

Gauging Market Responses to Monetary Policy Communication

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The modern model of central bank communication suggests that central bankers prefer to err on the side of saying too much rather than too little. The reason is that most central bankers believe that clear and concise communication of monetary policy helps achieve their goals. For the Federal Reserve, this means to achieve its goals of price stability, maximum employment, and stable long-term interest rates. This article examines the various dimensions of Fed communication with the public and financial markets and how Fed communication with the public has evolved over time. We use daily and intraday data to document how Fed communication affects key financial market variables. We find that Fed communication is associated with changes in prices of financial market instruments such as Treasury securities and equity prices. However, this effect varies by type of communication, by type of instrument, and by who is doing the speaking. (JEL E52, E58, E61, G10)

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KEYNES: Arising from Professor Gregory's questions, is it a practice of the Bank of England never to explain what its policy is?

HARVEY: Well, I think it has been our practice to leave our actions to explain our policy.

KEYNES: Or the reasons for its policy?

HARVEY: It is a dangerous thing to start to give reasons.

KEYNES: Or to defend itself against criticism?

HARVEY: As regards criticism, I am afraid, though the Committee may not all agree, we do not admit there is a need for defense; to defend ourselves is somewhat akin to a lady starting to defend her virtue.

Exchange between John Maynard Keynes and Bank of England Deputy Governor Sir Ernest Harvey, December 5, 1929.¹

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INTRODUCTION

Central bank communication has come a long way since the Bank of England's motto ostensibly was "Never explain, never apologize."² Today, the motto of central bankers might instead be "Can you hear me now?" The modern model of central bank communication suggests that central bankers prefer to err on the side of saying too much rather than too little. In this vein, central bank communication takes many forms, from economic forecasts and official reports, to speeches, interviews, testimonies before governmental bodies, and policy statements and press conferences immediately after policy meetings. In the United States, enhancements in central bank communication are most pronounced in the realm of speeches and other remarks (e.g., television interviews) by Federal Reserve (hereafter, Fed) governors and Reserve Bank presidents. These forms of communication have become more prominent since the recession and Financial Crisis. In an era of increased communication by Federal Open Market Committee (FOMC) participants, one may ask whether additional information is useful for financial market participants who carefully monitor monetary policy developments. Indeed, some economists and analysts have argued that Fed officials talk too much.³ There are many nuances to this argument, but the primary claim is that more information increases the probability of market mispricing. Shin (2017) discusses some of these issues.

There are at least two counterarguments to the market mispricing view. The first, as enunciated by Kocherlakota (2017), is that the price of an independent central bank is a set of independent voices to insure against group think. The second counterargument is that the pricing of financial instruments in markets is more efficient with more, not less, information. Regardless, central bank communication is important because individuals' economic decisions are based on *expectations* of future policies. Thus, clear communication of its policies and actions may help the Fed achieve its mandated goals of stable prices, maximum employment, and moderate long-term interest rates.

The purpose of this article is twofold. The first part examines the various dimensions of Fed communication with the public and financial markets. This includes documenting how communication with the public has evolved over time. The second part empirically analyzes the economic effects of Fed communication on key financial market variables. Our analysis uses daily and intraday data. We find that Fed communication can affect prices of financial market instruments such as equities and Treasury securities. However, this effect varies by type of communication, by type of instrument, and by who is doing the speaking. We also find that larger financial market reactions tend to be associated with communication from the Fed Chair, non-Chair Fed governors, and FOMC meetings without an associated press conference. We further find that financial market reactions following press conferences after FOMC meeting statements are not significant.

HOW DOES THE FED COMMUNICATE?

As the exchange between John Maynard Keynes and Bank of England Deputy Governor Sir Ernest Harvey demonstrated, the principles of central bank communication have evolved

Table 1**Types of Fed Communication**

Type	Communicator	Frequency	Release timing
Policy statement	FOMC	8 times per year	After each FOMC meeting, ~2 PM EST
Minutes	FOMC	8 times per year	3 weeks after each FOMC meeting, ~2 PM EST
Press conference	Chair	8 times per year*	After designated FOMC meeting, ~2:30 PM EST
Summary of Economic Projections	FOMC	4 times per year	After designated FOMC meeting, ~2 PM EST
Monetary Policy Report to Congress	Chair	2 times per year	~February and July of each year
Speeches and other public remarks	FOMC	Continuous [†]	NA
Statement of Longer-Run Goals and Policy Strategy	FOMC	1 time per year	Reaffirmed each January
Policy Normalization Principles and Plans [‡]	FOMC	Updated periodically	After associated FOMC meeting, ~2 PM EST

NOTE: Table reflects the present-day FOMC procedure. The timing and frequency of each event has changed over the past 20 years. ~Indicates times are approximations and may differ slightly from event to event. *During the period analyzed, press conferences were held only four times per year. Beginning in January 2019, press conferences are held after every FOMC meeting. [†]Excludes FOMC “blackout periods,” which begin the second Saturday preceding an FOMC meeting and end the Thursday following the meeting. [‡]Initially released in September 2014. An addendum was adopted in March 2015 and augmented in June 2017. For a history of revisions, see <https://www.federalreserve.gov/monetarypolicy/time-line-policy-normalization-principles-and-plans.htm>.

over time. A modern comparison describing the evolution of Fed communication was noted in 2003 by then Fed Governor Janet Yellen when she said that the FOMC “had journeyed from ‘never explain’ to a point where sometimes the explanation is the policy.”⁴ Some have termed this policy “open-mouth operations.”⁵ Although views may differ between policymakers and across central banks, the fundamental principles of central bank communication are founded on the dual notions that increased transparency enhances the effectiveness of policy and the accountability of policymakers in a democratic society.⁶ In this article, we focus on Fed communication, though the principles and practices are similar among many of the world’s central banks.

When analyzing central bank communication, the following questions come to mind: First, who should do the talking; second, what should the central bank talk about; and, third, who should the central bank talk to? There is a vast economic literature that attempts to answer these questions. One notable early effort was a cross-country study by Blinder et al. (2001), who surveyed communication methods and tactics, among other things. A subsequent article by Blinder et al. (2008) argued that there was large variation in strategies but no consensus on the best-practice approach to communicating monetary policy to the public. Woodford (2001) was an early proponent of using communication to influence market expectations. This view influenced several subsequent Fed officials, most notably former Fed Chairman Ben Bernanke.⁷ Finally, in the aftermath of the Financial Crisis of 2008, several event studies were published that analyzed the FOMC’s unconventional policy actions on prices of financial market instruments, macroeconomic outcomes, and the expectations about future monetary policy actions.⁸

In sum, the academic literature offers more support for the modern view of central bank communication: More is generally better. Table 1 lists the primary methods that the Fed uses to communicate its policies, procedures, and policy expectations to the public.⁹ These methods include the policy statement released at the end of the eight regularly scheduled FOMC meeting, the minutes released three weeks after each of the eight regularly scheduled FOMC meetings, the Chair's quarterly press conference, along with speeches, testimonies, and media interviews by Fed governors and Reserve Bank presidents. Some of these innovations are long standing, such as the FOMC minutes, while others are more recent, such as the Chair's press conferences.¹⁰ Given the prominence of FOMC policy statements as a communication instrument, the following discussion will first briefly focus on their history and role.

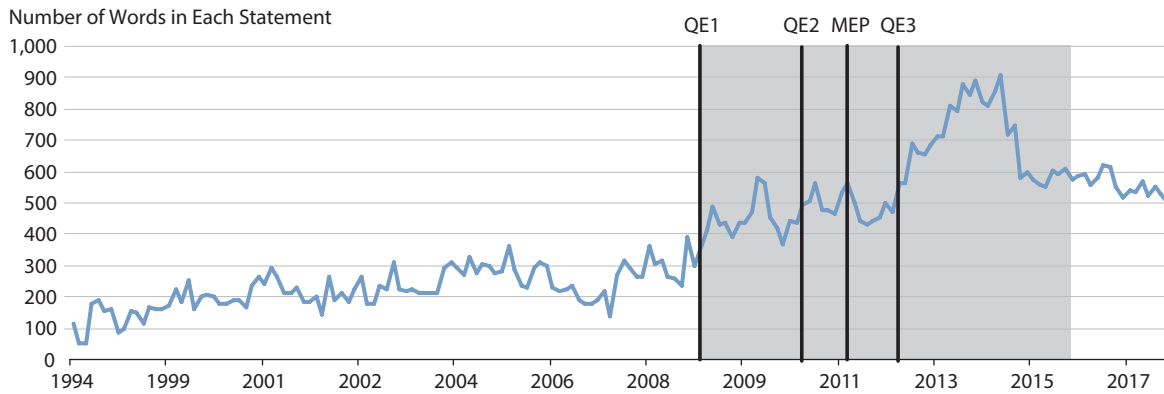
Policy Statements: Length and Readability

The Fed's principle medium of communication is the policy statement released after each FOMC meeting. The policy statement has evolved over time. From 1967 to 1992, the FOMC issued a "Record of Policy Actions" (ROPA), which were initially released with a 90-day lag.¹¹ Beginning under Chairman Alan Greenspan, the FOMC began to issue policy statements immediately after the February 4, 1994, meeting. The first policy statement was rather short, at 99 words, and made no mention of the intended federal funds target rate. Instead, the inaugural statement indicated that the Committee decided to "increase slightly the degree of pressure on reserve positions" in financial markets. In taking this action, the FOMC noted that they expected an "associated small increase in short-term money market interest rates."¹²

Following the release of the inaugural statement, the FOMC released a post-meeting statement four additional times in 1994. Three post-meeting statements were released in 1995, including the statement released after the July 6, 1995, meeting, which was the first instance that the FOMC specifically mentioned the federal funds rate. The FOMC continued to issue post-meeting statements over the next few years, but only at meetings where a policy change occurred. However, beginning with the May 18, 1999, meeting, statements were released after each FOMC meeting.¹³ The public focus on the policy statement was such that the financial press developed a "briefcase barometer."¹⁴

The post-meeting FOMC statements have evolved over time. Prior to the Financial Crisis, the post-meeting policy statement mostly focused on the state of the economy and the Committee's rationale for raising or lowering the policy rate or reasons why the policy rate was not changed. In general, less was said about the future path of interest rate changes. The policy statement evolved to take on a larger role in communicating the stance of monetary policy during the Financial Crisis after the federal funds rate reached the zero lower bound (ZLB) on December 16, 2008.¹⁵ Figure 1 shows that the word count of the policy statements began to increase steadily in 2007 during the early stages of the Financial Crisis. The word count continued to increase during the adoption of quantitative easing (QE) policies that both increased the size of the balance sheet and changed its composition. Prior to the ZLB period, the number of words in each statement averaged 223. During the ZLB period, the count was more than twice as much, averaging 580 words.

After the nominal federal funds target rate reached the ZLB in December 2008, the Fed provided the largest amount of monetary accommodation through balance sheet adjustments and

Figure 1**FOMC Statement Word Count**

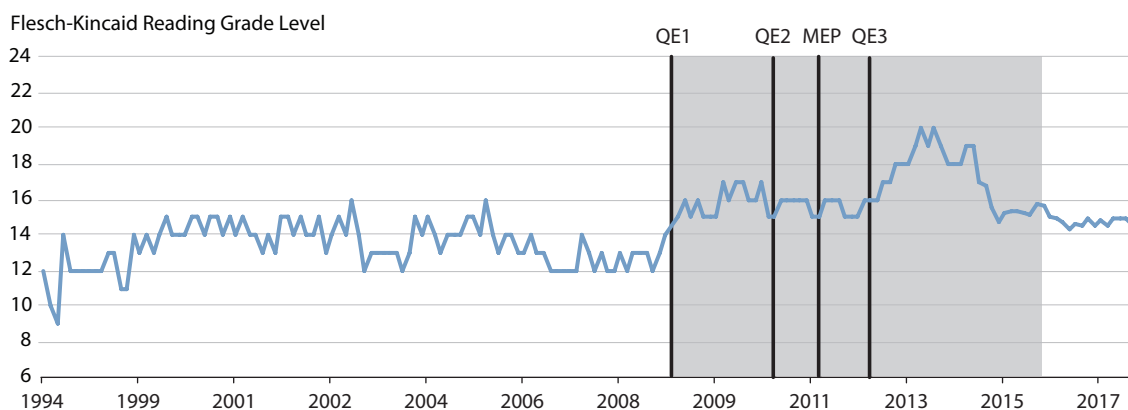
NOTE: Shaded area indicates the period of the FOMC’s unconventional monetary policy with interest rates at the effective ZLB. MEP, Maturity Extension Program. Under the MEP, the Fed sold or redeemed shorter-term Treasury securities and used the proceeds to buy longer-term Treasury securities, thereby extending the average maturity of the securities in the Fed’s portfolio. Updated through 2017.

SOURCE: Board of Governors of the Federal Reserve System.

other unconventional policies.¹⁶ But as the U.S. economy transitioned from recession to a slower-than-average recovery, the Fed’s policy approach also changed. The new approach focused instead on influencing the public’s *expectations* of the future direction and level of the federal funds target rate. This approach, in its current form, is referred to as forward guidance.¹⁷ For example, following the August 9, 2011, meeting, the policy statement stated the following:

The Committee currently anticipates that economic conditions—including low rates of resource utilization and a subdued outlook for inflation over the medium run—are likely to warrant exceptionally low levels for the federal funds rate at least through mid-2013.

In this case, the FOMC’s intent was to signal to the public that its policy rate would remain low for a long time in order to spur the economy’s recovery. This signal was meant to be taken as a public commitment, what Campbell et al. (2012) termed “Odyssean” policy. Using language from Greek mythology, Odyssean policy is meant to convey a public commitment not to change policy for a certain period—in this case, for more than two years. Instead, the public appeared to view this statement as a forecast, what Campbell et al. (2012) termed “Delphic” policy. In effect, the Delphic statement strongly suggested that, in the FOMC’s view, the economic weakness would persist for more than two years. However, at the June 2011 meeting two months earlier, the Summary of Economic Projections (SEP) indicated that real gross domestic product (GDP) would increase by 3.5 percent in 2012 and by 3.9 percent in 2013 (each measure is the midpoint of the central tendency).¹⁸ Thus, by August, the Committee appeared to have concluded that it, like most private sector forecasters, had been much too optimistic about the pace of real GDP growth during the early stages of the expansion. Indeed, by the January 2012 meeting, forecasts for real GDP growth in 2012 and 2013 had been marked down to 1.7 percent and 2.5 percent, respectively.

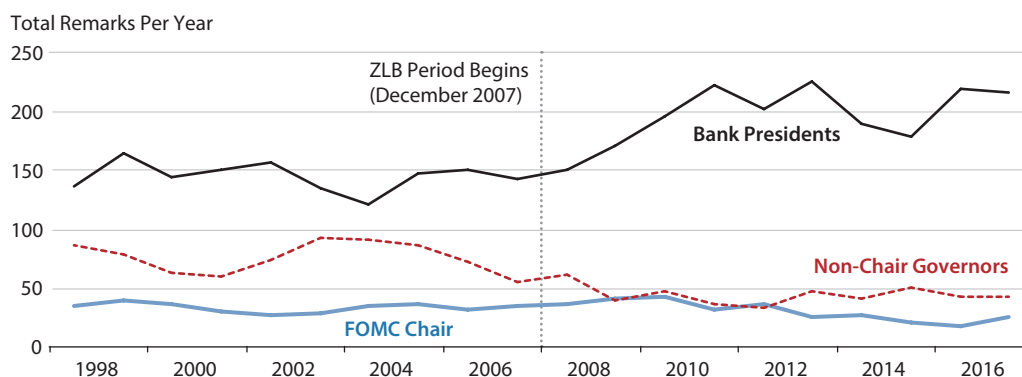
Figure 2**FOMC Statement Complexity**

NOTE: Shaded area indicates the period of the FOMC's unconventional monetary policy with interest rates at the effective ZLB. MEP, Maturity Extension Program. Under the MEP, the Fed sold or redeemed shorter-term Treasury securities and used the proceeds to buy longer-term Treasury securities, thereby extending the average maturity of the securities in the Fed's portfolio. Updated through December 2017.

SOURCE: Board of Governors of the Federal Reserve System (FOMC statements) and Educational Testing Service (word count).

To accomplish the Fed's goals and objectives in a slow-growth economy, the post-meeting statement changed in two dimensions. The first change, as noted above, was that the length increased. The statements included more discussion of the economic situation and its implication for the near-term direction of policy (changes in the federal funds target rate).¹⁹ Second, the statements incorporated more complex economic terms and analysis. This is shown in Figure 2, which uses text evaluation software to measure the Flesch-Kincaid reading grade level of the policy statement. A higher grade level is assumed to reflect increased complexity of the statement. Prior to the ZLB period, the median grade level was 13.5, indicating comprehension accessible to someone reading at a college undergraduate level. But by late 2013, when the FOMC was in the midst of increasing the size of its balance sheet through asset purchases, the grading level rose to 20, which is commensurate to a graduate school reading level. For the entire ZLB period, the grade level rose to 16 (median), but then fell to 15 (median) during the post-ZLB period.²⁰ Researchers find that the readability of central bank policy statements and remarks are an important factor in how they are received by financial markets. Not surprisingly, clearer statements lead to lower volatility.²¹

This section has highlighted how the FOMC changed the length and composition of the policy statement during the period of unconventional monetary policy. But the policy statement is only one form of central bank communication. Speeches and other public remarks are another form of communication that policymakers have deployed to increase the public's knowledge of the prevailing monetary policy regime. The next two sections will delve into monetary policy communication strategies by Fed officials, both old and new.

Figure 3**Number of Public Remarks by Type of Fed Official**

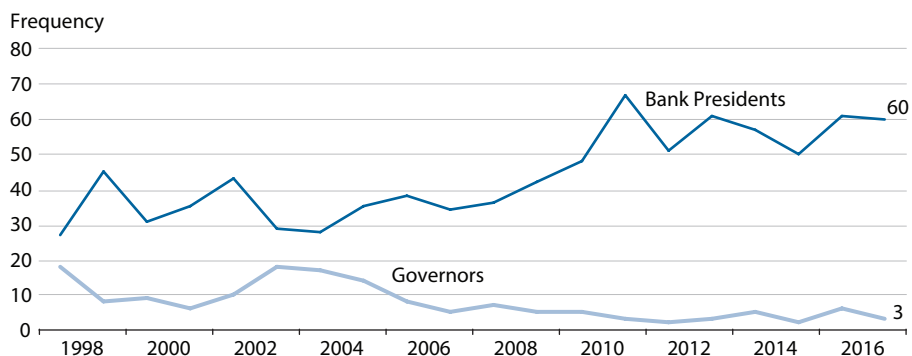
NOTE: Through 2017.

SOURCE: Board of Governors of the Federal Reserve System, the 12 Federal Reserve Banks, Bloomberg, and authors' calculations.

Public Remarks by Fed Officials

Fed officials have long used other forms of public communication besides policy statements.²² Public remarks can take many forms, including formal speeches, Congressional testimonies, interviews with the financial media, or published articles and commentaries. Sometimes, Fed officials do not comment on monetary policy issues that may be discussed at recent or upcoming FOMC meetings. In those instances, policymakers may instead choose to focus on other issues, such as local economic conditions, economic education, community development, or banking and financial market regulation.

The ZLB period witnessed an unprecedented rate of spoken and written communication with the public by Fed governors and Reserve Bank presidents. Figure 3 shows the annual number of public remarks by the Fed Chair, non-Chair governors, and Reserve Bank presidents since 1998.²³ From 1998 to 2004, the total number of public remarks by Reserve Bank presidents remained roughly constant at about 150 per year. A slightly different pattern occurred with governors and the Fed Chair. Total remarks over this period steadily fell, but then rebounded, so that the numbers of public remarks in 2004 were close to the 1998 totals. Beginning in 2005, the total number of public remarks by Reserve Bank presidents began to increase, reaching a peak in 2013 of a little more than 220 public remarks. Interestingly, though, the FOMC Chair and governors delivered public remarks slightly less frequently over the ZLB period. Some of the reduced frequency of public remarks by members of the Board of Governors (excluding the Chair) reflects the fact that the Board has rarely operated with a full complement of Governors (seven). From 1998 to 2017, there has only been four years when there were seven governors present at the last formal meeting of the year. Indeed, at the end of 2017, there were only four governors at the December meeting. At the March 2018 meeting, the number of governors had dwindled to three.

Figure 4**Number of Times More Than One Bank President or Governor Spoke on the Same Day, 1998-2017**

SOURCE: Board of Governors of the Federal Reserve System, Bloomberg, and authors' calculations.

Speeches have become important communication events. Chairman Greenspan's new economy speech in 1995 and his "irrational exuberance" speech in 1996 were among his more notable speeches. Chairman Ben Bernanke also gave notable speeches during his tenure. Two that stand out are his "Deflation: Making Sure 'It' Doesn't Happen Here" speech in 2002 and his global saving glut speech in 2005. Days with multiple Fed communication events have become more numerous over time—particularly since the Financial Crisis. Figure 4 shows the increase in multiple Fed communication events on the same day stems from an increase in more than one Reserve Bank president speaking on the same day. For example, in 2017, there were 60 days when more than one Reserve Bank president spoke. In 2004, it was about half as much. By contrast, in 2017 there were only three days when more than one Fed governor spoke publicly on the same day. This is down sharply from 2003, when there were 19 days when multiple Fed governors spoke on the same day.²⁴

In separate analysis, we looked at the annual number of public remarks by Reserve Bank presidents from January 1998 to December 2017. We separated the sample into roughly two 10-year periods: January 1998 to August 2008 (pre-Financial Crisis) and September 2008 to December 2017 (post-Financial Crisis). The number of public remarks by Reserve Bank presidents increased in all but three Fed Districts (Chicago, New York, and Richmond). The average increase in volume across these nine Districts was 46 percent. We did not examine whether the nature of the remarks by Reserve Bank presidents has changed over time. We did, however, analyze the number of speeches and public remarks given by presidents of the Fed Bank of St. Louis since January 1929. We have documented this in the boxed insert.

Other Forms of Fed Communication

In the past several years, chiefly under the Bernanke regime, the FOMC has adopted several new forms of communication to further increase transparency. As noted earlier, the Chair's quarterly press conference, beginning under Chairman Bernanke's term in January

Volume and Subject Matter Across Time: An Example Using St. Louis Fed Presidents

The table lists the number of speeches (including public remarks) given by presidents of the Federal Reserve Bank of St. Louis since January 1929. The table also lists the primary subject matter of the speeches under three broad headings: The economic outlook (which includes monetary policy related topics), banking and finance, and all other subjects. In general, St. Louis Fed presidents prior to the 1960s tended to give fewer speeches than presidents after the 1960s. Moreover, presidents prior to the 1960s tended to talk more about non-economic outlook topics and proportionately more about banking and finance issues relative to their modern-era counterparts.

Speeches by St. Louis Fed Presidents, 1929 to 2017

President	Start	End	Months in office	Total speeches	Economic outlook	Banking and finance	Other	% of total speeches about economic outlook	% of total speeches about banking and finance	% of total speeches about other	Average number of speeches per year
William McChesney Martin Sr.	Jan-1929	Feb-1941	145	4	0	3	1	0	75	25	0.3
Chester C. Davis	Apr-1941	Feb-1951	118	64	38	11	15	59	17	23	6.5
Delos C. Johns	Feb-1951	Feb-1962	132	25	15	8	2	60	32	8	2.3
Harry A. Shuford	Oct-1962	Jan-1966	39	9	4	5	0	44	56	0	2.8
Darryl R. Francis	Jan-1966	Feb-1976	121	110	94	11	5	85	10	5	10.9
Lawrence K. Roos	Mar-1976	Jan-1983	82	37	33	4	0	89	11	0	5.4
Theodore H. Roberts	Feb-1983	Dec-1984	22	8	6	2	0	75	25	0	4.4
Thomas C. Melzer	Jun-1985	Jan-1998	151	100	82	17	1	82	17	1	7.9
William Poole	Mar-1998	Mar-2008	120	140	133	4	3	95	3	2	14.0
James Bullard	Apr-2008	Dec-2017*	116	179	173	5	1	97	3	1	18.5

NOTE: *End date for President Bullard reflects our window for analysis rather than his tenure in office.

SOURCE: Presidents prior to Poole, FRASER®, Federal Reserve Bank of St. Louis. Poole and Bullard, Bloomberg.

As shown in the table, the focus in recent years has shifted toward a greater emphasis on the economic outlook, which includes macroeconomic conditions and monetary policy developments. Indeed, the economic outlook (and monetary policy related topics) comprised a very large percentage (more than 95 percent) of the speeches of the most recent two St. Louis Fed presidents—William Poole and James Bullard. Finally, consistent with the findings of Figure 3, the last column of the table shows that these two St. Louis Fed presidents have given the highest number of speeches per year of all St. Louis Fed presidents.

2012, is one key innovation. Current Chairman Jerome Powell expanded on this innovation, announcing that press conferences will be held after *every* FOMC meeting beginning in January 2019. Other innovations include the FOMC’s “Statement of Longer-Run Goals and Monetary Policy Strategy,” “Policy Normalization Principles and Plans,” and “Summary of Economic Projections” (SEP). These are also listed in Table 1. The first two are meant to provide clarity on the Fed’s dual mandate and balance sheet, respectively, while the SEP conveys projections for four key macroeconomic variables. In addition, the SEP conveys each FOMC participant’s assessment of appropriate monetary policy, as indicated by their federal funds rate projections over short-, medium-, and longer-term horizons.

Grading Fed Communication

The Hutchins Center on Fiscal and Monetary Policy at Brookings conducted a survey of academics and private sector Fed watchers to assess the effectiveness of different forms of Fed communication.²⁵ Survey participants viewed the FOMC policy statement, speeches by the FOMC Chair, and quarterly press conferences as the most useful forms of Fed communication. On net, academics generally found these forms of communication more useful than did the private sector economists and Fed watchers.

One of the key communication innovations during the Bernanke tenure was the public release of individual FOMC participants' expectations of the future level of the federal funds rate. Once a quarter, with the release of the SEP, each FOMC participant—anon­ymously—indicates their preference for the level of the federal funds rate at the end of the current year, at the end of the next two to three years, and over the “longer run.” According to the survey, these projections are often termed the FOMC “dot plots.” Both academics and those in the private sector found the dot plots of limited use as an instrument of Fed communication (more “useless” than “useful”). One-third of the respondents found the dot plots “useful or extremely useful,” 29 percent found them “somewhat useful,” and 38 percent found them “useless or not very useful.”

The limited usefulness of the dot plots probably reflects many factors. First, each participant's projection is conditioned on the highly restrictive assumption of “appropriate monetary policy.” Each participant's appropriate monetary policy stance is conditioned on their view of the outlook for real GDP growth, inflation, and the unemployment rate over the medium term. Moreover, the range of participants' views may not dovetail with the policy path outlined in the FOMC statement, which can further complicate the communicated outlook and diminish the tool's effectiveness. The regular presence of dissents suggests that appropriate policy can differ sharply across the Committee.

Second, the participants may have other vastly different assumptions that influence their outlook, such as the equilibrium real interest rate, the future path of crude oil prices, the foreign exchange value of the dollar, or their outlook for foreign economic growth. For these reasons and more, FOMC participants persistently over-projected the federal funds target rate path during the early years of the current expansion. [See earlier discussion on page 73.] These persistent one-sided forecast errors may have impaired the credibility of the dot plots to the extent that the projections were important inputs in establishing expectations about future monetary policy.

Finally, the Brookings study revealed that survey participants believe that Reserve Bank presidents' speeches are slightly less useful than the dot plots, but still more useful than Fed reports to Congress, such as the semi-annual Monetary Policy Report.²⁶ This finding is perhaps striking given that the number of public remarks by Reserve Bank presidents has been trending up over time, especially during the ZLB period, while the number of public remarks by the Chair and non-Chair governors has been trending down.

EMPIRICAL ANALYSIS

The final section of the article assesses how financial market participants respond to various forms of Fed communication. Admittedly, this is a difficult empirical exercise for many reasons. First, public remarks by Fed senior officials are often context- and perspective-dependent. Each individual brings their own perspective, model of the economy, and view of the monetary policy transmission mechanism. These views naturally inform their assessments of appropriate monetary policy going forward, which are then conveyed in public remarks. For their part, financial market participants may become familiar with a given policymaker's view or assume a given outcome for a particular FOMC meeting. If so, markets may react only to views that are sufficiently different from expectations. Past research has demonstrated that monetary policy surprises can have significant effects on high-frequency asset prices.²⁷ We acknowledge the importance of monetary policy surprises, but use a different approach to assess the significance of Fed communication events.

Second, when attempting to gauge the significance of public remarks, markets do not usually assign equal weights to all FOMC participants. Certainly, markets carefully parse remarks by the Chair, who is typically viewed as the public voice of the FOMC and the one who sets the policy agenda. Moreover, while the Chair's views often convey the *consensus view* of the Committee, the Chair nonetheless also has a policy preference. Although the Chair's preference invariably prevails, dissents still occur periodically. Indeed, Reserve Bank presidents sometimes use their public remarks, or dissents, with the intention of signaling future policy preferences or advocating for alternative frameworks.²⁸ Still, markets may discount the views of the presidents, on average, because they believe their views unnecessarily distort market signals or future policy intentions. For example, Lustenberger and Rossi (2017) claim that remarks by Reserve Bank presidents worsen the accuracy of private sector forecasts.

With these caveats in mind, we adopt a two-pronged empirical exercise. The first exercise uses daily data to examine whether Fed communication events are associated with significant movements in key financial market variables. Admittedly, this approach has some drawbacks. First, daily financial market data tend to be more volatile compared with monthly or quarterly data. Second, this volatility arises, in part, because financial markets trade on many types of information, such as macroeconomic data or global financial or geopolitical developments. Thus, while Fed communication comprises one set of information the market uses to price assets, there are potentially many other sources of information that the market uses that we can't readily account for. Our intent is to assess market reactions to Fed communication events and not to model changes in asset price movements at a high frequency.

The second empirical exercise uses intraday data at 5-minute frequencies. Using intraday data allows us to more closely match the timing of Fed communication events with the responses in financial markets. This is the approach adopted by most of the aforementioned event studies. Our intent is to determine if the empirical results using the daily data are consistent with those from the intraday data. Before presenting the results, we provide a detailed description of our data sources and approach.

Data Sources and Approach

We study the effects of seven types of Fed communication events: FOMC meeting statements;²⁹ FOMC minutes; Fed Chair press conferences; public remarks by the Fed Chair, non-Chair Fed governors, and Reserve Bank presidents; and unconventional monetary policy announcements.³⁰ Five of the seven categories are included in the Brookings study. It is important to note that there is an overlap between FOMC meetings and six of the seven unconventional policy announcements we include.³¹ Initially, our data set included public remarks made after market hours and on weekends. Consistent with some of the literature, we initially moved an after-hours communication event to the following trading day to gauge the market's reaction to the remark. However, this approach ended up producing large reactions that were probably not tied to the public remark itself. For example, many key data releases are often issued before the market opens.³² In this case, it is difficult to determine whether the market is responding to the public remarks by a Fed official or to economic data releases that may be a surprise.³³

Empirical Analysis: Daily Data

We create a series of dummy variables for the Fed communication events. Because the Brookings study found that survey participants viewed the Fed Chair press conferences as a useful form of communication, we identify regularly scheduled FOMC meetings with and without an associated press conference. In recent years, FOMC press conferences have occurred after the March, June, September, and December meetings. Since the liftoff from the ZLB at the December 2015 meeting, increases in the FOMC's federal funds target rate have occurred at meetings with an associated press conference by the Fed Chair. Our sample period is January 6, 1998, to December 29, 2017. There are nine types of communication events:

- Non-press conference FOMC meeting statements
- Press conference FOMC meeting statements
- Releases of FOMC minutes
- Remarks by the FOMC Chair
- Remarks by all other Fed governors
- Remarks by Reserve Bank presidents
- Days when there are multiple Fed communication events (e.g., speeches)
- Unconventional policy actions (e.g., large-scale asset purchases)
- Key macroeconomic data releases (e.g., industrial production)

We evaluate the market reaction for three financial instruments: the absolute value of the daily change in the yield on 2-year Treasury notes, the yield on 10-year Treasury notes, and the Chicago Board Options Exchange equity market volatility index (VIX). Changes in 2-year Treasury yields are widely viewed as being sensitive to expected changes in FOMC policy. The 10-year Treasury yield is the most liquid, long-term, risk-free interest rate in the financial markets. It is also sensitive to changes in inflation expectations and longer-term expectations about short-term interest rates. Finally, the VIX, which is often termed the mar-

ket’s “fear gauge,” is sometimes viewed as signaling changes in economic uncertainty. This exercise can be represented by the following equation:

$$\Delta Y_{i,t} = \alpha + \beta_1 \Delta Y_{i,t-1} + \beta_2 NPC_{i,t} + \beta_3 PC_{i,t} + \beta_4 MIN_{i,t} + \beta_5 CHAIR_{i,t} + \beta_6 GOV_{i,t} + \beta_7 PRES_{i,t} + \beta_8 MULT_{i,t} + \beta_9 UNCONV_{i,t} + \beta_{10} MACRO_{i,t},$$

where $\Delta Y_{i,t}$ represents the absolute value of the daily change in financial variable i (either the 2-year Treasury yield, 10-year Treasury yield, or VIX) on day t . The independent variables include a constant, a one-day lag of the dependent variable, and a series of dummy variables (specified earlier in this section) that take the value of 1 if that event occurs on day t or are zero if the event does not occur on day t .

We analyze daily data with three ordinary least-squares regressions. We use the absolute value of the daily changes because some communication events will cause yields to increase or decrease, while others will generate no market response. Using absolute values are a more effective way to gauge the effects of communication events on financial market activity.³⁴ We also include another dummy variable (*MACRO*) on days when key economic statistics are released. The motivation for this is that the market trades on information contained in these reports. Our economic statistic dummy variable takes the value of 1 when the following monthly economic reports are released (and is zero on all other days): the consumer price index, monthly employment situation, industrial production, retail sales, the Institute for Supply Management Report on Manufacturing, and the three GDP releases (advance, second, and third estimates).

Table 2 shows the results of our analysis using daily data. Daily data allow us to make a few noteworthy observations. First, for the change in the 2-year Treasury yield, markets react significantly (at the 1 or 5 percent level) to Fed Chair and Fed governor communication events and also to FOMC statements at non-press conference meetings. Table 2 further indicates that changes in 2-year Treasury securities do not react significantly on days when one Reserve Bank president speaks, but they do react significantly on days when there are multiple Fed speakers. (Recall from Figure 4 that the number of days with multiple Fed speakers has increased since the Financial Crisis). Finally, 2-year yields also react significantly to macroeconomic data releases. Unconventional policy actions are marginally significant (at the 8 percent level). With the exception of days with multiple Fed speakers, the signs of the coefficients on the significant variables are positive.

The second and third sets of regressions in Table 2 show results for the change in the 10-year Treasury yield and in the VIX. Traders of longer-term Treasury securities react broadly similarly to Fed communication events and data releases as traders of 2-year Treasury securities. For instance, 10-year yields react significantly to the Fed Chair’s remarks, on days when there are multiple Fed speakers, and to macroeconomic data releases; the coefficients generally have the same signs and magnitudes as those from the regression using 2-year yields. However, there are some differences between the 2-year and 10-year responses. For example, the change in the 10-year yield is significantly associated with unconventional policy actions. Moreover, 10-year yields do not react significantly to remarks by Fed governors or to non-press conference FOMC statements.

Table 2
Federal Reserve Communication Events and Financial Market Responses Using Daily Data

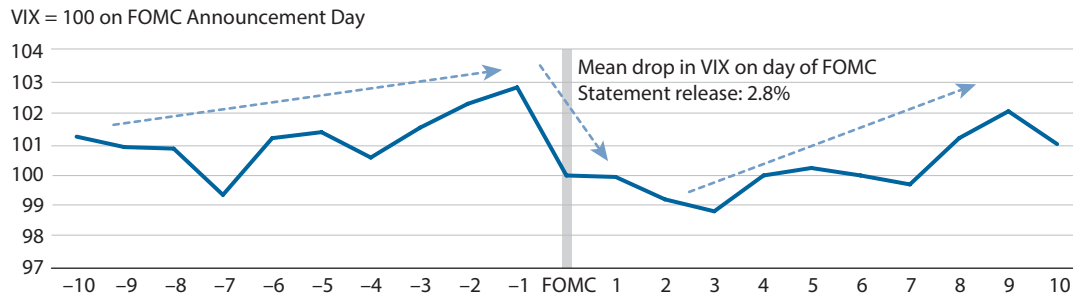
Independent variables	Dependent variables		
	2-year Treasury	10-year Treasury	VIX
Constant	0.023 (0.000)**	0.035 (0.000)**	0.641 (0.000)**
Lagged dependent variable	0.248 (0.000)**	0.132 (0.000)**	0.321 (0.000)**
Non-press conference FOMC meetings	0.013 (0.001)**	0.006 (0.187)	0.059 (0.588)
Press conference FOMC meetings	0.004 (0.594)	0.001 (0.880)	0.092 (0.626)
FOMC minutes	0.004 (0.154)	0.004 (0.309)	-0.078 (0.315)
FOMC Chair remarks	0.006 (0.001)**	0.005 (0.012)*	0.018 (0.787)
Fed governor remarks	0.004 (0.003)**	0.001 (0.347)	0.020 (0.645)
Fed president remarks	0.000 (0.775)	0.000 (0.877)	0.093 (0.111)
Multiple Fed speakers	-0.004 (0.032)*	-0.004 (0.018)*	-0.068 (0.265)
Unconventional policy actions	0.036 (0.080)	0.044 (0.021)*	0.626 (0.176)
Macroeconomic data releases	0.009 (0.000)**	0.009 (0.000)**	0.077 (0.031)*
Adjusted <i>R</i> -squared	0.089	0.040	0.109
Durbin-Watson statistic	2.107	2.043	2.264

NOTE: *p*-values listed in parentheses. The sample period is January 6, 1998 to December 29, 2017.

* and ** indicate significance at the 5 percent and 1 percent levels, respectively. Dependent variables are expressed as the absolute value of their one-day changes.

Column 3 presents the results for the change in the VIX. Equity market volatility does not react significantly to Fed communication events. The closest variable of significance ($p = 0.11$) are remarks by Reserve Bank presidents. Equity market volatility does, however, react significantly to macroeconomic data releases. Finally, in all three regressions, the constant and the lagged dependent variable are significant at the 1 percent level.

Figure 5 provides some visual evidence for the behavior of equity market volatility around FOMC meetings: From January 1994 to December 2017, the VIX begins to rise about a week before an FOMC meeting. The VIX then drops relatively sharply (nearly 3 percent) on the day the FOMC statement is released. This finding suggests that equity markets appear to be increasingly uncertain about the meeting outcome, or its effects on financial markets, in the run-up to FOMC meetings.³⁵ Likewise, we see a noticeable reduction in market volatility

Figure 5**Relative Changes in the VIX Near FOMC Announcement Days**

NOTE: Sample includes all regularly scheduled FOMC meetings between January 1994 and December 2017.
SOURCE: Haver Analytics and authors' calculations.

after the policy announcement (statement), perhaps indicating a decline in uncertainty and clearer understanding of the Fed's reaction function. Finally, other than the lagged dependent variable, the dummy variable that accounts for the release of key economic reports is the only other independent variable that is statistically significant.

We now turn to the second approach of our empirical exercise, namely, examining the effects of communication events on financial market outcomes using intraday data.

Empirical Analysis: Intraday Data

We use intraday data to estimate the effects of Fed communication on key financial market variables. Many researchers have used intraday data to gauge market reactions to monetary policy surprises or to the Fed's announcements of unconventional policies after the Financial Crisis. These event studies, as they are often called, are intended to measure the financial market's response to news at intervals measured in minutes. Our analysis of the market's response to Fed communication events generally follows the form and practice of the event study literature.

Event studies can be criticized for many reasons. First, the studies gauge only the initial announcement responses rather than the responses across time. Second, the results can be sensitive to the choice of window size—that is, responses evaluated over a 1-minute window versus a 5- or 10-minute window. Third, responses could be affected by non-announcement effects, such as from economic data releases or geopolitical events. In view of these concerns, we tested several different window sizes for robustness and used minute-by-minute asset price data for the S&P 500 stock prices and 10-year Treasury futures prices.³⁶ For FOMC meeting statements, FOMC minutes, and unconventional policy announcements (non-speaker events), a window of plus or minus 15 minutes is used. For FOMC press conferences and other public remarks (speaker events), a window of 15 minutes before to 60 minutes after the event is used. We do not find that the interpretation of the results meaningfully changes when the event window is adjusted.³⁷

Since these two variables are both prices, we calculate the percent change in each series over each event window.³⁸ We then summarize this information via two metrics: mean absolute change and cumulative change. For non-speaker events, where the event window is +/-15 minutes, the mean absolute change can be represented as

$$MAC_{Non-Speaker}^j = \frac{1}{N} \sum_{i=1}^N \left| \left(\frac{Y_{i,t+15}^j}{Y_{i,t-15}^j} - 1 \right) * 100 \right|,$$

where $Y_{i,t}^j$ represents, for each non-speaker event category j , the asset price associated with observation i at time t , and N represents the total number of observations for each non-speaker event category j over the sample.

Likewise, for speaker events, where the event window is -15/+60 minutes, the mean absolute change can be represented as

$$MAC_{Speaker}^j = \frac{1}{N} \sum_{i=1}^N \left| \left(\frac{Y_{i,t+60}^j}{Y_{i,t-15}^j} - 1 \right) * 100 \right|,$$

using the same notation as before.

The cumulative change is calculated similarly, but we are now summing (instead of averaging) over our sample, and we are not taking the absolute value beforehand. We represent this as

$$CC_{Non-Speaker}^j = \sum_{i=1}^N \left[\left(\frac{Y_{i,t+15}^j}{Y_{i,t-15}^j} - 1 \right) * 100 \right]$$

and

$$CC_{Speaker}^j = \sum_{i=1}^N \left[\left(\frac{Y_{i,t+60}^j}{Y_{i,t-15}^j} - 1 \right) * 100 \right]$$

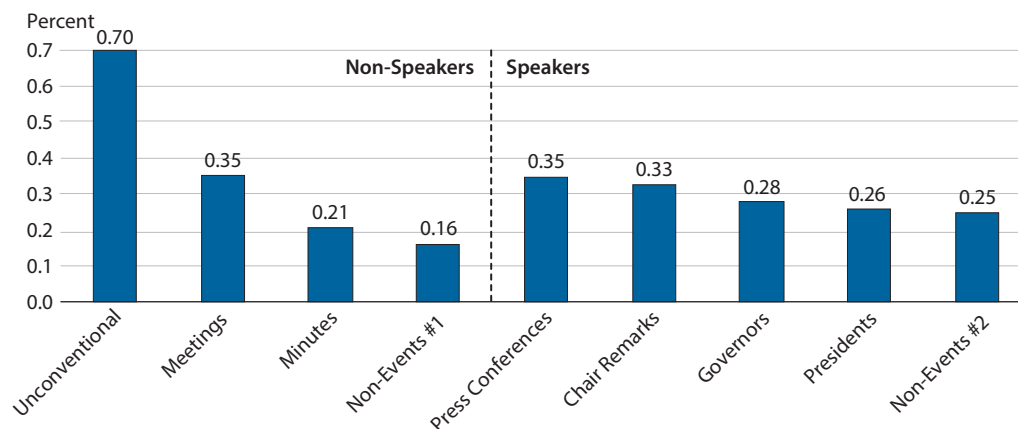
for non-speaker and speaker events, respectively, again using the same notation as before.

The results are shown in Figure 6A, Figure 6B, and Figure 7. The grouping on the left side of Figure 6A shows the mean absolute changes in the S&P 500 index in response to Fed communication events not associated with an individual Fed official (non-speaker events), while the grouping on the right side of Figure 6A shows those in response to events with public remarks by a Fed official (speaker events).³⁹ On the left side, we find that stock prices react most strongly to unconventional policy actions—indeed, twice as strong as the next-largest event (FOMC meeting statements). This finding appears consistent with the event study literature cited earlier. On the right side, stock prices react the most to the Chairs' press conferences and their remarks. In contrast, stock price changes in response to Fed communication events by Reserve Bank presidents and Governors are similar in magnitude.

Figure 6B shows the same calculation for 10-year Treasury bond futures prices. The results in Figure 6B are broadly similar to those in Figure 6A. In particular, responses to unconventional policies are substantially larger than to other forms of Fed communication, such as FOMC meeting statements. As with stock prices, bond markets appear to react more strongly

Figure 6A

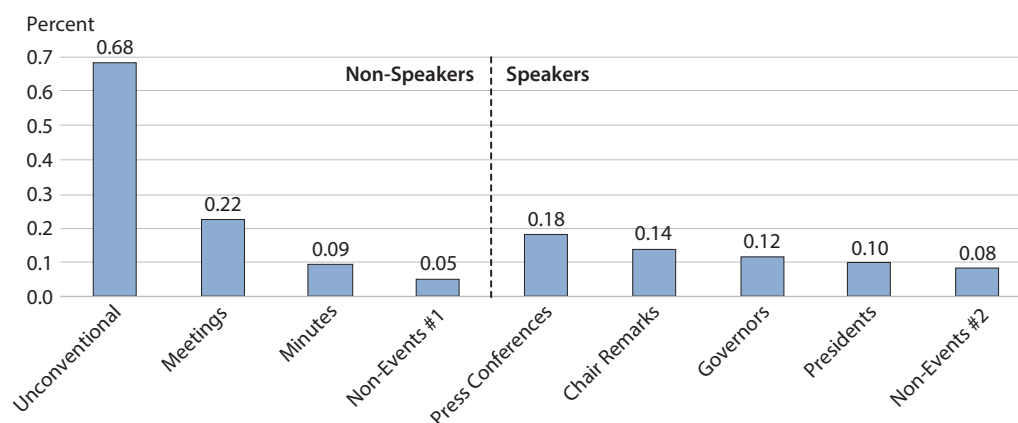
Mean Absolute Changes in S&P 500 Index



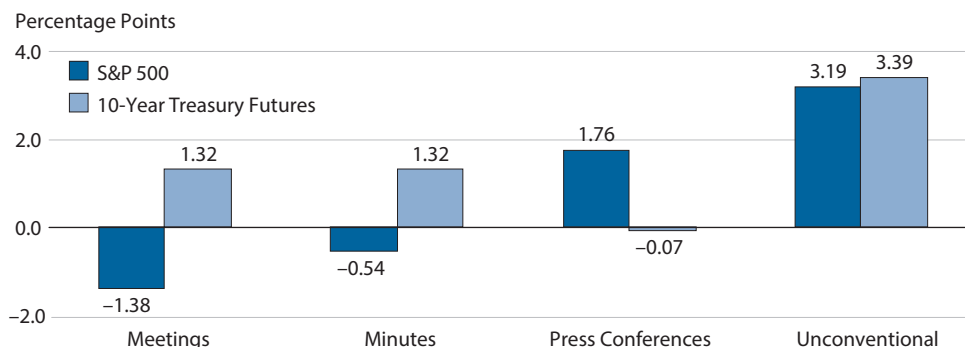
NOTE: Underlying data are expressed as a percent change in the S&P 500 index over an event window of -15/+15 minutes (non-speaker events) or of -15/+60 minutes (speaker events). The absolute values of these percent changes are then averaged, for each event category, over the full sample. Non-event days are days with no Fed communication event. Non-speaker events and speaker events have different non-event day controls because they are associated with different window sizes.

Figure 6B

Mean Absolute Changes in 10-Year Treasury Futures Prices



NOTE: Underlying data are expressed as a percent change in 10-year Treasury futures price over an event window of -15/+15 minutes (non-speaker events) or of -15/+60 minutes (speaker events). The absolute values of these percent changes are then averaged, for each event category, over the full sample. Non-event days are days with no Fed communication event. Non-speaker events and speaker events have different non-event day controls because they are associated with different window sizes.

Figure 7**Cumulative Changes for Fed Communication Events**

NOTE: Underlying data are expressed as a percent change in the index (S&P 500) or price (10-year Treasury futures) over the event window. These percent changes are then summed, by category, over the full sample. For FOMC meetings, minutes, and unconventional policy measures, the window is $-/+15$ minutes. For press conferences, the window is $-15/+60$ minutes. For illustrative purposes, other public remarks were removed from the figure because of very high cumulative change values.

to meeting statements than the release of FOMC minutes. The right side of Figure 6B shows that the bond market's responses to the Chair's press conferences and the Chair's remarks are appreciably larger than to non-Chair Fed governors and Reserve Bank presidents.

Figure 7 plots the *cumulative* changes for FOMC meeting statements, minutes, press conferences, and unconventional monetary policy announcements. We exclude other events for illustrative purposes, as they exhibit very high cumulative change values. Similar to the findings in Figures 6A and 6B, unconventional policies are associated with large stock and bond market responses during our sample. The cumulative change in stock prices associated with FOMC press conferences is also relatively large and positive. However, for FOMC meeting statements and the release of FOMC minutes, the cumulative response of stock prices is negative, with the response of the latter more than double the former. The response of bond futures prices to FOMC meeting statements is of the same magnitude as the minutes, but, again, far smaller than to unconventional policies. For Chair press conferences, the near-zero cumulative change is not a function of the bond futures market ignoring this information; rather, it is the result of large, positive price reactions negating large, negative price reactions over the sample. In summary, the empirical analysis presented in this article suggests that stock and bond markets respond to a variety of Fed communication events, especially FOMC meeting statements, FOMC press conferences, and remarks by the Fed Chair.

CONCLUSION

Clear and concise communication of monetary policy helps the Fed achieve its congressionally mandated goals of price stability, maximum employment, and stable long-term

interest rates. It does so by helping to reduce uncertainty about the future direction of policy. This helps to reduce distortions in market pricing, thereby improving the efficient allocation of resources by firms, households, and governments. This article has examined the various dimensions of Fed communication with the public and financial markets. This includes documenting how the Fed’s communication with the public has evolved over time. Using both daily and intraday data, our empirical analysis documents how Fed communication affects key financial market variables. We find that Fed communication is associated with changes in prices of financial market instruments such as Treasury securities and equity prices. However, this effect varies by type of communication, by type of instrument, and by who is doing the speaking. Perhaps not surprisingly, we find that the largest financial market reactions tend to be associated with communication by Fed Chairs rather than by other Fed governors and Reserve Bank presidents and with FOMC meeting statements rather than FOMC minutes. ■

NOTES

- ¹ The occasion was a hearing of the Committee on Finance and Industry. According to Ahamed (2009), this was a select committee to investigate the British banking system in the aftermath of the 1929 collapse in stock prices and the poor performance of the British economy. See Ahamed (2009, pp. 371-72).
- ² Ahamed (2009, p. 371).
- ³ For example, see Cochrane (2017), Cogan and Shultz (2017), and Derby (2017).
- ⁴ From a 2003 speech by Governor Yellen, as quoted in Holmes (2013). Holmes argues that central bankers, both in the United States and elsewhere, have increasingly (even before the Financial Crisis) moved away from traditional instruments, such as interest rates or exchange rates, toward “communicative experiments” designed to influence public sentiments and expectations.
- ⁵ For an early discussion of this phenomenon applied to the Reserve Bank of New Zealand and the FOMC, see Guthrie and Wright (2000) and Thornton (2004), respectively.
- ⁶ See Blinder et al. (2001).
- ⁷ See Bernanke, Reinhart, and Sack (2004). A synthesis of Bernanke’s views was presented in a 2013 speech, “Communication and Monetary Policy.”
- ⁸ See, for example, Neely (2015) or Bauer and Rudebusch (2014).
- ⁹ We define the public as anyone who uses expectations about future monetary policy actions as an input into their decisionmaking process.
- ¹⁰ Current Chairman Jerome Powell expanded on this innovation, announcing that press conferences will be held after every FOMC meeting beginning in January 2019.
- ¹¹ For example, the ROPA for the January 15, 1970, meeting was released on April 15, 1970, a three-month lag. The FOMC ceased publication of the ROPA after the December 22, 1992, meeting. Beginning in 1993, the ROPA was effectively folded into the FOMC minutes and released with a much shorter lag. For more historical detail, see https://www.federalreserve.gov/monetarypolicy/fomc_historical.htm.
- ¹² This statement, and subsequent policy statements, can be found on the Board of Governors of the Federal Reserve System website: https://www.federalreserve.gov/monetarypolicy/fomc_historical_year.htm.
- ¹³ Wynne (2013) provides a short history of the FOMC’s communication practices.
- ¹⁴ See Gavin and Mandal (2000).
- ¹⁵ The ZLB is the period when the target range for the intended federal funds rate was 0 percent to 0.25 percent. The ZLB period ended at the December 2015 FOMC meeting.

- ¹⁶ The monetary easing commenced in August 2007, when the Board of Governors voted to reduce the discount rate by 50 basis points. See <https://www.stlouisfed.org/financial-crisis/full-timeline>.
- ¹⁷ Wynne (2013) documented that the Fed used forward-looking language to shape expectations before the Financial Crisis. For example, in 2003, the FOMC noted that “policy accommodation can be maintained for a considerable period” in its post-meeting statement. Most economists and policymakers, though, would probably agree that the use was most pronounced during the ZLB era. The FOMC’s forward guidance policy was influenced importantly by Woodford (2001) and Eggertsson and Woodford (2003).
- ¹⁸ The midpoint of the central tendency excludes the three highest and three lowest projections for each variable in each year.
- ¹⁹ Moreover, following the November 3, 2010, meeting, the policy statements crafted under the leadership of Chairman Bernanke began to emphasize the economy’s current performance and expected outcome relative to the Fed’s “statutory mandate” of price stability and maximum employment. This was a departure from the Greenspan era, when the statement rarely—if ever—mentioned the Fed’s statutory mandate. The November 2010 statement was also noteworthy because it announced the second round of the large-scale asset purchase program (QE2).
- ²⁰ The average Flesch-Kincaid scores during this period were very close to the reported medians.
- ²¹ See also Jansen (2011). Others have found similar findings for other major central bank communications. See Coenen et al. (2017), Haldane (2017), and Ehrmann and Talmi (2017).
- ²² Meltzer (2009) documents a 1962 FOMC meeting where communication with the public was discussed. Then-Chairman Martin favored increased communication with the public as a way to counter academic critics of Fed policy who he believed were mistaken in their analysis. However, Martin opposed regular (quarterly) policy reviews because there were instances where the FOMC would not wish to explain its decision. See discussion on p. 337 of Meltzer (2009).
- ²³ The source of this repository is Bloomberg. More detail on this source, and its limitations, is provided in the empirical analysis section.
- ²⁴ As noted above, the declining number of Fed governors speaking on the same day reflects to some extent the dwindling number of years when there was full complement of governors (seven) serving on the FOMC.
- ²⁵ See Olson and Wessel (2016).
- ²⁶ See https://www.federalreserve.gov/monetarypolicy/mpr_default.htm.
- ²⁷ See Fawley and Neely (2014).
- ²⁸ See Bullard (2016), Evans (2017), and Kashkari (2017).
- ²⁹ Conference calls and unscheduled FOMC meetings were excluded from the analysis.
- ³⁰ For simplicity, we only focus on announcements directly related to a large-scale asset purchase program. These include the following: QE1 announcement and expansion, QE2 announcement, Maturity Extension Program announcement and expansion, and QE3 announcement and expansion.
- ³¹ The initial QE1 announcement, which was made on November 25, 2008, did not coincide with an FOMC meeting.
- ³² For example, the release of nonfarm payroll employment, CPI inflation, and GDP (advance, second, and third estimates) all occur before or at the market open.
- ³³ As previously mentioned, our database for public remarks comes from Bloomberg; it begins in 1998. For consistency, we start all Fed communication event categories at this date, where applicable. Only public remarks made during market hours are included in the event study. If Bloomberg did not provide a time for an event, and this time could not be identified by other sources, the event was removed from the sample. We considered merging Bloomberg’s repository with other databases, but since there was not a consistent time horizon or speaker overlap, we did not proceed with this approach. In particular, we examined databases from the Board of Governors of the Federal Reserve System and the Federal Reserve Bank of St. Louis’s “FOMC Speak.” The Board’s database does not include public remarks made by Bank presidents, while “FOMC Speak” only begins in 2010. Merging either database with Bloomberg’s would result in an upward estimate of governors’ remarks (for the former scenario) or an upward estimate of remarks over the 2010-17 period (for the latter scenario), which would also affect Figure 3.

Nevertheless, we acknowledge that the Bloomberg database is only a proxy for public remarks when presenting this analysis.

- ³⁴ Our dependent variable is very similar to the approach used by Andersson (2010), who used intraday data to analyze financial market responses to Federal Reserve and European Central Bank monetary policy decisions.
- ³⁵ Andersson (2010) studied intraday volatility in the bond futures market and in the equity market (S&P 500 index) around FOMC statement releases from April 1999 to May 2006. He found that intraday volatility rises sharply at the time of the release of FOMC meeting statements.
- ³⁶ TickWrite is the source for the intraday data used in this analysis.
- ³⁷ The one exception is for press conferences, where expanding our event window noticeably increased the market reaction relative to other events. One possible explanation is that press conferences are often more than an hour long. However, a closer inspection reveals that the press conferences driving this jump in magnitude are those on June 22, 2011, and June 19, 2013. The latter was noteworthy because this is when Chairman Bernanke discussed the so-called taper tantrum that had developed in the markets in response to his Congressional testimony a month earlier. In that testimony, he raised the possibility of the FOMC beginning to taper asset purchases later that year.
- ³⁸ It is not our intent to examine whether stock and bond prices may react differently to Fed communication events. We refer the reader to numerous studies on the effects of these dynamics in the interactions with monetary policy actions. For example, see Campbell and Ammer (1993), Bernanke and Kuttner (2005), Andersen et al. (2007), and Connolly, Stivers, and Sun (2005).
- ³⁹ The non-event day controls in Figures 6A and 6B are constructed to have similar response windows to the events they are compared with. For example, in Figure 6A, we use a rolling event window of 30 and 75 minutes to calculate a benchmark for non-speakers and speakers, respectively. Windows that either include an event or overlap days are removed before calculating the benchmark mean absolute changes. We follow the same procedure for Figure 6B. The authors thank Chris Neely for helpful comments in this regard.

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