0.12]
p-value (bootstr.)	*0.14*	*0.00*	*0.97*	*0.00*	*0.19*	*0.00*	*0.97*	*0.00*
Std. Deviation	0.404	0.368	0.317		0.409	0.363	0.335	
Minimum	-0.720	-0.296	-0.720		-0.865	-0.267	-0.865	
25th Percentile	-0.153	0.086	-0.363		-0.156	0.054	-0.359	
Median	0.102	0.251	-0.092		0.080	0.242	-0.101	
75th Percentile	0.256	0.478	0.119		0.266	0.464	0.095	
Maximum	1.037	1.037	0.225		1.052	1.052	0.221	
Proportion <0	0.400	0.176	0.625		0.371	0.176	0.563	
N	35	17	16		35	17	16	

Table VI
FOMC Announcement Return Regressions

This table reports coefficients from regressions of FOMC announcement returns on a press-conference indicator PC, equal to one if a meeting is followed by a press conference and zero otherwise, non-$PC = 1 - PC$, and control variables. Announcement returns are the log returns of SPY and the shortest maturity S&P 500 E-mini Futures, in %, over the 31-minute intervals starting one minute before FOMC announcements. ΔCPI, ΔUE, and ΔGDP are log changes in, respectively, the consumer price index, the unemployment rate, and the gross domestic product. $R_{\text{S\&P}}$ is the S&P 500 log return over the 21-day interval ending 3 days before the announcement. Asymptotic heteroscedasticity robust and bootstrapped standard errors are presented in parenthesis and square brackets, respectively, and bootstrapped p-values for the test that coefficients are less than or equal to zero in italics. Adjusted R^2 and the number of observations N are also reported. The sample period is April 2011 to October 2015.

Intraday SPY data are obtained from NASDAQ TotalView-ITCH and E-MINI data from Thomson Reuters Tick History. Other data sources are provided in the text.

	Announcement Returns (SPY)				Announcement Returns (E-MINI)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept		-0.244	-0.247	-0.341		-0.287	-0.329	-0.443
		(0.14)	(0.23)	(0.23)		(0.17)	(0.27)	(0.27)
		[0.12]	[0.19]	[0.17]		[0.14]	[0.21]	[0.19]
		0.99	*0.92*	*0.98*		*0.99*	*0.96*	*0.99*
PC	0.305	0.549	0.567	0.570	0.295	0.582	0.598	0.602
	(0.10)	(0.17)	(0.17)	(0.15)	(0.10)	(0.19)	(0.19)	(0.17)
	[0.12]	[0.17]	[0.17]	[0.16]	[0.13]	[0.19]	[0.19]	[0.17]
	0.01	*0.00*	*0.00*	*0.00*	*0.02*	*0.00*	*0.00*	*0.00*
non-PC	-0.244				-0.287			
	(0.14)				(0.17)			
	[0.12]				[0.14]			
	0.99				*0.99*			
ΔCPI			-15.587	-20.335			-12.668	-18.438
			(34.78)	(32.26)			(39.51)	(36.16)
			[35.23]	[32.52]			[39.57]	[35.97]
			0.70	*0.75*			*0.65*	*0.71*
ΔUE			-72.158	-141.642			-69.078	-153.514
			(53.79)	(77.35)			(56.05)	(83.62)
			[74.54]	[73.82]			[83.76]	[81.69]
			0.84	*0.97*			*0.81*	*0.97*
ΔGDP			-2.198	-2.804			-0.359	-1.095
			(5.01)	(5.08)			(5.49)	(5.39)
			[6.19]	[5.71]			[6.95]	[6.32]
			0.65	*0.69*			*0.53*	*0.57*
$R_{\text{S\&P}}$				0.055				0.067
				(0.04)				(0.05)
				[0.02]				[0.02]
				0.01				*0.00*
Adjusted R^2	0.197	0.197	0.146	0.252	0.178	0.178	0.121	0.253
N	37	37	37	37	37	37	37	37

Table VII
Returns of VIX at FOMC Announcements

This table reports coefficients from regressions of log returns in VIX around FOMC announcements on a press-conference indicator PC, equal to one if a meeting is followed by a press conference and zero otherwise, non-$PC = 1 - PC$, and control variables. VIX announcement returns are the log changes in the VIX, in %, over the 31-minute intervals starting one minute before FOMC announcements. ΔCPI, ΔUE, and ΔGDP are log changes in, respectively, the consumer price index, the unemployment rate, and the gross domestic product. $R_{\text{S\&P}}$ is the S&P 500 log return over the 21-day interval ending 3 days before the announcement. T is an indicator variable equal to one for events between 2013 and 2015, and zero otherwise. Asymptotic heteroscedasticity robust and bootstrapped standard errors are presented in parenthesis and square brackets, respectively, and bootstrapped p-values for the test that coefficients are less than or equal to zero in italics. Adjusted R^2 and the number of observations N are also reported. The sample period is April 2011 to October 2015.
VIX data are from Thomson Reuters Tick History. Other data sources are provided in the text.

	ΔVIX						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intercept		0.395	0.559	0.917	2.375	2.530	2.448
		(0.92)	(1.46)	(1.48)	(1.62)	(2.20)	(1.73)
		[1.01]	[1.48]	[1.49]	[1.64]	[1.84]	[1.80]
		0.35	*0.36*	*0.27*	*0.07*	*0.08*	*0.08*
PC	-4.168	-4.564	-4.827	-4.839	-4.532	-4.777	-3.781
	(1.07)	(1.41)	(1.36)	(1.35)	(2.00)	(2.15)	(1.80)
	[0.99]	[1.42]	[1.35]	[1.32]	[2.17]	[2.08]	[2.16]
	1.00	*1.00*	*1.00*	*1.00*	*0.98*	*0.99*	*0.96*
PC x T					-0.504	-0.472	-2.074
					(2.69)	(2.71)	(2.55)
					[2.74]	[2.63]	[2.82]
					0.57	*0.57*	*0.77*
non-PC	0.395						
	(0.92)						
	[1.01]						
	0.35						
ΔCPI			323.167	341.281		198.487	212.750
			(251.55)	(251.28)		(275.52)	(272.86)
			[281.10]	[276.70]		[269.34]	[263.00]
			0.13	*0.11*		*0.23*	*0.21*
ΔUE			1055.980	1321.071		1030.144	1348.603
			(465.63)	(526.65)		(523.05)	(630.26)
			[593.75]	[627.10]		[556.81]	[590.63]
			0.04	*0.02*		*0.03*	*0.01*
ΔGDP			21.029	23.342		20.403	19.090
			(44.90)	(44.85)		(44.24)	(45.07)
			[49.36]	[48.55]		[46.76]	[45.63]
			0.33	*0.31*		*0.33*	*0.34*
$R_{\text{S\&P}}$				-0.210			-0.254
				(0.26)			(0.22)
				[0.18]			[0.19]
				0.88			*0.91*
T					-2.969	-2.747	-1.831
					(1.90)	(2.12)	(1.65)
					[2.00]	[1.93]	[2.00]
					0.93	*0.92*	*0.82*
Adjusted R^2	0.197	0.197	0.216	0.218	0.261	0.265	0.277
N	37	37	37	37	37	37	37

Table VIII
Probability of Interest Rate Changes before FOMC Announcements

This table reports coefficients from regressions of meeting-to-meeting changes in the probability of interest rate changes on changes ΔPC of an indicator variable, PC, equal to one if a meeting is followed by a press conference and zero otherwise, and control variables. Probabilities of changes, $\Delta Prob$(Change), or increases, $\Delta Prob$(Increase), in Federal funds rates are derived from Federal Funds Futures and Overnight Index Swap prices as measured one day prior to each FOMC meeting. ΔCPI, ΔUE, and ΔGDP are log changes in, respectively, the consumer price index, the unemployment rate, and the gross domestic product. $R_{\text{S\&P}}$ is the S&P 500 log return over the 21-day interval ending 3 days before the announcement. Asymptotic heteroscedasticity robust and bootstrapped standard errors are presented in parenthesis and square brackets, respectively, and bootstrapped p-values for the test that coefficients are less than or equal to zero in italics. Adjusted R^2 and the number of observations N are also reported. The sample period is April 2011 to October 2015. Detailed information on the construction of implied probability measures and data sources is provided in the text.

	Federal Fund Futures						Overnight Index Swaps					
	$\Delta Prob$(Change)			$\Delta Prob$(Increase)			$\Delta Prob$(Change)			$\Delta Prob$(Increase)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Intercept	0.001	0.008	0.024	0.001	0.003	0.014	0.001	0.003	0.019	0.002	-0.002	0.010
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)
	[0.01]	[0.02]	[0.02]	[0.01]	[0.02]	[0.02]	[0.01]	[0.02]	[0.02]	[0.01]	[0.02]	[0.02]
	0.48	*0.36*	*0.11*	*0.47*	*0.43*	*0.23*	*0.48*	*0.44*	*0.18*	*0.42*	*0.54*	*0.28*
ΔPC	0.028	0.028	0.029	0.033	0.032	0.033	0.024	0.026	0.028	0.021	0.022	0.023
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
	0.01	*0.01*	*0.00*	*0.00*	*0.00*	*0.00*	*0.04*	*0.02*	*0.01*	*0.03*	*0.02*	*0.01*
ΔCPI		-2.209	-1.553		-0.436	0.004		2.157	2.787		3.508	4.009
		(4.48)	(4.24)		(3.89)	(3.81)		(4.75)	(4.17)		(4.33)	(3.95)
		[5.01]	[4.33]		[4.48]	[4.15]		[5.06]	[4.45]		[4.43]	[3.99]
		0.67	*0.64*		*0.54*	*0.50*		*0.33*	*0.26*		*0.20*	*0.15*
ΔUE		3.211	14.911		6.180	14.039		-27.531	-16.292		-17.935	-9.008
		(10.37)	(7.68)		(9.00)	(6.81)		(10.01)	(8.41)		(8.80)	(5.56)
		[10.26]	[9.48]		[9.17]	[9.08]		[10.37]	[9.74]		[9.06]	[8.73]
		0.38	*0.06*		*0.25*	*0.06*		*1.00*	*0.95*		*0.97*	*0.85*
ΔGDP		-0.098	-0.017		0.159	0.213		-1.370	-1.292		-0.728	-0.666
		(0.82)	(0.66)		(0.77)	(0.67)		(0.75)	(0.66)		(0.65)	(0.53)
		[0.86]	[0.74]		[0.77]	[0.71]		[0.87]	[0.76]		[0.76]	[0.69]
		0.55	*0.51*		*0.42*	*0.38*		*0.94*	*0.95*		*0.84*	*0.84*
$R_{\text{S\&P}}$			-0.949			-0.638			-0.912			-0.724
			(0.29)			(0.28)			(0.28)			(0.33)
			[0.27]			[0.26]			[0.28]			[0.25]
			1.00			*0.99*			*1.00*			*1.00*
Adjusted R^2	0.106	0.029	0.250	0.177	0.110	0.211	0.052	0.157	0.328	0.058	0.099	0.244
N	36	36	36	36	36	36	36	36	36	36	36	36