

Speeches by the Fed Chair Are More Important Than FOMC Announcements: An Improved High-Frequency Measure of U.S. Monetary Policy Shocks

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Abstract

We extend the high-frequency monetary policy shock measures of Kuttner (2001) and Gürkaynak, Sack, and Swanson (2005a) to other major types of Fed communication beyond FOMC announcements, including post-FOMC-meeting press conferences, speeches and Congressional testimony by the Fed Chair and Vice Chair, and FOMC meeting minutes releases, all from 1988 to 2023. We find that speeches and press conferences by the Fed Chair are more important than FOMC announcements for stock prices, Treasury yields, and all but the shortest-maturity interest rate futures. Thus, previous studies' focus on FOMC announcements has generally missed the most important source of variation in U.S. monetary policy. We identify federal funds rate, forward guidance, and LSAP components for each of these announcement types and show that their effects are consistent across types. We illustrate the benefits of our expanded set of monetary policy announcements with an application to a monetary policy VAR.

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1. Introduction

Many recent studies have used high-frequency changes in asset prices around Federal Reserve Federal Open Market Committee (FOMC) announcements to measure the effects of monetary policy on financial markets (e.g., Kuttner, 2001; Gürkaynak, Sack, and Swanson, 2005a; Bernanke and Kuttner, 2005; Swanson, 2021) or as an “external instrument” to estimate the effects of monetary policy on macroeconomic variables such as output, unemployment, and inflation (e.g., Cochrane and Piazzesi, 2002; Faust et al., 2003; Faust, Swanson, and Wright, 2004; Stock and Watson, 2012; Gertler and Karadi, 2015; Ramey, 2016; Bauer and Swanson, 2023b). A significant challenge facing these applications, however, is that there are only eight scheduled FOMC announcements per year, with a mean absolute change in short-term interest rates of just 3 basis points (bp) per announcement. It is very difficult to obtain statistically significant, robust estimates of the effects of monetary policy on monthly or quarterly macroeconomic variables with just eight 3bp changes in monetary policy per year. Indeed, Ramey (2016) argues that this is why standard high-frequency external instruments estimates of monetary policy’s effects on macroeconomic variables are fragile with respect to changes in sample period and specification.¹

In this paper, we address this challenge by expanding the set of U.S. monetary policy announcements to include much more than just the eight scheduled FOMC announcements per year. In particular, we collect the dates, times, and high-frequency, intradaily financial market responses from January 1988 to December 2023 for: i) all unscheduled and scheduled FOMC announcements, ii) all post-FOMC-meeting press conferences, iii) all speeches and Congressional testimony by the Federal Reserve Chair, iv) all speeches and Congressional testimony by the Federal Reserve Board Vice Chair, and v) all minutes releases a few weeks after each FOMC meeting. This greatly expands the set of monetary policy announcements: for example, there were 927 speeches and Congressional testimony by the Fed Chair from 1988 to 2023, compared to 288 scheduled FOMC announcements.

We find that speeches and Congressional testimony by the Fed Chair, in particular, have large effects on financial markets and are even more important than FOMC announcements for stocks, bonds, and all but the very shortest-maturity interest rate futures. Intuitively, FOMC

¹ Bauer and Swanson (2023b) draw on the data from the present paper to address Ramey’s critique. Note also that this critique does not apply to estimates of the effects of monetary policy on financial market variables, since in that case both the left- and right-hand side variables in the regression can be sampled at high frequency around the FOMC announcement, removing the confounding effects of other news each month (Bernanke and Kuttner 2005, Gürkaynak et al. 2005a, Swanson 2021, Bauer and Swanson 2023b).

decisions are typically communicated to financial markets ahead of time through speeches by the Fed Chair and other FOMC members. As a result, FOMC announcements themselves are rarely a surprise, while significant changes in monetary policy are frequently communicated to the markets beforehand via speeches. The end result is that, for all but the very shortest-maturity assets, Fed Chair speeches are more important than FOMC announcements.

A main reason previous studies have focused on FOMC announcements is that the Fed only changes its conventional monetary policy tool—the federal funds rate—with one of those announcements (where the term “announcement” here includes post-FOMC-meeting open market operations, which were important before the Fed began issuing explicit press releases about federal funds rate changes in 1994). However, as U.S. monetary policy has become more transparent over time, changes in the federal funds rate have become more predictable (Swanson, 2006), so that increasingly the most important news about monetary policy in an FOMC announcement is the FOMC’s forward guidance about the likely future path of the federal funds rate rather than the current federal funds rate decision itself (Gürkaynak, Sack, and Swanson, 2005a). This trend accelerated after 2008, when the FOMC lowered the federal funds rate to essentially zero and began focusing its announcements entirely on forward guidance and long-term bond purchases (Swanson, 2021). Thus, empirical studies of FOMC announcement effects since 2008 have used changes in interest rates with a longer maturity than the overnight federal funds rate to capture some of the effects of forward guidance as well as the federal funds rate. For example, Wright (2012) uses the two-year Treasury yield as his measure of monetary policy, Gertler and Karadi (2015) use the one-year Treasury yield and three-month-ahead federal funds futures rate, and Gürkaynak, Sack, and Swanson (2005a) and Nakamura and Steinsson (2018) extract principal components from federal funds futures and Eurodollar futures with maturities of up to one year. One of the main findings of the present paper is that restricting attention to FOMC announcements alone misses the most important source of variation in many of those interest rates: speeches by the Fed Chair.

We also show that post-FOMC-meeting press conferences have become increasingly important over time, while speeches and testimony by the Fed Vice Chair and FOMC meeting minutes releases are only modestly important as a source of news about monetary policy.

We then follow Swanson (2021) and identify federal funds rate, forward guidance, and large-scale asset purchase (LSAP) components for each of our five monetary policy announcement types (FOMC announcements, Fed Chair speeches, press conferences, Vice Chair speeches, and

minutes releases). The federal funds rate only changes with an FOMC announcement, but there are forward guidance and LSAP components for all five announcement types, and we show that the effects of those components are consistent across those announcement types. That is, we do not reject the hypothesis that forward guidance has identical effects no matter what the source of that forward guidance was (and similarly for news about LSAPs). This suggests that a unified measure of forward guidance (LSAPs) across these different announcement types can help researchers improve their estimates of the effects of forward guidance (LSAPs) in the data.

Finally, we demonstrate some of the benefits of our expanded set of monetary policy announcements with an application to a monetary policy VAR. In particular, we estimate the effects of changes in forward guidance on macroeconomic variables such as output and inflation. A few previous authors have tried to answer this question, but have had problems with weak instruments, robustness, and puzzling impulse response functions. In contrast, our expanded set of monetary policy announcements produces a much stronger instrument for forward guidance that leads to better estimates.

After a brief literature review, the remainder of the paper proceeds as follows. In Section 2, we describe how we construct our data set of monetary policy announcements, including the dates, times, and intradaily financial market responses to those announcements. In Section 3, we compare the importance of these different monetary policy announcement types for different financial market assets. In Section 4, we show how the importance of these different monetary policy announcement types has varied over time. In Section 5, we decompose each of these monetary policy announcements into federal funds rate, forward guidance, and LSAP components and compare those effects across announcement types. Section 6 presents a brief application to a monetary policy VAR with forward guidance. Section 7 concludes.

Related Literature

Many previous papers have used high-frequency changes in interest rates around FOMC announcements to measure changes in U.S. monetary policy. Kuttner (2001) uses the one-day change in the current- or next-month federal funds futures contract around FOMC announcements to measure the unexpected component of the FOMC's federal funds rate decisions and the effects of those decisions on financial markets. His sample runs from June 1989 to February 2000 but includes only the 42 FOMC announcements in that period at which the FOMC changed the federal funds rate. Gürkaynak et al. (2005a, henceforth GSS) extend Kuttner's (2001) analysis

in several ways: first, by considering every FOMC announcement, whether the federal funds rate target was changed or not, thus including cases where the FOMC did not change the target but surprised markets with its inaction;² second, by using intra-daily interest rate data to distinguish the effects of FOMC announcements from the effects of other macroeconomic news that day;³ and third, by showing that the effects of FOMC announcements are not one-dimensional, but instead require two factors to adequately capture their effects on financial markets, and that these two factors can be interpreted as the surprise change in the federal funds rate and the surprise change in forward guidance.⁴ Many additional authors use these high-frequency monetary policy surprises to estimate the effects of monetary policy changes on financial or macroeconomic variables: see Cochrane and Piazzesi (2002), Faust et al. (2003), Faust, Swanson, and Wright (2004), Gürkaynak, Sack, and Swanson (2005b), Bernanke and Kutner (2005), Stock and Watson (2012), Gertler and Karadi (2015), Ramey (2016), Nakamura and Steinsson (2018), Miranda-Agrippino and Ricco (2021, 2023), and Bauer and Swanson (2023b). In contrast to these studies, we use high-frequency interest rate changes around other major monetary policy announcements, such as post-FOMC press conferences and Fed Chair speeches, as well as FOMC announcements, to measure changes in U.S. monetary policy.

A number of papers have also built on the GSS insight that monetary policy has multiple dimensions. Brand, Buncic, and Turunen (2010) apply GSS’s methods to the ECB’s monetary policy announcements and post-meeting press conferences, as well as the separation in time between those two announcement types, to identify the effects of each on financial markets. Swanson (2021) extends the GSS analysis to include the U.S. zero lower bound (ZLB) and post-ZLB periods from 2009–15 and 2015–19 and finds that these periods require a third factor to explain asset price responses to FOMC announcements, which he shows can be interpreted as the surprise change in the Fed’s large-scale asset purchases (LSAPs). Altavilla et al. (2019) apply Swanson’s (2021) methods to data from the euro area. In the present paper, we use many of the same methods as these papers, but apply those methods to a much wider set of monetary policy announcements,

²This happens on several occasions; for example, on Dec. 20, 1994, the FOMC left the federal funds rate unchanged at 5.5 percent even though markets had widely expected them to tighten; as a result, the Kuttner-type monetary policy surprise on that date is -22.5bp , a large easing surprise relative to market expectations, which is not in Kuttner’s (2001) sample.

³This is important because several FOMC announcements took place on the same day as a weak Employment Report.

⁴Nakamura and Steinsson (2018) use the same data as GSS but extract only the first principal component, for simplicity. Their one-dimensional monetary policy surprise measure is thus a weighted average of the GSS “target” and forward guidance “path” factors.

including post-FOMC press conferences, speeches by the Fed Chair, etc.

Finally, there are several papers that go beyond FOMC announcements and include other types of monetary policy announcements in their analysis. Gagnon et al. (2011) analyze FOMC announcements from Jan. 2009 to Feb. 2010 and one speech by Fed Chair Bernanke. Wright (2012) considers FOMC announcements from Nov. 2008 to Sept. 2011 and four speeches by Fed Chair Bernanke. Cieslak and Schrimpf (2019) include FOMC announcements, post-FOMC press conferences, and FOMC meeting minutes releases from Oct. 1997 to Dec. 2017, but no speeches by the Fed Chair or Vice Chair. Kim, Laubach, and Wei (2020) include FOMC announcements and post-FOMC press conferences from July 1991 to Dec. 2015, but just “a few” Fed Chair speeches. In contrast to these papers, we include all speeches and Congressional testimony by the Fed Chair and Federal Reserve Board Vice Chair, as well as all FOMC announcements, press conferences, and minutes releases from 1988 to 2023 and examine how important these different announcement types are. In addition, we construct a much longer history of monetary policy announcements than previous studies. The early years of our sample may be a particularly useful contribution, since interest rates varied more substantially during this period. For example, Ramey (2016) suggests that data from years prior to the mid-1990s could be particularly helpful for estimating the effects of monetary policy on macroeconomic variables due to the greater interest rate variation during that period.

2. Construction of Monetary Policy Announcement Data

In this section, we describe each of the monetary policy announcement types we consider in detail, how we determined the dates and times of each of those announcements, and the high-frequency data used to construct the financial market responses to those announcements.

2.1 Types of Monetary Policy Announcements Considered

The Federal Reserve’s primary instrument of monetary policy is the overnight federal funds rate, an interbank market interest rate that the Fed historically targeted by varying the aggregate supply of federal funds reserves in that market.⁵ The FOMC has eight scheduled meetings per year at which it decides what the federal funds rate target will be, and the outcome of those decisions

⁵ See Swanson (2023) for a survey of the federal funds market before and after 2008.

is announced following the end of the FOMC meeting.⁶ In addition, the FOMC sometimes changes its target for the federal funds in between scheduled meetings—typically when economic conditions deteriorate rapidly and the FOMC does not want to wait several weeks for the next scheduled FOMC meeting—and announces its decision shortly afterward.⁷ These are referred to as “unscheduled” or “intermeeting” FOMC announcements. Unless otherwise specified, the term “FOMC announcement” includes both types: scheduled and unscheduled. Since 1994, these announcements have typically been accompanied by an FOMC statement that explains the rationale for the decision; these statements have gradually grown in length over time and currently span about six paragraphs.

Beginning in April 2011, the Federal Reserve Chair held a press conference in the afternoon after approximately every other FOMC meeting (and after every FOMC meeting beginning in 2019) to answer questions from the press about the FOMC’s decision, the FOMC statement, the rationale for its decision, and monetary policy and the economy more generally.

A few weeks after each FOMC meeting, the FOMC approves the minutes of the meeting and those minutes are released to the public. The minutes summarize all of the discussion that took place at the meeting, including issues related to the U.S. and global macroeconomy, U.S. and global financial market conditions, and the rationale for the FOMC’s monetary policy decision, including any debates or disagreement about that decision. The minutes are much more detailed and much longer than the original FOMC statement, spanning about 10–20 pages of text.

In addition to official FOMC communication, individual FOMC members frequently give speeches to the public or testimony to Congress in which they discuss their views of the economy and U.S. monetary policy and answer questions from the audience. (For brevity, the term “speeches” will be taken to include both speeches and Congressional testimony throughout the remainder of the paper, unless otherwise specified.) Financial market participants read and watch these speeches very carefully to look for hints about future U.S. monetary policy, and these

⁶The FOMC has explicitly announced its decisions for the federal funds rate target after each FOMC meeting since the beginning of 1994. Prior to 1994, the FOMC effectively announced its decisions for the federal funds rate target through the size and type of open market operation conducted in the federal funds market the morning following the FOMC meeting. See below for additional details.

⁷For example, on January 22, 2008, the FOMC made an unscheduled announcement that it was cutting the federal funds rate by 75 bp “in view of a weakening of the economic outlook and increasing downside risks to growth” (FOMC statement, Jan. 22, 2008). Although the next scheduled FOMC meeting was only nine days away, Chairman Bernanke argued that “seven trading days is a long time in financial markets” and “I think we have to take a meaningful action” (FOMC transcript of January 21, 2008). Prior to 1994, the FOMC’s unscheduled decisions were typically made in the morning and effectively announced to financial markets through the size and type of open market operation conducted later that morning. See below for additional details.

speeches often cause significant financial market movements. Ideally, we would like to include every speech by every FOMC member over our sample, but there are 19 members who participate in FOMC meetings, each of whom often gives 20 or more speeches per year, which would result in over ten thousand observations over our 36-year sample.⁸ To keep the set of speeches down to a more manageable number, we focus on two of the most influential members of the FOMC: the Federal Reserve Board Chair and Vice Chair.

The Federal Reserve Board Chair is also the Chair of the FOMC and is by far the most influential member of the Committee. The Chair sets the agenda for each FOMC meeting, determines the order in which the Committee members present their views, often presents their own views at the end, and has never been on the losing side of an FOMC vote. While financial market participants closely watch speeches by all FOMC members, those by the Fed Chair are given extra attention due to the Chair's outsized influence on the Committee.

The Federal Reserve Board Vice Chair is less influential than the Chair, but is generally more influential than the other Federal Reserve Board Governors and Bank Presidents, with the possible exception of the Federal Reserve Bank of New York President. For example, the Board Vice Chair, like the Chair, frequently testifies before Congress, which other Governors and Bank Presidents rarely do. The Board Vice Chair is also located in the same building as the Chair, is typically in frequent communication with the Chair, and has never voted against the Chair's position at an FOMC meeting. Thus, in addition to all speeches by the Fed Chair, we also consider all speeches by the Board Vice Chair over our sample.⁹

2.2 Dates and Times of Monetary Policy Announcements

To measure the high-frequency, intra-daily financial market responses to each of the monetary policy announcements above, we first determined the date and time of each announcement, as follows.

⁸The FOMC consists of the 7 Federal Reserve Board Governors and the 12 regional Federal Reserve Bank Presidents. Only 12 members of the FOMC have a vote at any one time, but all 19 members attend each FOMC meeting and present their views on the economy and the appropriate course for monetary policy. The 19 FOMC members vote on a rotating basis from year to year.

⁹After 2010, the Dodd-Frank Act established the additional position of Federal Reserve Board Vice Chair for Supervision. We do not include speeches by the Vice Chair for Supervision in our analysis. Also note that the Board Vice Chair is not the same as the Vice Chair of the FOMC—that latter position is always held by the President of the Federal Reserve Bank of New York. Although we would ideally like to include speeches by the NY Fed President in our analysis as well, the dates and times of those speeches are more difficult to determine than those for the Chair and Board Vice Chair, so we leave them as a topic for future research.

2.2.1 FOMC Announcements

In 1994, the FOMC began issuing a press release shortly after every regularly-scheduled FOMC meeting and every unscheduled FOMC interest rate change, and those press releases explicitly communicated to the markets the Fed’s target for the federal funds rate.¹⁰ Gürkaynak et al. (2005a) obtained the dates and times of each of these press releases from the Office of the Secretary of the Federal Reserve Board for the period from 1994 to May 2004, and we use their dates and times. After 2004, we again obtained the dates and times of FOMC announcements from the Office of the Secretary of the Federal Reserve Board, which are also available on the Federal Reserve Board’s public website from 2016 onward.

Prior to 1994, the FOMC did not explicitly announce its target for the federal funds rate, but implemented changes in its target via open market operations that altered the aggregate quantity of reserves in the federal funds market. Thus, financial market participants could typically infer changes in Fed policy from the size and type of open market operation conducted following any such policy change. These open market operations were conducted at 11:30am every business day over this period, so the outcome of a regularly-scheduled FOMC meeting could typically be inferred at 11:30am the following morning, while unscheduled interest rate changes by the FOMC could typically be inferred at the time of the next open market operation (often later that same morning). Thus, the date and time of each pre-1994 FOMC announcement is usually the date and time of the first open market operation after that FOMC decision.

There are a few exceptions to this pre-1994 timing, however. First, the Fed’s ability to signal its intentions in the federal funds market was sometimes diminished by natural variation in the supply of reserves (such as changes in the float due to large payments by the U.S. Treasury or a delay in the transportation of checks across the country due to bad weather) that caused the Fed to conduct offsetting open market operations. In those cases, there was often some debate in financial markets about whether the FOMC had actually changed policy or not, and this uncertainty might take one or more *additional* open market operations over the next several days to be resolved. This was never a problem from 1991 onward, but from 1988–90 there are several instances where the FOMC’s decision was not immediately clear to market participants and it took several days for the market to gradually arrive at a consensus regarding the Fed’s

¹⁰ At first, from 1994 to March 1999, the FOMC did not issue a press release if there was no change in the federal fund rate target, and the markets correctly interpreted the absence of a press release as signalling no change in policy. Beginning in May 1999, the FOMC began releasing a statement after every FOMC meeting, whether or not there was a change in the federal fund rate target (Swanson, 2006).

policy decision. In those cases, we read the “Credit Markets” column of *The New York Times* every day to determine how many open market operations it took for the financial markets to achieve a reasonable degree of consensus, and we consider *each* of these open market operations to be a monetary policy announcement (albeit typically a small one). For example, the FOMC made an unscheduled change to the federal funds rate target on the morning of May 9, 1988, but it took the markets two days—May 9 and 10, 1988—to determine that a change had taken place, so there are effectively FOMC monetary policy announcements at 11:30am on both May 9 and 10, 1988.¹¹

Second, in a few cases, the FOMC changed the discount rate (the interest rate that the Fed charges banks to borrow directly from the Fed’s discount window) as well as the federal funds rate target, and announced the change in the discount rate immediately via a press release. Financial market participants typically inferred from this press release that the FOMC had also changed its target for the federal funds rate. In those cases, the date and time of the FOMC decision is usually the date and time of the discount rate change press release. However, from 1988–91, there was sometimes some uncertainty in financial markets whether the discount rate change would also be accompanied by a change in the federal funds rate target or not. (By 1992, it was clear to financial markets that a change in the discount rate was always accompanied by a change in the federal funds rate target.) Thus, on those dates, there are actually *two* FOMC announcements: one at the time of the discount rate change press release (typically before 10am in the morning) and one at the time of the open market operation at 11:30am.¹²

Over our sample from 1988 to 2023, there are 288 scheduled FOMC announcements—eight per year—plus an additional 73 intermeeting FOMC announcements of the types described above, for a total of 361 FOMC announcements. However, one of those announcements—the FOMC’s intermeeting announcement on September 17, 2001—occurred before financial markets

¹¹In 1988 and 1989, the FOMC frequently adjusted the federal funds rate by small amounts, often in between regularly-scheduled meetings, so there are effectively many FOMC announcements in those two years: 27 in 1988 and 23 in 1989. In fact, in those years it’s not unreasonable to think of there being a small FOMC announcement *every* business day at 11:30am, when the Fed’s open market operation is announced. We do not take that approach in this paper, and instead concentrate attention only on those open market operations that generated a significant amount of attention in financial markets due to their proximity to a scheduled FOMC meeting or a change in Fed policy. This reduces the size of our set of FOMC announcements and concentrates attention on those open market operations that were the most significant to financial markets.

¹²Note that Gürkaynak et al. (2005a) missed these announcements because they assumed that markets always understood that a discount rate change would be accompanied by a change in the federal funds rate target, even though our readings of *The New York Times* “Credit Markets” column made clear that that was not the case prior to 1992. Thus, the GSS listing of FOMC announcement dates and times in their Appendix A1 does not include these post-discount-rate-change open market operation announcements.

opened that day and after they had been closed for several days following the September 11 terrorist attacks, which makes it impossible to get high-frequency measures of the financial market responses to that announcement that exclude the effects of the terrorist attack itself. We thus exclude that announcement from our analysis, as is standard in the literature, leaving us with 360 FOMC announcements total.

2.2.2 Post-FOMC-Meeting Press Conferences

We obtained the dates and times of the post-FOMC-meeting press conferences from the Federal Reserve Board’s public website. When the press conferences were first introduced in 2011, they were held at 2:15pm on the last day of essentially every other FOMC meeting.¹³ Since March 2013, the press conferences have been held at 2:30pm. The duration of the press conferences is typically about one hour, but ranges in length from about 45 minutes to 1 hour and 15 minutes. Overall, there are 73 post-FOMC-meeting press conferences in our sample.

2.2.3 FOMC Meeting Minutes Releases

We obtained a listing of FOMC meeting minutes release dates and times from the Office of the Secretary of the Federal Reserve Board. The dates of the minutes releases from 1993 onwards are also available on the Federal Reserve Board’s public website.

Prior to 2005, the minutes for each FOMC meeting were approved by a vote at the next FOMC meeting and then released to the public about three days after approval. From 1988 to 1996, that public release was made on Friday afternoons at 4:30pm Eastern Time, after financial markets had closed for the week. From 1997 to 2004, the minutes were released at 2:00pm on Thursday afternoons, with two exceptions (July 2, 1998, and August 20, 1998, on which dates the minutes were released at 12:00 noon). Beginning in 2005, this release schedule was accelerated in the interest of transparency, so the minutes of each FOMC meeting were approved by a vote of the FOMC and released to the public approximately three weeks after the meeting, typically on Tuesdays at 2:00pm Eastern Time.

Overall, there are 288 FOMC meeting minutes releases in our sample—one after each of the eight regularly-scheduled FOMC meetings each year from 1988 to 2023. However, in our analysis

¹³In 2011, post-FOMC press conferences were held after the April, June, and November FOMC meetings; the April and June meetings were consecutive and there was no press conference after either the August or September FOMC meeting. In 2012, press conferences were held after the January, April, June, September, and December FOMC meetings, and the April and June meetings were consecutive. From 2013 to 2018, press conferences were held after the March, June, September and December meetings. From 2019 onward, there is a post-FOMC meeting press conference after every FOMC meeting.

below, we found that FOMC minutes releases before 1997 essentially never had a significant effect on financial markets, at least not as reported in contemporaneous accounts in the “Credit Markets” column of *The New York Times*. This is probably partly because they were released after the market close on Friday afternoons, which prevented markets from responding directly to the minutes and may have made it difficult for market participants to attribute any moves in asset prices on Monday morning to the minutes release from the previous Friday. Thus, we drop the pre-1997 minutes releases from the rest of our analysis, since we are trying to focus on market responses that can be attributed to potential information about U.S. monetary policy. This leaves us with 216 minutes releases.

2.2.4 Speeches by the Federal Reserve Board Chair and Vice Chair

We obtained the dates and times of speeches (including Congressional testimony) by the Federal Reserve Board Chair and Vice Chair from multiple sources. First, we obtained the dates of the speeches from 1996 onwards from the Federal Reserve Board’s public website.¹⁴ Dates prior to 1996 were obtained from the FRASER digital library of the Federal Reserve Bank of St. Louis. From 2010 onwards, the Federal Reserve Board’s website typically has a digital copy of the speech that lists the time that the document was released to the public.¹⁵ Prior to 2010, FRASER typically has a digital copy of the speech that lists the time that the document was released to the public. For those cases where the time of the speech is not available from either the Board’s website or FRASER, we conducted a Factiva search of the financial press and newswires. If the speech appears in any of the daily or weekly calendars of economic events in the financial press, then we used the time listed on that calendar as the start of the speech. If the speech is not listed on a daily or weekly calendar of events, we picked the time that news about the speech first appeared on the newswires or in an article on Factiva. Note that speeches by the Federal Reserve Board Chair and Vice Chair are often given in locations around the U.S. or in other countries; thus, the time of the speeches must be converted to U.S. Eastern Time in each case.

Over our sample from 1988 to 2023, the Fed Chair gave 927 speeches, not counting the 73

¹⁴In our readings of the market responses to the Chair’s speeches, below, we discovered that the Board’s website did not report two of the Chair’s semiannual Monetary Policy Reports to Congress: Feb. 21, 1996, and July 17, 2002. Our sample includes these two important testimonies.

¹⁵Beginning in 2013, the Federal Reserve Board sometimes released the text of the Chair’s opening remarks for Congressional testimony at 8:30am before the testimony later that day, or at 4:30pm the day before the testimony. In those cases, there are effectively two separate Chair speech announcements: one at the time the opening remarks were released, and the second at the time of the testimony itself. The dates and times of the testimonies are available from the GovInfo public website for Congressional hearing transcripts. Note that non-testimony speeches by the Chair were never released to the public before the speech was scheduled to be delivered.

post-FOMC press conferences described above. The Federal Reserve Board Vice Chair gave 348 speeches. However, in our analysis and our application below, we wish to focus on announcements that potentially had implications for U.S. monetary policy. The Fed Chair and Vice Chair often give speeches that are either ceremonial (e.g., commencement or dedication speeches) or on topics other than monetary policy, such as bank regulation, securities market regulation, fiscal policy, Social Security, the stock market, check clearing, and other economic and financial issues of national importance. To identify those speeches that did contain information about monetary policy, we read the market commentary in *The Wall Street Journal* or *The New York Times* following each speech. This resulted in 411 Fed Chair speeches and 123 Vice Chair speeches that contained enough information about monetary policy to be mentioned as having possible implications for interest rates in the market commentary.

2.3 Intradaily Financial Market Changes

To measure the effects of the monetary policy announcements described above, we purchased historical intradaily financial market data from Tick Data, LLC, covering the history of Eurodollar futures contracts (December 1981 to June 2023), S&P 500 futures (April 1982–present), 30-year U.S. Treasury bond futures (October 1982–present), 10-year U.S. Treasury note futures (January 1983–present), 5-year U.S. Treasury note futures (July 1988–present), 2-year U.S. Treasury note futures (January 1991–present), S&P 500 e-mini futures (September 1997–present), federal funds futures (January 2010–present), and 3-month SOFR futures (May 2018–present).¹⁶

Eurodollar futures settle based on the spot 90-day Eurodollar deposit rate at expiration, and we consider contracts that expire near the end of the current quarter and one, two, and three quarters ahead.¹⁷ Gürkaynak, Sack, and Swanson (2007) show that these contracts are the best financial market predictors of the future federal funds rate at horizons of six months or more, and are virtually as good as federal funds futures at horizons less than six months. In May 2018, the Chicago Mercantile Exchange began trading 3-month SOFR futures as an alternative to Eurodollar futures, and in June 2023 ended trading of Eurodollar futures in favor of SOFR

¹⁶Federal funds futures data exist prior to 2010 but are not available from Tick Data before Jan. 2010. This is not a serious concern for our analysis because Eurodollar futures are close substitutes for federal funds futures (Gürkaynak, Sack, and Swanson, 2007). SOFR futures only began trading in May 2018, but we consider them because the market gradually phased out Eurodollar futures in 2023 and transitioned to SOFR futures, which were designed to be very close substitutes.

¹⁷Eurodollar futures expire on the International Monetary Market (IMM) dates: the third Wednesday of March, June, September, and December.

futures. Thus, on January 1, 2023, we likewise switch from Eurodollar futures to SOFR futures, although we continue to use the phrase “Eurodollar futures” when discussing our results below, for simplicity. SOFR futures settle based on the realized average daily SOFR (Secured Overnight Financing Rate) published by the Federal Reserve Bank of New York beginning on the IMM date of the futures contract reference month and ending the day before the IMM date 3 months later. Thus, the March 2023 3-month SOFR future contract corresponds extremely closely to the March 2023 90-day Eurodollar future contract.

Federal funds futures settle based on the average federal funds rate for the contract month, as reported by the Federal Reserve Bank of New York. We consider contracts that expire at the end of the current month and the next month. We convert these futures price changes into the surprise change in the federal funds rate target using the same scale factor as described in Kuttner (2001) and GSS (2005a). Although Tick Data does not have intradaily federal funds futures data prior to 2010, we have data on the intradaily change in federal funds futures contracts around FOMC announcements going back to 1990 from an updated version of the GSS (2005a) dataset maintained by staff at the Federal Reserve Board. For monetary policy announcements that are not FOMC announcements, we assume that the surprise change in the federal funds rate target is zero, since every federal funds rate target change is accompanied by an FOMC announcement, as discussed above.

Treasury futures settle every quarter through delivery of Treasury securities with maturity close to that stated in the contract, for the contracted price.¹⁸ We consider only the current-quarter contract for these securities, and we convert the price change around monetary policy announcements into a yield change using the duration of the cheapest-to-deliver security underlying the contract, which can be downloaded from a Bloomberg terminal.

S&P 500 and S&P 500 e-mini futures settle every quarter based on the level of the S&P 500 stock index at expiration. We consider only the current-quarter contract for these securities, and we use the change in the natural log of the price around monetary policy announcements to compute the percent change in the S&P 500 around those announcements. The S&P 500 e-mini futures contract was introduced in September 1997, has a smaller contract size, is generally more liquid, and has longer trading hours over most of our sample than the S&P 500 futures contract,

¹⁸For the 2-year Treasury futures contract, the delivered securities must have remaining maturity between one year 9 months and 2 years; for the 5-year contract, the maturity must be between 4 years 2 months and 5 years 3 months; for the 10-year futures contract, the maturity must be between 6 years 6 months and 8 years; and for the 30-year futures contract, the maturity must be between 15 years and 25 years. See the CME’s website for details.

so we use the change in the log S&P 500 e-mini futures price as our measure of the stock price change from September 1997 onward; from 1988 to August 1997, we use the change in the log S&P 500 futures price.

To facilitate working with the data, we convert the individual trades into minute-by-minute data for each security, recording the high and low trade price for each minute. (If there is only one trade in a particular minute, or all trades take place at the same price, then the high and low prices for that minute coincide.)

For FOMC announcements, we follow Gürkaynak et al. (2005a) and measure the change in financial markets using an intradaily window beginning 10 minutes before the announcement and ending 20 minutes after the announcement. If there are multiple trades in the minute exactly 10 minutes before the announcement, we take the midpoint between the high and low price of the trades that took place that minute; if there are no trades exactly 10 minutes before the announcement, we search backward for the most recent minute in which there was a trade and use the midpoint of the high and low prices from that minute. Similarly, if there are multiple trades in the minute exactly 20 minutes after the announcement, we take the midpoint of the high and low prices that minute, and if there are no trades exactly 20 minutes after the announcement, we search forward for the next minute in which there was a trade and use the midpoint of the high and low prices from that minute.¹⁹

We follow an exactly analogous procedure for each of the other monetary policy announcement types described above, albeit with different window lengths. Post-FOMC meeting press conferences typically last for about one hour, so we begin the intradaily window 10 minutes before the start of the press conference and end it 1 hour and 15 minutes after the start, for a total window length of 85 minutes. FOMC meeting minutes are much longer than an FOMC statement, comprising about 10–20 pages of text, so we also use a longer intradaily window for those announcements than for FOMC announcements, beginning 10 minutes before the release and ending 50 minutes after, for a total window length of 60 minutes.

Speeches (other than Congressional testimony) by the Fed Chair and Board Vice Chair are typically 30–45 minutes long and are sometimes followed by a question-and-answer session with the audience. For these speeches, we use a 90-minute window from 15 minutes before the

¹⁹There is one announcement (December 18, 1990) that occurs at 3:30pm, which is after the Eurodollar and Treasury futures markets closed for the day. For those contracts and that announcement, the last trades before the announcement take place at the market close at 3pm, and the first trades after the announcement occur at the market open the following morning at 8:20am.

start of the speech to 1 hour and 15 minutes after. Congressional testimony is typically even longer, consisting of an opening statement followed by a few hours of questioning from members of Congress. In many cases, the start time and end time of the testimony are provided in the public transcript on the GovInfo website, and we use a window from 10 minutes before the start of the testimony to 10 minutes after the end. When the testimony’s end time is unknown, we use a window that ends 2 hours and 55 minutes after the testimony’s start; this window is long enough to include the entire testimony in almost all cases while still avoiding Treasury auction results that are released at 1pm on some days (since most testimonies begin at 10am).²⁰

Some of these announcements, particularly speeches by the Fed Chair or Board Vice Chair, can take place near the end of market trading hours or while the markets are closed. (Tick Data contains almost around-the-clock electronic trading data beginning in July 2003, so this is a relatively rare occurrence after that point.) In this case, we compute the change in financial market prices using the same algorithm as described above, which often implies that the market close is the last minute of trading preceding the announcement window and the next day’s market open is the first minute of trading after the announcement window. Although this creates a relatively long window of time around the announcement, the market open typically occurs at 8:20am, before any macroeconomic data is released at 8:30am, so the major source of economic news in our announcement windows is typically the monetary policy announcement itself.²¹

Finally, we check whether the intradaily windows around any of the announcements overlap with a macroeconomic data release or other market-moving event such as a Treasury auction. When such an overlap occurs, we read the market commentary in *The Wall Street Journal* or *The New York Times* to determine whether the data release was a significant mover of financial markets that day. If the data release was not reported as having caused any market reaction or was completely dominated by the Fed announcement, then we just use the asset price changes

²⁰ As noted above, beginning in 2013 the Chair’s opening remarks for testimony are sometimes released earlier the same day or the afternoon before the testimony; for those releases, we use a 60-minute window from 10 minutes before the release of the remarks to 50 minutes after.

²¹ The 8:20am market open time is for Eurodollar and Treasury futures; prior to July 2003, the S&P 500 futures market opened at 9:30am Eastern Time, so some macroeconomic data releases could be included in our measure of stock price changes if our intradaily window rolls over to the next day’s open. From September 1997 onward, we use the S&P 500 e-mini futures contract, for which Tick Data has electronic trading data that extends beyond normal market hours. Prior to September 1997, we check whether there are any major macroeconomic announcements on the morning in question and, if so, whether that announcement was a significant surprise relative to the Money Market Services expectation for the value of that release (see Gürkaynak et al., 2005b, or Swanson and Williams, 2014, for discussions of these expectations data). If there was a macroeconomic data release that was a substantial surprise, then we treat the stock price change for that window as a missing observation, since we are unable to separate the effects of the monetary policy announcement from the macroeconomic data release.

around the monetary policy announcement as is. However, if the data release did move markets, then we adjust the event window around the monetary policy announcement to avoid overlapping with the data release.²² Finally, there are two cases where the Chair and the Vice Chair gave a speech at exactly the same time, and both speeches had implications for monetary policy. In those cases, we attributed the market response to the Chair’s speech and dropped the Vice Chair’s speech from our sample.

2.4 Summary Statistics

Table 1 reports summary statistics for our five different types of U.S. monetary policy announcements: FOMC announcements, speeches and testimony by the Federal Reserve Chair, post-FOMC-meeting press conferences, FOMC meeting minutes releases, and speeches and testimony by the Federal Reserve Board Vice Chair. We report the number of each type of announcement over our sample, 1988–2023 (2011–23 for press conferences, 1997–2023 for minutes releases), the mean asset price response, standard deviation of each asset price response, and minimum and maximum asset price responses for five representative assets: the current-quarter and three-quarter-ahead Eurodollar futures contracts (ED1, ED4), the 2-year and 10-year Treasury yields, and the S&P 500 stock price index. (Results for the other Eurodollar futures rates and Treasury yields are similar and are not reported in the interest of space.) Interest rate changes are reported in basis points (bp) and S&P 500 stock price changes in log basis points (10,000 times the change in the log of the S&P 500 index).

The first point to note in Table 1 is that there are more Fed Chair speeches than FOMC announcements—411 vs. 360. (Recall that this is after we have taken the original 927 Fed Chair speeches and eliminated those that were not reported as having possible implications for interest rates.) The large number of Fed Chair speeches is one of the reasons we find them to be so important. Post-FOMC press conferences are the least numerous announcement type, but that is because they do not begin until 2011 and even then occur only four times per year until 2019.

Second, the standard deviations and minimum and maximum changes for each announcement type also show that Fed Chair speeches and press conferences are very important. The

²²For example, Treasury auction results are released at 1pm, so we would use an end window time of a few minutes before 1pm to avoid overlapping with the auction results. There are also a few cases where the Fed Chair began testifying to Congress at 10am and a macro data release also occurred at 10am and moved markets. In those cases, we begin the event window for the Chair’s testimony at 10:10am, which misses the first 10 minutes of the Chair’s opening remarks, but still captures the majority of the opening remarks and all of the Q&A, while avoiding almost all of the effects of the macro data release. See Gürkaynak et al. (2005a) for evidence on the speed of the market reaction to important macroeconomic and monetary policy announcements.

TABLE 1: SUMMARY STATISTICS FOR U.S. MONETARY POLICY ANNOUNCEMENTS, 1988–2023

	FOMC announcemnts	Chair speeches	Press conferences	Minutes	Vice Chair speeches
Number	360	411	73	216	123
Standard deviation (bp)					
ED1	5.4	2.8	2.9	1.2	1.2
ED4	6.2	5.9	5.9	3.0	2.1
2-yr Treasury	5.2	4.3	4.9	2.5	1.9
10-yr Treasury	3.6	3.5	3.3	2.0	1.6
S&P 500	65.9	60.0	78.2	37.3	33.8
Minimum change (bp)					
ED1	−32.3	−18.0	−19.5	−3.3	−5.5
ED4	−27.5	−30.5	−20.0	−11.8	−8.0
2-yr Treasury	−20.9	−15.6	−16.4	−12.6	−7.5
10-yr Treasury	−29.6	−12.2	−8.8	−9.6	−3.7
S&P 500	−201.3	−297.4	−234.4	−133.9	−109.3
Maximum change (bp)					
ED1	18.3	10.0	5.5	4.5	3.5
ED4	24.3	27.0	18.0	13.3	10.3
2-yr Treasury	20.5	22.7	14.5	9.3	9.5
10-yr Treasury	16.4	14.1	8.8	8.8	6.9
S&P 500	619.0	221.9	275.7	118.5	116.4
Mean change (bp)					
ED1	−0.9	−0.1	−0.6	0.0	−0.2
ED4	−0.8	−0.1	−1.5	−0.0	0.0
2-yr Treasury	−0.7	0.1	−1.1	−0.1	−0.0
10-yr Treasury	−0.2	−0.1	−0.9	−0.1	0.1
S&P 500	4.8	5.0	2.5	0.1	2.2

Number of each type of monetary policy announcement and summary statistics for high-frequency responses of current-quarter and 3-quarter-ahead Eurodollar futures rates (ED1, ED4), 2-year and 10-year Treasury yields, and S&P 500 index to each announcement type. Changes for ED1, ED4, and 2- and 10-yr Treasuries are in basis points; changes for S&P 500 are 10,000 times the change in the log of the index. Sample for 2-yr Treasury is 1991–2023 due to data availability; sample for press conferences is 2011–23; sample for minutes is 1997–2023. See text for details.

standard deviations, maxima, and minima for Fed Chair speeches and press conferences are often equal to or even greater than those of FOMC announcements for all but the shortest-maturity Eurodollar future rate (ED1). The last two announcement types—minutes releases and Vice Chair speeches—are clearly less important than those first three.

Third, the mean changes for all five announcement types in Table 1 are close to zero, as expected. FOMC announcements and press conferences show a slight easing bias of about 1bp

per announcement for short- and medium-term interest rates, but this is small relative to the standard deviations of those changes.

Figure 1 compares histograms of FOMC announcements and Fed Chair speeches for the three-quarter-ahead Eurodollar futures rate (ED4), 10-year Treasury yield, and S&P 500 stock price index (results for the other Eurodollar futures rates and Treasury yields are similar and are not reported in the interest of space). As can be seen in the figure, the effects of Fed Chair speeches generally look very similar to those of FOMC announcements, both in the shape of the distributions and in the magnitudes of the announcement effects, consistent with the general patterns observed in Table 1.

We can see already from the summary statistics in Table 1 and Figure 1 that speeches by the Fed Chair are very important. The previous literature’s tendency to focus only on FOMC announcements thus seems likely to have missed a very important source of information about U.S. monetary policy.

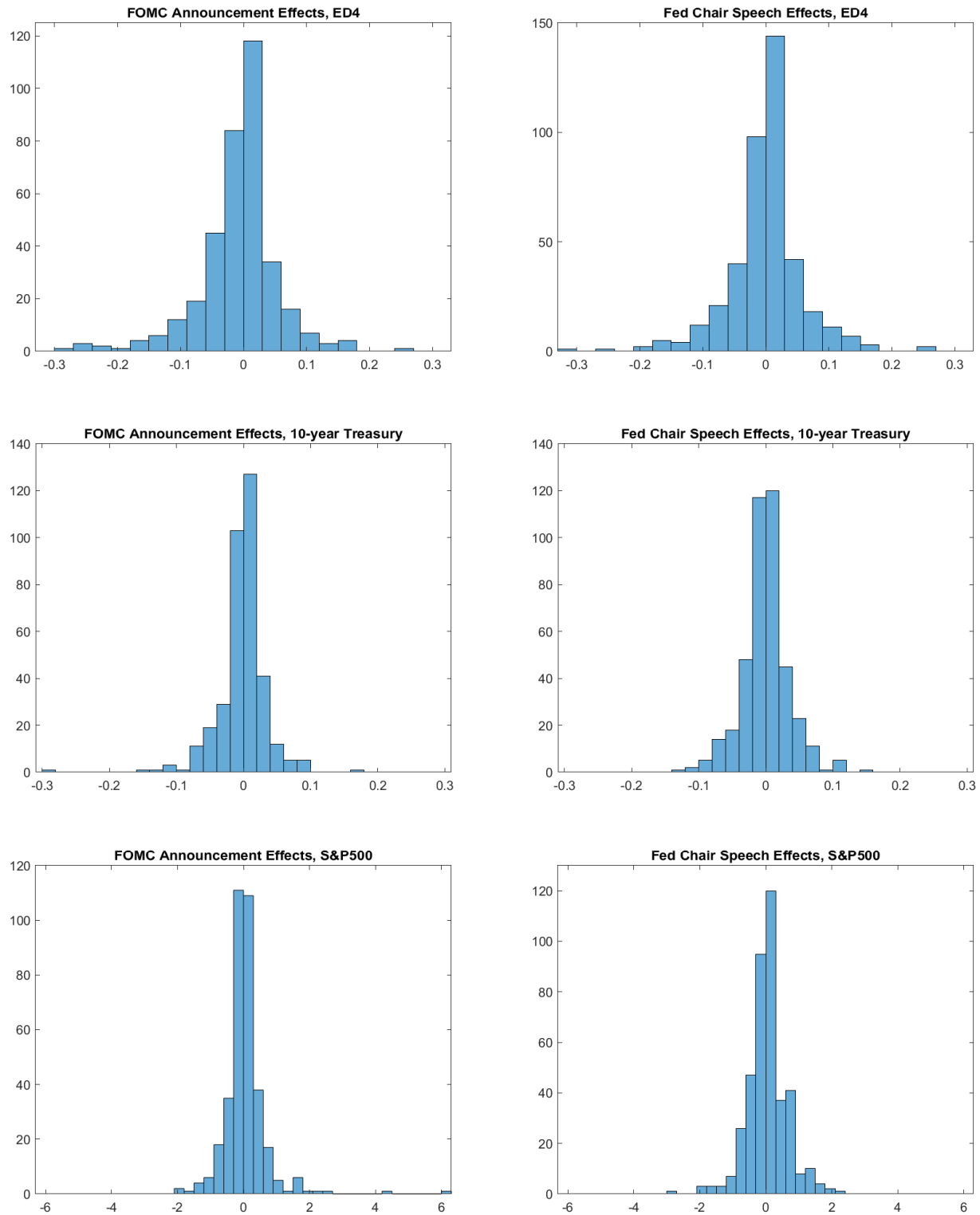
3. Importance of Different Monetary Policy Announcement Types

Table 2 reports different measures of the importance of the five monetary policy announcement types described above: FOMC announcements, speeches and Congressional testimony by the Fed Chair, post-FOMC press conferences, FOMC meeting minutes releases, and speeches and Congressional testimony by the Federal Reserve Board Vice Chair. Each column considers a different financial asset response: the current-quarter and 1-, 2-, and 3-quarter-ahead Eurodollar futures rates (ED1–ED4), the 2-, 5-, 10-, and 30-year Treasury yields, and the S&P500 stock price index.²³

Each entry in panel (A) reports the sum from 1988–2023 of the absolute values of all the asset price changes around the events in the corresponding row for the asset in the corresponding column. The units for Eurodollar futures and Treasuries are interest rate changes in percentage points and for the S&P 500 they are 100 times the change in the log index. In each column, the largest value is highlighted in boldface. For almost every asset, the most important of the five announcement types is the Fed Chair’s speeches. For the S&P 500 and 30-year Treasury yield, Chair speeches are 30–40% more important than FOMC announcements, while for 2- and

²³ As discussed in Section 2, above, beginning on Jan. 1, 2023, we switch from Eurodollar futures to the corresponding SOFR futures responses, but refer to the full sample results as Eurodollar futures results because the two contracts track each other so closely.

FIGURE 1: HISTOGRAMS OF FOMC ANNOUNCEMENT AND FED CHAIR SPEECH EFFECTS ON ED4, 10-YEAR TREASURY YIELD, AND S&P 500, 1988–2023



Histograms of the set of high-frequency, intradaily effects of FOMC announcements and Fed Chair speeches on the 3-quarter-ahead Eurodollar futures rate (ED4), 10-year Treasury yield, and S&P 500 stock price index over our sample from 1988 to 2023. See text for details.

TABLE 2: IMPORTANCE OF DIFFERENT TYPES OF U.S. MONETARY POLICY ANNOUNCEMENTS

	Eurodollar Futures				Treasury Yields				S&P500
	ED1	ED2	ED3	ED4	2yr	5yr	10yr	30yr	
(A) Sum of Absolute Changes (in pp)									
FOMC Annncmts	10.63	12.51	13.60	14.38	10.14	10.88	8.23	6.81	134.3
Chair Speeches	6.65	11.17	13.94	15.54	11.18	12.31	10.02	9.81	172.0
Press Confs	1.03	1.79	2.33	2.77	2.41	2.49	1.91	1.51	41.6
Minutes	1.52	2.77	3.64	4.09	3.49	3.84	3.02	2.77	58.1
Vice Chair Spchs	0.77	1.22	1.41	1.66	1.37	1.60	1.36	1.37	28.5
(B) Mean Absolute Change per Announcement (in bp), 1988–2019									
FOMC Annncmts	2.94	3.44	3.71	3.93	2.72	2.96	2.27	1.90	35.2
Chair Speeches	1.68	2.79	3.48	3.88	2.76	3.08	2.53	2.45	40.8
Press Confs	0.81	1.32	1.82	2.28	2.27	2.78	2.18	1.77	42.1
Minutes	0.69	1.31	1.76	1.98	1.68	1.84	1.45	1.32	26.7
Vice Chair Spchs	0.64	1.04	1.15	1.36	1.13	1.27	1.07	1.02	23.2
(C) Mean Absolute Change per Announcement (in bp), 2020–2023									
FOMC Annncmts	3.03	3.78	4.36	4.59	3.66	3.57	2.43	1.77	55.4
Chair Speeches	1.08	2.07	2.63	2.88	2.36	2.24	1.64	1.84	50.8
Press Confs	2.13	3.82	4.85	5.62	4.56	4.17	3.15	2.44	74.9
Minutes	0.77	1.10	1.25	1.40	1.22	1.41	1.08	1.06	28.2
Vice Chair Spchs	0.55	0.75	1.09	1.25	1.03	1.47	1.31	1.60	23.1
(D) Explanatory R^2 for Monthly Interest Rate Changes and Stock Returns, 1988–2019									
FOMC Annncmts	.123	.095	.065	.046	.015	.022	.021	.018	.039
Chair Speeches	.030	.062	.064	.071	.057	.053	.037	.039	.050
Press Confs	.002	.001	.000	.001	.001	.005	.003	.001	.009
Minutes	.006	.006	.005	.005	.002	−.001	−.002	.002	−.011
Vice Chair Spchs	.005	.005	.003	.003	.001	.003	.002	.003	−.004
All of the Above	.167	.169	.141	.131	.080	.083	.062	.064	.089
(E) Explanatory R^2 for Monthly Interest Rate Changes and Stock Returns, 2020–2023									
FOMC Annncmts	.219	.207	.184	.169	.223	.171	.105	.052	−.086
Chair Speeches	.003	−.010	−.011	−.009	.012	.016	.013	.016	−.001
Press Confs	−.137	−.137	−.087	−.062	−.063	−.053	−.028	−.016	.040
Minutes	.001	.004	.001	−.001	−.008	−.003	−.000	.002	.012
Vice Chair Spchs	−.019	−.017	−.021	−.018	−.016	−.010	−.009	−.010	.008
All of the Above	.091	.079	.090	.099	.162	.126	.075	.033	−.015

Notes: (A) cumulative sum, in percentage points, of the absolute value of the change in interest rates or stock returns around each type of monetary policy announcement; (B)–(C) mean absolute value per announcement, in basis points, of the change in interest rates or stock returns around each announcement type; (D)–(E) R^2 of monthly sum of interest rate changes or stock returns for the total interest rate change or stock return in each month (R^2 can be negative if the monthly sum for an announcement type frequently goes in the wrong direction). For each panel, boldface numbers denote the largest value in each column. Sample: Jan 1988–Dec 2023 (Sep 1988–Dec 2023 for 5-year Treasury and Jan 1991–Dec 2023 for 2-year Treasury); panels (B)–(E) consider subsamples. See Table 1 and text for details.

TABLE 3: UNCONDITIONAL VOLATILITIES OF INTEREST RATES AND STOCK PRICES

	Eurodollar Futures				Treasury Yields				S&P500
	ED1	ED2	ED3	ED4	2yr	5yr	10yr	30yr	
FOMC Annmcmts	10.63	12.51	13.60	14.38	10.14	10.88	8.23	6.81	134.3
Chair Speeches	6.65	11.17	13.94	15.54	11.18	12.31	10.02	9.81	172.0
Press Confs	1.03	1.79	2.33	2.77	2.41	2.49	1.91	1.51	41.6
Minutes	1.52	2.77	3.64	4.09	3.49	3.84	3.02	2.77	58.1
Vice Chair Spchs	0.77	1.22	1.41	1.66	1.37	1.60	1.36	1.37	28.5

Notes: Sample: Jan 1988–Dec 2023 (Sep 1988–Dec 2023 for 5-year Treasury and Jan 1991–Dec 2023 for 2-year Treasury); panels (B)–(E) consider subsamples. See Table 1 and text for details.

3-quarter-ahead Eurodollar futures and 2-, 5-, and 10-year Treasuries, Chair speeches are about 3–25% more important, with greater importance at the longer maturities. Only at the very shortest horizons—the current-quarter and 1-quarter-ahead Eurodollar futures—are FOMC announcements more important. Post-FOMC press conferences, minutes releases, and speeches by the Vice Chair are much less important, although that is partly due to the fact that there are simply fewer of those types of announcements: for example, there were no post-FOMC press conferences until 2011, and even then they occurred only four times per year until 2019.

To address this issue, panels (B)–(C) report the mean absolute effect per announcement for each announcement type. Panel (B) reports results for 1988–2019 and panel (C) for 2020–2023, because the relative importance of the different announcement types changes somewhat around 2020, as discussed further below. On a per-announcement basis, minutes releases, Vice Chair speeches, and post-FOMC press conferences are more comparable to FOMC announcements and Chair speeches; Chair speeches are still the most important announcement type for Treasury yields from 1988–2019, but press conferences are much closer and are the most important for stocks over this same period. FOMC announcements are the most important at the short end of the yield curve. After 2020, the picture changes somewhat: press conferences were the most powerful on a per-announcement basis, for every asset except the current-quarter Eurodollar futures, for which FOMC announcements were more important (panel C). In Section 4, below, we examine the changing importance of press conferences and other announcement types over time in detail.

It is natural to ask how significant each of these announcement types is relative to typical fluctuations in interest rates or stock prices throughout the day. Table 3 reports these unconditional interest rate volatilities for comparison.

Panels (D)–(E) of Table 2 report how important each announcement type was for the total change in interest rates or stock returns each month. For example, for Fed Chair speeches and the 2-year Treasury yield, we compute the monthly change in the 2-year yield that is due to Fed Chair speeches by adding up the effects of all of the Chair’s speeches on the 2-year yield that month. We then compare that sum to the total change in the 2-year yield each month over our sample and report the result as an R^2 statistic, which is 5.7 percent in panel (D).²⁴ Thus, about 5.7 percent of the monthly changes in the 2-year Treasury yield from 1988–2019 occurred around Fed Chair speeches. We repeat this analysis for each entry in panels (D)–(E). The advantage of this approach over panel (A) is that it rewards not just volatility but rather informativeness about the total change in the asset price each month. Note that the R^2 values in panels (D)–(E) can be zero if the asset price changes around an announcement type were uncorrelated with the monthly changes in that asset over the sample, and can even be negative if an announcement type caused the asset to move in the *wrong* direction relative to the total change each month on average over the sample. (A negative R^2 is possible because we impose a unit coefficient in footnote 24 rather than estimate that coefficient in a regression.) Unfortunately, that was the case for press conferences from 2020–2023, as can be seen in the third row of panel (E).

In fact, many of the Fed’s announcement types produced a low or even negative R^2 in the 2020–2023 sample (panel E). Press conferences were the most extreme, but Vice Chair speeches also wrong-footed markets during this period, minutes releases did so for intermediate-maturity yields, and Fed Chair speeches did so for shorter maturities. In contrast, FOMC announcements themselves were extremely informative about monetary policy each month over this period, pro-

²⁴ Let t index months, i index assets, y_t^i denote the end-of-month value of asset i , and $\Delta y_t^i \equiv y_t^i - y_{t-1}^i$, the total change in asset i over month t . For each asset i and $type \in \{\text{FOMC announcement, Chair speech, press conference, minutes, Vice Chair speech}\}$, let

$$\text{MPMTH}_t^{i,type} \equiv \sum_{\tau_{type} \in t} \text{MPHF}_{\tau_{type}}^{i,type}, \quad (1)$$

denote the monthly change in asset i due to that monetary policy announcement $type$, where τ_{type} indexes announcements of each type, $\text{MPHF}_{\tau_{type}}^{i,type}$ denotes the high-frequency, intradaily response of asset i to announcement τ_{type} , t indexes months, and the summation is taken over all announcements τ_{type} that occurred in month t . (If there are no announcements of a given $type$ in month t , then the summation on the right-hand side of (1) is empty and we define $\text{MPMTH}_t^{i,type} = 0$ for that month.)

For each asset i , let $\text{MPMTH}_t^{i,all\ types} \equiv \sum_{type} \text{MPMTH}_t^{i,type}$ denote the total change in asset i in month t that is due to any of the five monetary policy announcement types in our data set.

The R^2 statistic is computed as $1 - \text{USS}^{i,type} / \text{TSS}^i$, where TSS^i denotes the sum of squared monthly changes $\sum_t (\Delta y_t^i)^2$, and $\text{USS}^{i,type}$ denotes the sum of squared residuals that remain after subtracting the effects of $\text{MPMTH}_t^{i,type}$ from the total Δy_t^i each month,

$$\text{USS}^{i,type} = \sum_t (\Delta y_t^i - \text{MPMTH}_t^{i,type})^2.$$

Note that this R^2 measure can be negative if $\text{MPMTH}_t^{i,type}$ is negatively correlated with Δy_t^i .

ducing R^2 values that are far larger than any other announcement type and much larger than their historical average in panel (D).

Overall, the results in panel (D) generally confirm those in panel (A), with FOMC announcements being important and Fed Chair speeches even more important for all but the shortest maturities. Minutes releases and Vice Chair speeches provide only a low R^2 .

discuss unconditional volatility

Overall, there are four main points to take away from Table 2. First, prior to 2020, Fed Chair speeches are more important than FOMC announcements for stocks, Treasuries, and all but the shortest-maturity interest rate futures. This observation is particularly important because studies of the effects of monetary policy have increasingly used longer-term futures and Treasury yields to measure the stance of monetary policy—see, e.g., Gürkaynak et al., (2005a), Wright (2012), Swanson and Williams (2014), Gertler and Karadi (2015), Nakamura and Steinsson (2018), and Swanson (2021). For example, Gertler and Karadi (2015) use the one- and two-year Treasury yields and the three-month-ahead federal funds futures rate as measures of monetary policy. As discussed by Swanson and Williams (2014), these longer-maturity interest rates measure not just the current level of the federal funds rate, but also where financial markets expect the federal funds rate to go over the next several quarters, which is a better overall indicator of the cost of funding for households and firms. Thus, previous studies of the effects of monetary policy on financial markets and the economy have ignored the most important type of U.S. monetary policy announcement.

Second, for very short-term interest rates, FOMC announcements are the most important. This is not surprising—FOMC announcements are the only times at which the current federal funds rate target changes, so the very shortest end of the yield curve is essentially perfectly anchored except on the dates of FOMC announcements.

Third, the final rows of panels (D)–(E), labeled “All of the Above”, sum up the high-frequency effects of all five monetary policy announcement types each month and reports the explanatory R^2 for monthly asset price changes. Prior to 2020, or even over our whole sample, the increase in R^2 from considering all of our announcement types is substantial, even for short-maturity interest rate futures. For longer maturities, the increase is much greater, with R^2 typically rising by a factor of two to five in panel (D): for example, the R^2 for the 2-year Treasury yield is more than 5.5 times larger using all of our announcements vs. FOMC announcements

alone. Where Gertler and Karadi (2015) found first-stage F -statistics for the 2-year Treasury yield of 4 or 5 using high-frequency interest rate changes around FOMC announcements as an instrument, our more powerful high-frequency instrument produces first-stage F -statistics greater than 30 (Bauer and Swanson, 2023b; Swanson, 2023b).

Fourth, Fed Chair speeches and press conferences in 2020–23 were potentially less informative about monetary policy than in earlier years. Those speeches and press conferences continued to move markets substantially (as shown in the next section), but their explanatory power for monthly interest rate changes was very low during this period. Applications using these data, such as our structural VAR analysis in Section 6, below, should keep this issue in mind, as we discuss in our application.

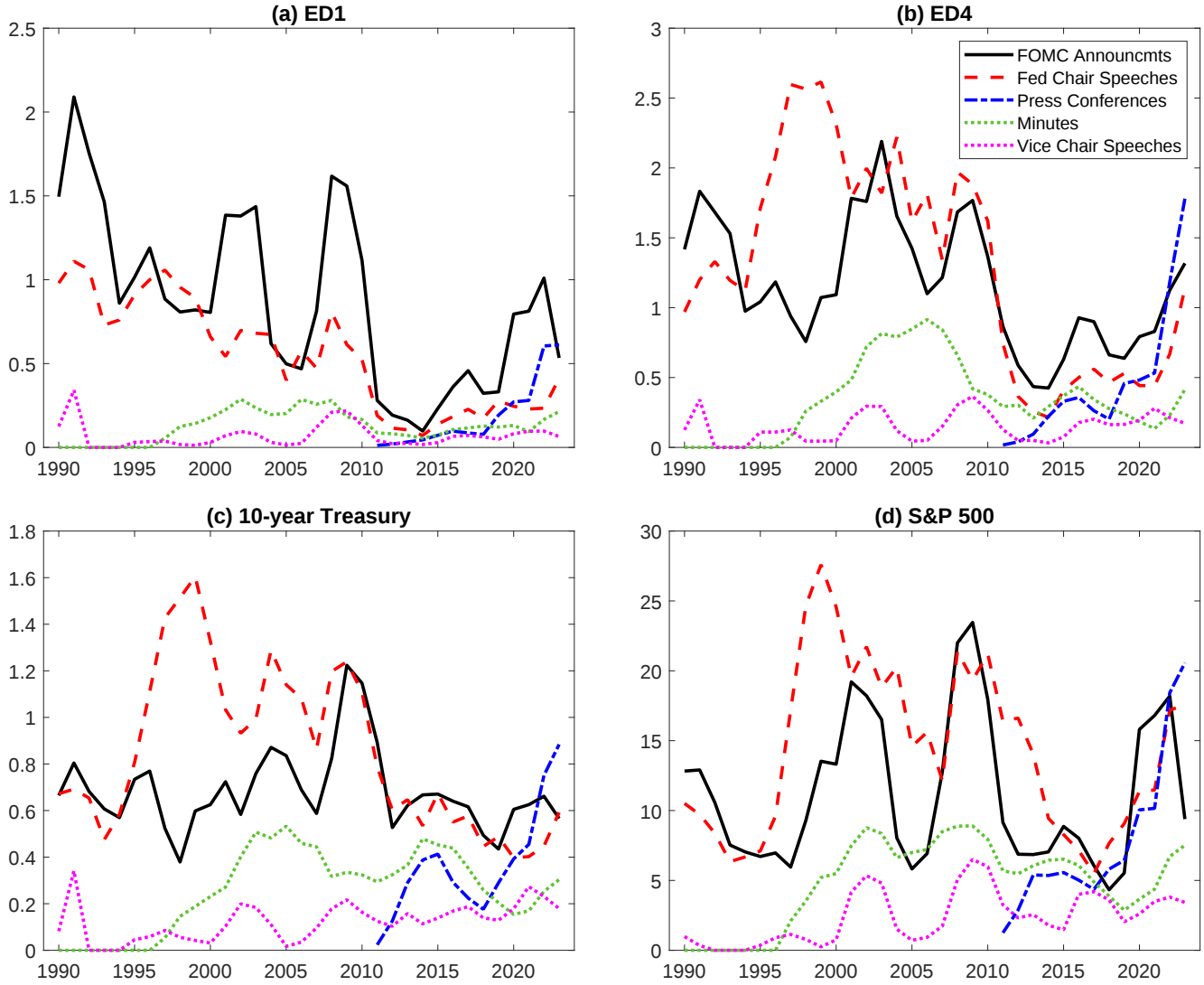
4. Importance of Different Announcement Types over Time

We next analyze how the importance of the different U.S. monetary policy announcement types has evolved over time, which is an important issue since some announcement types, like post-FOMC press conferences, did not exist in the early years of our sample, while others, like FOMC announcements, have evolved substantially over time. It’s also reasonable to think that the amount of communication about monetary policy in the Fed Chair’s and Vice Chair’s speeches has evolved over time, especially since our sample covers several different Chairs and Vice Chairs.

Figure 2 reports rolling-window estimates of the effects of our five different monetary policy announcement types on four representative assets: the current-quarter Eurodollar future rate (ED1), the 3-quarter-ahead Eurodollar future rate (ED4), the 10-year Treasury yield, and the S&P 500. Each panel reports the cumulative sum of interest rate (or log S&P 500) changes around FOMC announcements (solid black line), Fed Chair speeches (dashed red line), post-FOMC press conferences (dash-dotted blue line), FOMC minutes releases (dotted green line), and Vice Chair speeches (dotted purple line), analogous to panel (A) of Table 2, except over three-year trailing rolling windows instead of over the entire sample.

There are several important points to take away from Figure 2. First, there is a strong downward trend in panel (a) for both FOMC announcements and Fed Chair speeches. That is, both types of announcements have caused smaller moves in the current-quarter Eurodollar future rate over time. Part of this trend is due to the U.S. zero lower bound period from 2009–15 mechanically making ED1 changes small during that period, but the trend is clear prior to 2009

FIGURE 2: IMPORTANCE OF DIFFERENT U.S. MONETARY POLICY
ANNOUNCEMENT TYPES OVER TIME



Notes: cumulative sum over trailing 3-year rolling windows, in percentage points, of the absolute value of the change in interest rates or log stock prices around each monetary policy announcement type. Sample: Jan 1988–Dec 2023. See notes to panel (A) of Table 2 and text for details.

as well (see also Swanson, 2006). Intuitively, the Fed has become more transparent over time and has given financial markets increasingly more information about the near-term outlook for the federal funds rate; as a result, FOMC announcements and Fed Chair speeches have become less surprising for very short-term interest rates.

Second, for all the assets in Figure 1, there are clear upward spikes in the importance of FOMC announcements, Fed Chair speeches, and Vice Chair speeches around 1990–91, 2001–03, 2008–09, and 2020–22 which correspond to periods when monetary policy was very active due to increases in unemployment or inflation.

Third, the importance of Fed Chair speeches vis-a-vis FOMC announcements in panels (b), (c), and (d) has neither increased nor decreased substantially over time, but rather has been present throughout the sample. It's true that Fed Chair speeches were particularly important in the late 1990s, a period when Fed Chair Greenspan testified frequently before Congress, but Fed Chair speeches have been roughly as important as FOMC announcements throughout the entire sample. Similarly, in panel (a), FOMC announcements have been more important than Fed Chair speeches throughout the entire sample.

Fourth, post-FOMC press conferences have become steadily more important over time, ever since their introduction in 2011. By the end of our sample in 2023, they move markets even more than FOMC announcements and Fed Chair speeches, although the caveat regarding low explanatory power in Table 2 should be kept in mind.

Fifth, speeches by the Federal Reserve Board Vice Chair are the least important of the announcement types we consider, and have consistently been the least important over our sample. Their importance does increase modestly in 1990–91, 2001–03, 2007–09, and 2020–22, as mentioned above, but aside from those episodes, the Vice Chair's speeches have not been very important.

Sixth and finally, the importance of FOMC minutes releases is somewhat mixed. On the one hand, they have sometimes approached FOMC announcements in importance, such as around 2005. On the other hand, their importance has diminished since 2005 and their explanatory power for monthly interest rate changes is low, as reported in Table 2. Overall, they are not as important as FOMC announcements or Fed Chair speeches, but they are also non-negligible and should be included in applications if possible.

The main conclusion from Figure 2 is that empirical researchers using high-frequency monetary policy announcement data have much to gain by extending their analysis beyond just FOMC announcements. Fed Chair speeches are clearly as important as FOMC announcements for all but the shortest-maturity interest rate futures, and post-FOMC press conferences have become increasingly important over time as well. In Section 6, below, we present an application of our expanded data set to a monetary policy VAR and show that interest rate changes around FOMC announcements alone are a weak instrument for forward guidance in the VAR. By contrast, including all five monetary policy announcement types above increases the relevance of the instrument dramatically, far above the weak instruments cutoff suggested by Stock and Watson (2012).

5. Federal Funds Rate, Forward Guidance, and LSAPs

Gürkaynak, Sack, and Swanson (2005a) decompose FOMC announcements into two components: the surprise change in the federal funds rate and the surprise change in forward guidance. Swanson (2021) extends this methodology to estimate the surprise change in the Federal Reserve’s large-scale asset purchases (LSAPs) as well. In this section, we apply these methods to decompose each of the five types of monetary policy announcements above (FOMC announcements, Fed Chair speeches, post-FOMC press conferences, FOMC minutes releases, and Fed Vice Chair speeches) into federal funds rate, forward guidance, and LSAP components. We then compare these components across the five monetary policy announcement types.

5.1 Identification of Federal Funds Rate and Forward Guidance Components

We begin by identifying federal funds rate and forward guidance components for each of our announcement types, and then identify LSAPs below. Changes in the Fed’s target for the federal funds rate are always accompanied by an FOMC announcement, as discussed in Section 2, above, so none of the other monetary policy announcement types in our sample result in a change in the federal funds rate. We thus define the surprise change in the federal funds rate to be zero for all of those non-FOMC announcements.

For the federal funds rate and forward guidance component of FOMC announcements, we follow GSS and let X^{FOMC} be the 360×5 matrix of short- and medium-term interest rate futures responses to FOMC announcements. Each row of X^{FOMC} corresponds to an FOMC announcement and each column to MP1, ED1, ED2, ED3, and ED4, respectively, where MP1 denotes the surprise change in the federal funds rate computed from fed funds futures, as in Kuttner (2001) and GSS, and ED1–4 are the changes in the current-quarter through three-quarter-ahead Eurodollar futures rates, as discussed in Section 2, above. The (i, j) th element of X^{FOMC} thus corresponds to the change in futures rate j in a narrow, 30-minute window of time around FOMC announcement i . We follow GSS and extract the first two principal components from X^{FOMC} and rotate those two principal components so that the second one has no effect on the current federal funds rate (MP1). As discussed in GSS, the first of these two factors then corresponds to the surprise change in the federal funds rate and the second factor to the surprise change in forward guidance (because it causes interest rate futures to change for reasons other than changes in the current federal funds rate).

We use essentially the same methods to identify the forward guidance component of each of our other announcement types (Fed Chair speeches, press conferences, minutes, and Vice Chair speeches), except that there is no federal funds rate change for these other announcements. Thus, the matrix X^{type} for each of these other monetary policy announcement types has dimensions $T_{type} \times 4$, where T_{type} denotes the number of announcements of the given type and the four columns of X^{type} correspond to the futures rates ED1–ED4, with no MP1 because the surprise change in the federal funds rate is zero. We take the first principal component of the matrix X^{type} and define that to be the change in forward guidance around the announcement—this is analogous to the definition of forward guidance for FOMC announcements, above, because here there are no changes in the federal funds rate.

Finally, we normalize the scale of each factor (federal funds rate and forward guidance) for each type of monetary policy announcement to have a standard deviation of unity.²⁵

5.2 Forward Guidance Effects for Different Announcement Types

For each type of monetary policy announcement (FOMC announcements, Fed Chair speeches, etc.), we run high-frequency event study regressions of the form

$$\Delta y_t = \alpha + \beta' F_t^{type} + \varepsilon_t, \quad (2)$$

where t indexes announcements of the given type, Δy_t denotes the change in a particular interest rate or stock return in a narrow window of time around announcement t , F_t^{type} contains the federal funds rate and forward guidance factors identified above for announcement t , α and β are parameters, and ε_t is a regression residual.

The results from these regressions are reported in Table 3. Each column corresponds to a different interest rate maturity or S&P 500 stock return, and each element of the table is from a separate regression of the form (2) (except for FOMC announcements, for which the coefficients in panels (A) and (B) are from a single regression for each column). The coefficients in the table are in units of basis points per standard deviation change in the factor for that announcement type. Thus, a one-standard-deviation change in forward guidance coming from a Fed Chair speech over our sample led to a 4.11bp change in the 2-year Treasury yield. Heteroskedasticity-consistent standard errors are reported in parentheses below each coefficient estimate.

²⁵In particular, we follow Swanson (2021) and normalize the federal funds rate factor (which is nonzero for FOMC announcements only) to have a unit standard deviation from 1988–2008, before the zero lower bound began to be a constraint. We normalize the forward guidance factor for each announcement type to have a unit standard deviation over the whole sample, 1988–2023.

TABLE 3: EFFECTS OF FEDERAL FUNDS RATE AND FORWARD GUIDANCE ON INTEREST RATES AND STOCK RETURNS FOR DIFFERENT TYPES OF MONETARY POLICY ANNOUNCEMENTS

	Eurodollar Futures				Treasury Yields				S&P500
	ED1	ED2	ED3	ED4	2yr	5yr	10yr	30yr	
(A) Effects of Federal Funds Rate Changes									
FOMC Announcemts	5.50 (0.18)	4.94 (0.09)	4.36 (0.09)	3.77 (0.11)	2.43 (0.21)	1.81 (0.22)	0.90 (0.17)	0.25 (0.16)	−30.6 (7.79)
(B) Effects of Forward Guidance Changes									
FOMC Announcemts	2.27 (0.12)	3.81 (0.08)	4.68 (0.04)	5.21 (0.09)	3.94 (0.14)	3.68 (0.18)	2.60 (0.13)	1.77 (0.13)	−14.9 (3.99)
Chair Speeches	2.57 (0.13)	4.32 (0.05)	5.27 (0.10)	5.71 (0.16)	4.11 (0.16)	3.63 (0.20)	2.70 (0.18)	2.16 (0.19)	−11.4 (3.55)
Press Conferences	2.62 (0.35)	4.40 (0.11)	5.36 (0.24)	5.80 (0.56)	4.76 (0.41)	4.15 (0.29)	2.80 (0.09)	1.71 (0.07)	−42.3 (12.28)
Minutes	1.01 (0.06)	2.01 (0.04)	2.58 (0.07)	2.79 (0.10)	2.22 (0.12)	2.00 (0.12)	1.40 (0.11)	1.01 (0.11)	−2.7 (3.28)
Vice Chair Speeches	1.04 (0.12)	1.61 (0.05)	1.74 (0.10)	1.93 (0.13)	1.69 (0.16)	1.39 (0.13)	1.02 (0.10)	0.76 (0.10)	−0.4 (3.73)
(C) Effects of Forward Guidance Changes, Estimated Jointly									
all announcemnt types	2.22 (0.10)	3.90 (0.11)	4.77 (0.14)	5.17 (0.16)	3.92 (0.13)	3.59 (0.14)	2.59 (0.12)	1.92 (0.11)	−11.3 (2.38)
$\hat{\gamma}^{CS} = 1.10$	(0.03)								
$\hat{\gamma}^{PC} = 1.11$	(0.04)								
$\hat{\gamma}^{Min} = 0.53$	(0.02)								
$\hat{\gamma}^{VC} = 0.41$	(0.01)								

Notes: Panels (A)–(B) report estimated coefficients β from regressions $\Delta y_t = \alpha + \beta F_t^{type} + \varepsilon_t$, where t indexes announcements of the given type in each row, Δy_t denotes the interest rate change or S&P500 stock return in a narrow window around each announcement, and F_t^{type} denotes the federal funds rate and forward guidance factors for each announcement. Panel (C) reports estimated coefficients β^i and γ^{type} from regressions $\Delta y_t^{i,type} = \alpha^{i,type} + \gamma^{type} \beta^i F_t^{type} + \varepsilon_t^{i,type}$, estimated jointly for all 5 announcement types and 9 assets i , with γ^{FOMC} normalized to 1. Coefficients are in basis points per standard deviation change. Heteroskedasticity-consistent standard errors in parentheses. Sample: 1988–2023 (2011–2023 for press conferences, 1997–2023 for minutes releases, Sep. 1988–2023 for 5-year Treasury, 1991–2023 for 2-year Treasury). See text for details.

Panel (A) reports results for the effects of changes in the federal funds rate. The funds rate only changes when there is an FOMC announcement, so there is no federal funds rate component for any other announcement type. A one-standard-deviation change corresponds to a surprise increase in the federal funds rate of 7.45bp (not shown in the table), which raises the current-quarter Eurodollar futures rate by 5.5bp and has effects on other interest rates that are highly statistically significant but diminish with maturity. These estimates are all very similar to those

in Kuttner (2001), GSS, and Swanson (2021). The effects on the stock market are -0.31 percent for a one-standard-deviation tightening and are highly statistically significant, consistent with Bernanke and Kuttner (2005) and Swanson (2021).

Panel (B) of Table 3 reports results for the effects of forward guidance. A one-standard-deviation increase in the forward guidance component of FOMC announcements raises the 2-year Treasury yield by 3.94bp, while a one-standard-deviation increase in the forward guidance component of Fed Chair speeches raises that yield by 4.11bp. The interest rate responses in panel (B) are all highly statistically significant, with t -statistics ranging from 7 to over 90—thus, there is no question that interest rates respond systematically to these announcements in the narrow intradaily windows we consider. Also note that for each announcement type, the effects on the yield curve have a very similar hump shape, with a peak effect at a horizon of about 1 year (the ED4 rate). This finding is very similar to GSS and Swanson (2021), and suggests that our identifying assumptions are working as intended.

The very similar hump shapes across the different rows in panel (B) suggest that forward guidance is essentially the same across these announcement types, as one might expect. We thus re-estimate the effects of forward guidance for all five announcement types and all nine assets in Table 3 jointly, using the restricted specification

$$\Delta y_t^{i,type} = \alpha^{i,type} + \gamma^{type} \beta^i F_t^{type} + \varepsilon_t^{i,type}, \quad (3)$$

where i indexes different assets (ED1, ED2, etc.), $type$ denotes different announcement types (FOMC announcements, Chair speeches, etc.), and t indexes the times at which any of the announcements were made. The coefficients β^i are allowed to vary across assets i —for example, by having a hump shape—but are restricted to be the same across announcement types; the scalar coefficients γ^{type} allow the different announcement types to differ in scale—so that minutes releases and Vice Chair speeches can have smaller effects on average. We normalize the γ^{FOMC} scale factor for FOMC announcements to be 1, and estimate the scale factors γ^{type} for the other announcement types.

We estimate the nonlinear specification (3) by GMM, and report the results in panel (C) of Table 3. In contrast to panel (B), every estimated coefficient in panel (C) comes from a single, joint regression (3). A J -test of the over-identifying restrictions in equation (3) has a p -value of 0.65, so the restricted specification is consistent with the data and confirms the similarity across rows observed in panel (B). The estimates for β^i in panel (C) are very similar to those for FOMC

announcements in panel (B), albeit with smaller standard errors due to the larger sample. Chair speeches on average have 10 percent larger effects than FOMC announcements ($\gamma^{CS} = 1.10$) and press conferences have effects that are 11 percent larger, while minutes releases and Vice Chair speeches have effects that are only 53 and 41 percent as large as FOMC announcements, respectively. Thus, Fed Chair speeches and press conferences were the most powerful source of forward guidance over our sample, followed by FOMC announcements, and lastly minutes releases and Vice Chair speeches.

The last column of Table 3 reports the response of the stock market to forward guidance. Consistent with GSS, Swanson (2021), and Bernanke and Kuttner (2005), higher interest rates cause the stock market to decline. Based on the joint estimates in panel (C), a one-standard-deviation tightening of forward guidance causes the S&P 500 to fall about 0.1 percent, smaller than the effect of the federal funds rate on the stock market (again consistent with GSS and Swanson, 2021). This is surprising, because stocks have very long duration and forward guidance has substantially larger effects on long-term interest rates than do changes in the federal funds rate. This finding also sheds light on a puzzle raised by Bauer and Swanson (2023b): namely, why does the stock market respond more strongly to FOMC announcements than to Fed Chair speeches? According to Table 3, this is because changes in the federal funds rate have larger effects on the stock market than do changes in forward guidance, and speeches by the Fed Chair don't change the current federal funds rate. If we focus only on the forward guidance component of FOMC announcements and Fed Chair speeches, then the two have similarly-sized effects on the S&P 500 and the difference between them is not statistically significant.

Overall, the main takeaway from Table 3 is that the effects of forward guidance are consistent across all five monetary policy announcement types, suggesting that they can be combined into a single forward guidance series, as in panel (C). Indeed, we do this in our application in Section 6, below: by combining all five measures of forward guidance into a single instrument, we have a much more powerful instrument for changes in forward guidance.

5.3 Identification of LSAP Components

We now turn to identifying the LSAP component of each of our announcement types. Swanson (2021) separately identifies the LSAP component of FOMC announcements by imposing that LSAPs are a latent factor that has minimum variance in the pre-2009 period, because the Fed generally did not conduct LSAPs before 2009. We cannot apply that approach in all cases here,

however, because post-FOMC press conferences only begin in 2011 and Vice Chair speeches generate little variation prior to 2009 (see Figure 2).

We thus pursue a slightly different and somewhat simpler approach. For each monetary policy announcement type, we define the change in LSAPs to be the change in the long-term Treasury bond yield, orthogonalized with respect to changes in the federal funds rate and forward guidance.²⁶ This identifying assumption is intuitive and is essentially the same as in Rogers, Scotti, and Wright (2018) and Gilchrist, Yue, and Zakrajsek (2019); it is also simpler than the one in Swanson (2021) and can be used for all of our announcement types. Finally, we normalize the LSAP factor to have a negative effect on the 10-year Treasury yield, so that an increase in LSAPs causes long-term Treasury yields to fall.

5.4 LSAP Effects for Different Announcement Types

Table 4 reports our estimates for the effects of LSAPs. Panel (A) reports the results for each monetary policy announcement type and each asset estimated separately, as in regression (2). The effects of LSAPs on Eurodollar futures are typically small and often statistically insignificant, but the effects on longer-term Treasury yields are much larger, negative, and highly statistically significant. A one-standard-deviation increase in the LSAP component of an FOMC announcement lowers the 10-year Treasury yield by 4.31bp, while a one-standard-deviation increase in the LSAP component of a Fed Chair speech reduces the 10-year yield by 2.36bp. In contrast to forward guidance, the effects of LSAPs are largest at maturities of 5 to 30 years. These results are consistent with Swanson (2021), suggesting that our identifying assumptions for LSAPs are working as intended.

As was the case for forward guidance in Table 3, the yield curve responses to LSAPs in Table 4 have similar shapes across the different announcement types. The effects on shorter-term Eurodollar futures are small and often insignificant, while the effects on long-term Treasury yields are large, negative, and significant, with a peak effect at 10 or 30 years. We thus likewise estimate the effects of LSAPs across announcement types and assets jointly using the single joint nonlinear regression specification (3), estimated via GMM. (However, because the effects on stock prices in the last column are not consistent across announcement types, we do not include stock price responses in this specification and estimate (3) using only the interest rate responses.) The results

²⁶We compute the change in the long-term Treasury bond yield around each announcement as the average change in the 10-year and 30-year Treasury yields. We measure the predicted effects of the federal funds rate and forward guidance on these Treasury yields using the estimates in panels (A) and (C) of Table 3.

TABLE 4: EFFECTS OF LSAPs ON INTEREST RATES AND STOCK RETURNS
FOR DIFFERENT TYPES OF MONETARY POLICY ANNOUNCEMENTS

	Eurodollar Futures				Treasury Yields				S&P500
	ED1	ED2	ED3	ED4	2yr	5yr	10yr	30yr	
(A) Effects of LSAP Changes									
FOMC Announcemnts	-0.19 (0.19)	0.12 (0.13)	0.10 (0.09)	-0.08 (0.19)	-0.63 (0.22)	-2.96 (0.54)	-4.31 (0.17)	-5.10 (0.14)	14.3 (13.91)
Chair Speeches	0.34 (0.08)	0.23 (0.05)	-0.25 (0.05)	-0.71 (0.16)	-0.89 (0.11)	-2.31 (0.13)	-2.36 (0.06)	-2.88 (0.06)	-20.1 (5.58)
Press Conferences	0.43 (0.20)	0.31 (0.07)	-0.22 (0.15)	-1.01 (0.25)	-1.21 (0.25)	-2.56 (0.31)	-2.60 (0.11)	-2.48 (0.09)	0.8 (8.96)
Minutes	0.06 (0.05)	0.09 (0.03)	0.00 (0.05)	-0.27 (0.09)	-0.56 (0.09)	-1.86 (0.11)	-1.87 (0.07)	-2.02 (0.06)	-0.5 (4.70)
Vice Chair Speeches	0.08 (0.03)	0.06 (0.03)	-0.05 (0.03)	-0.15 (0.05)	-0.32 (0.06)	-1.01 (0.07)	-1.00 (0.04)	-1.08 (0.04)	-4.8 (3.97)
(B) Effects of LSAP Changes, Estimated Jointly									
all announcemnt types	0.25 (0.18)	0.25 (0.27)	-0.11 (0.32)	-0.57 (0.34)	-1.22 (0.28)	-3.84 (0.42)	-4.19 (0.36)	-4.60 (0.37)	—
$\hat{\gamma}^{CS} = 0.61$	(0.06)								
$\hat{\gamma}^{PC} = 0.57$	(0.06)								
$\hat{\gamma}^{Min} = 0.44$	(0.04)								
$\hat{\gamma}^{VC} = 0.24$	(0.02)								

Notes: Panel (A) reports estimated coefficients β on the LSAP factor from regressions $\Delta y_t = \alpha + \beta F_t^{type} + \varepsilon_t$, where t indexes announcements of the given type in each row, Δy_t denotes the interest rate change or S&P500 stock return in a narrow window of time around each announcement, and F_t^{type} denotes the federal funds rate, forward guidance, and LSAP factors for each announcement. Panel (B) reports estimated coefficients β^i and γ^{type} from regressions $\Delta y_t^{i,type} = \alpha^{i,type} + \gamma^{type} \beta^i F_t^{type} + \varepsilon_t^{i,type}$, estimated jointly for all 5 announcement types and 9 assets i , with γ^{FOMC} normalized to 1. Coefficients are in basis points per standard deviation change in LSAPs. Heteroskedasticity-consistent standard errors in parentheses. Sample: 1988–2023 (2011–2023 for press conferences, 1997–2023 for minutes releases, Sep. 1988–2023 for 5-year Treasury, 1991–2023 for 2-year Treasury). See Table 3 and text for additional details.

of this joint estimation are reported in panel (B) of Table 4. The J -test of the over-identifying restrictions in equation (3) has a p -value of 0.99, so the restricted specification is very consistent with the data and confirms the similarity across rows observed in panel (A). The estimates for β^i in panel (B) are very similar to those for FOMC announcements in panel (A).

For LSAPs, FOMC announcements are the most powerful announcement type. Chair speeches are on average 61 percent as powerful, while press conferences, minutes releases, and Vice Chair speeches have effects that are only 57, 44, and 24 percent as large as FOMC announcements, respectively.

Finally, the last column of Table 4 reports the estimated effects of LSAPs on the stock market. The results for stock prices are mixed: the LSAP component of FOMC announcements has the expected sign, with a one-standard-deviation decrease in interest rates due to an LSAP causing stock prices to rise 0.14 percent, but the LSAP components of Fed Chair speeches, minutes releases, and Vice Chair speeches have puzzling, negative signs, with speeches by the Fed Chair being statistically significant. This sharp contrast between the effects of LSAPs announced at FOMC meetings vs. LSAPs announced via Fed Chair speeches presents a significant puzzle for future research.

6. Application: Forward Guidance in a Monetary Policy VAR

A large literature estimates the effects of changes in the federal funds rate on macroeconomic variables in a VAR (e.g., Christiano, Eichenbaum, and Evans, 1999; Cochrane and Piazzesi, 2002; Faust, Swanson, and Wright, 2004). However, there are only a few studies of the effects of forward guidance on macroeconomic variables, despite the fact that forward guidance has become an increasingly important component of monetary policy over time (Gürkaynak, Sack, and Swanson, 2005a; Swanson, 2021). Lakdawala (2019) and Miranda-Agrippino and Ricco (2023) are two notable attempts to estimate these effects, but in both cases the estimates are often not very precise, puzzling (e.g., tighter forward guidance causing output to increase), and somewhat fragile. In this section, we revisit this application and show that these problems are likely due to a weak instrument. Here, we bring to bear the forward guidance components of all of our monetary policy announcements (speeches by the Fed Chair, post-FOMC press conferences, etc.), and thus have a much stronger instrument.

We keep the discussion of the application relatively brief here and refer the reader to the papers above and Bauer and Swanson (2023b) for additional details. We include five monthly macroeconomic variables in our VAR: the log of industrial production, the log of the consumer price index, the log of the Commodity Research Bureau’s commodity price index, the Gilchrist-Zakrajsek (2012) credit spread, and the two-year Treasury yield.²⁷ Including commodity prices in the VAR is not necessary but helps to illustrate the effects of monetary policy and is recommended

²⁷ Industrial production and the CPI are from the Federal Reserve Bank of St. Louis FRED database. The Commodity Research Bureau (CRB) commodity price index is the end-of-month value from Bloomberg. An updated version of the Gilchrist-Zakrajsek (2012) credit spread is from the Federal Reserve Board. The 2-year Treasury yield is the end-of-month zero-coupon yield from the updated Gürkaynak, Sack, and Wright (2007) database at the Federal Reserve Board.

as “best practice” by Bauer and Swanson (2023b). We include the GZ credit spread because Caldara and Herbst (2019) found credit spreads to be important for the estimation of monetary policy VARs. Finally, we use the two-year Treasury yield as our measure of the overall stance of monetary policy because it is was largely unconstrained by the zero lower bound from 2009–15 (Swanson and Williams, 2014; Gertler and Karadi, 2015; Swanson, 2018) and is also very sensitive to changes in forward guidance (Gürkaynak et al., 2005a; Swanson, 2021). Overall, this VAR specification is essentially identical to the “best practice” recommendation in Bauer and Swanson (2023b), except that our monetary policy instrument here is forward guidance.

We stack these five variables into a vector Y_t and estimate the reduced-form VAR,

$$Y_t = \alpha + B(L)Y_{t-1} + u_t, \quad (4)$$

from January 1973 to February 2020, where α is a constant, $B(L)$ a matrix polynomial in the lag operator with 12 monthly lags, and u_t is a 5×1 vector of serially uncorrelated regression residuals. The Gilchrist-Zakrajsek (2012) credit spread data begin in 1973, which prevents us from beginning the sample earlier, and we end the sample in February 2020 to avoid the large swings in the macroeconomic data due to the Covid pandemic.

We assume that the economy is driven by a set of serially uncorrelated structural shocks, ε_t , with

$$u_t = S\varepsilon_t, \quad (5)$$

$\text{Var}(\varepsilon_t) = I$, and S a matrix of appropriate dimensions (see, e.g., Ramey, 2016). We assume that one of the structural shocks is a “forward guidance shock” and we denote that shock by ε_t^{fg} and order it first in the vector ε_t . The first column of S , denoted s_1 , then describes the impact effects of the structural forward guidance shock ε_t^{fg} on u_t and hence Y_t .

Let $\tilde{z}_t^{fg}$ denote the set of high-frequency changes in forward guidance around all of the monetary policy announcements above (FOMC announcements, Fed Chair speeches, press conferences, etc.). Let z_t^{fg} denote the monthly version of $\tilde{z}_t^{fg}$, obtained by summing over all of the high-frequency changes in forward guidance within each month. The idea is that z_t^{fg} is very plausibly a relevant and exogenous instrument for ε_t^{fg} : in particular, FOMC announcements, Fed Chair speeches, etc. are a very important part of the news about monetary policy each month, suggesting relevance, while the fact that z_t^{fg} excludes any other interest rate changes outside of very narrow windows around these monetary policy announcements suggests exogeneity (see

Stock and Watson, 2018, and Bauer and Swanson, 2023b, for a more detailed discussion).²⁸

Given the instrument z_t^{fg} , we estimate the impact effect s_1 in the VAR as described in Stock and Watson (2012, 2018), Gertler and Karadi (2015), and Bauer and Swanson (2023b), regressing

$$Y_t = \tilde{\alpha} + \tilde{B}(L)Y_{t-1} + s_1 Y_t^{2y} + \tilde{u}_t \quad (6)$$

via equation-by-equation two-stage least squares, where $\tilde{B}(L)$ has the same number of lags as $B(L)$ and z_t^{fg} is the instrument for Y_t^{2y} .²⁹ It is straightforward to show that regression (6) produces an unbiased and consistent estimate of s_1 with the impact effect on Y_t^{2y} normalized to unity. In our empirical results below, we rescale s_1 so that the impact effect on Y_t^{2y} is 25 basis points (bp), rather than 1 percentage point.

Once we have estimated the impact effect s_1 , it is straightforward to use the estimated matrix lag polynomial $B(L)$ from (4) to compute the impulse response functions for Y_t to the structural shock ε_t^{fg} .³⁰ Figure 3 reports those estimated impulse response functions. The first column of Figure 3 reports estimates analogous to Lakdawala (2019) and Miranda-Agrippino and Ricco (2023), restricting attention to the forward guidance component of FOMC announcements alone to construct the high-frequency instrument z_t^{fg} . The second column of Figure 3 repeats the analysis using the forward guidance component of all of our monetary policy announcement types (FOMC announcements, Fed Chair speeches, press conferences, etc.) to construct z_t^{fg} .

When we restrict attention to FOMC announcements alone, as in the left column of Figure 3, the high-frequency instrument z_t^{fg} is weak. The first-stage F -statistic for the instrument in regression (6) is very low: just 1.8, far below the weak instrument threshold of 10 suggested by Stock and Watson (2012).³¹ We thus report weak-instrument-robust 90% confidence intervals around the impulse response function estimates in the left column of Figure 3, using the methods

²⁸ Following Bauer and Swanson (2023b), we also orthogonalize the instrument z_t^{fg} with respect to macroeconomic and financial news released in the weeks prior to the FOMC announcement. Bauer and Swanson (2023a,b) and others show that the high-frequency instrument z_t^{fg} is correlated with these news releases, apparently because the Fed responded to them more aggressively than markets expected. Failing to orthogonalize z_t^{fg} with respect to this news would cause the instrument to fail the exogeneity condition and tend to confound our estimated impulse response functions with the effects of the correlated economic news.

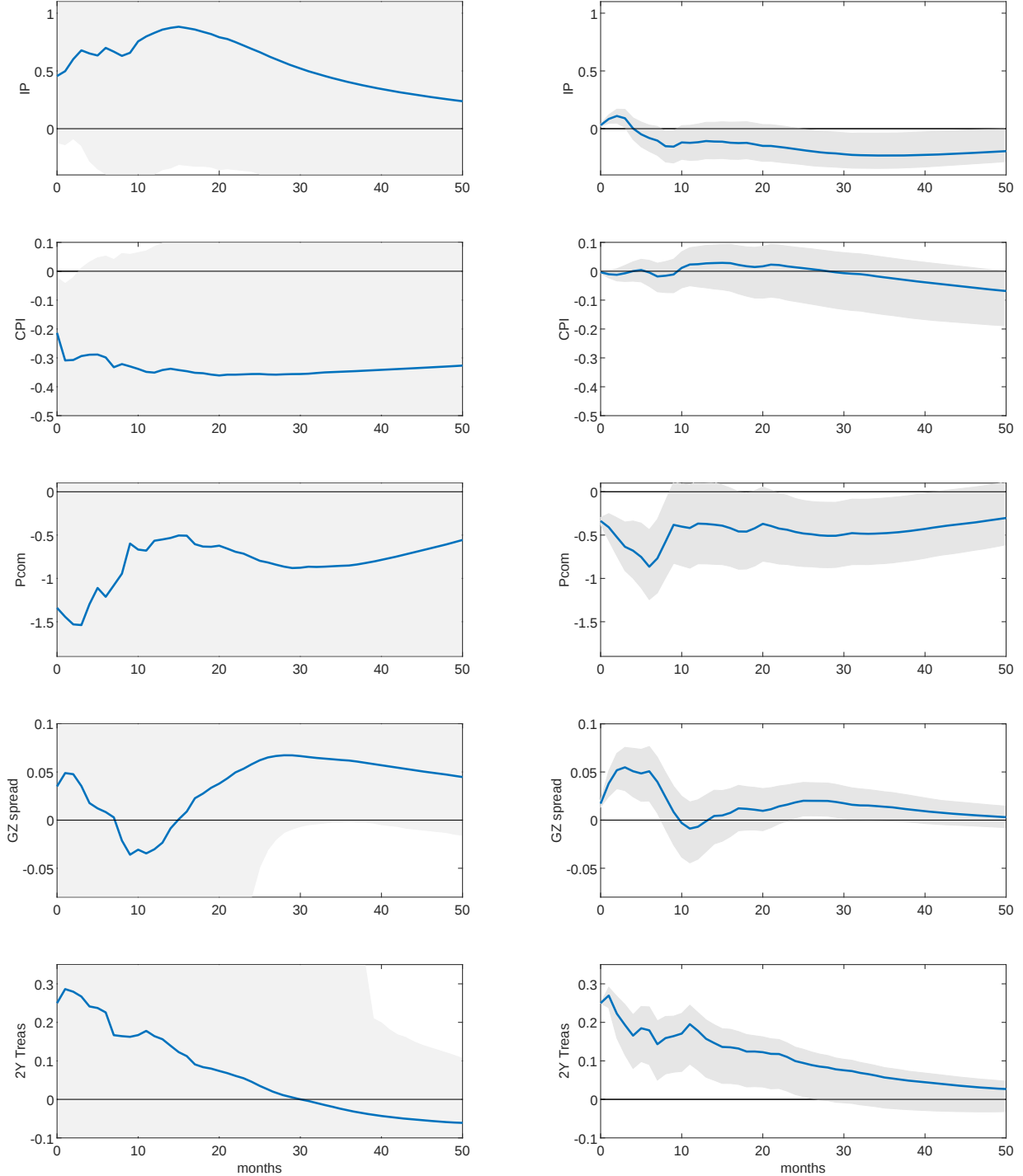
²⁹ Note that one can obtain the same point estimates for s_1 by regressing the reduced-form residuals u_t from (4) on u_t^{fg} using z_t^{fg} as the instrument; Stock and Watson (2012) recommend using specification (6) to avoid generated regressors and correctly estimate the standard errors for s_1 .

³⁰ Note that the sample for the two-stage least squares regression (6) used to estimate s_1 does not have to be the same as for the reduced-form VAR regression (4) used to estimate α and $B(L)$. In fact, our high-frequency interest rate instrument is available only beginning in 1988, while we can estimate the reduced-form VAR coefficients α and $B(L)$ over the longer sample 1973:1–2020:2.

³¹ The first-stage F -statistic is the squared t -statistic for θ in the regression

$$Y_t^{2y} = \gamma + C(L)Y_{t-1} + \theta z_t^{fg} + \eta_t, \quad (*)$$

FIGURE 3: EFFECTS OF FORWARD GUIDANCE IN A MONETARY POLICY VAR



Notes: Structural VAR impulse response functions to a 25bp forward guidance shock, identified using high-frequency interest rate changes around FOMC announcements only (left column) or around FOMC announcements, Fed Chair speeches, post-FOMC press conferences, FOMC minutes releases, and Vice Chair speeches (right column). Sample: 1973:1–2020:2. First-stage F -statistic is 1.8 in the left column and 26.7 in the right column. Shaded regions report weak-instrument-robust 90% confidence intervals (Montiel Olea, Stock, and Watson, 2021) in the left column, and bootstrapped 90% standard-error bands (Gertler and Karadi, 2015) in the right column. See text for details.

where $C(L)$ has the same number of lags as $\tilde{B}(L)$. Note that the first-stage F -statistic is not the exclusion F -

of Montiel Olea, Stock, and Watson (2021). Note that these confidence intervals are very wide, because the instrument is so weak that very little can be said about the IRFs with 90% confidence.

Lakdawala (2019) and Miranda-Agrippino and Ricco (2023) do not consider the issue of weak instruments and report standard strong-instrument confidence bands, but our point estimates in the first column of Figure 3 are comparable to and generally consistent with theirs. For example, in response to a 25bp monetary policy tightening, there is a puzzling and strong positive response of output, which is clearly not statistically significant according to our estimates in Figure 3. The response of the CPI is also somewhat unusual, with a fairly large negative effect on impact. Consistent with the instrument being weak, Miranda-Agrippino and Ricco (2023) report problems with the robustness of their forward guidance estimates.

In the second column of Figure 3, we repeat the analysis using the forward guidance component of all of our monetary policy announcements (FOMC announcements, Fed Chair speeches, press conferences, etc.) to construct z_t^{fg} . In this case, the first-stage F -statistic is dramatically higher: 26.7, well above the weak instruments threshold. Given the strength of the instrument, we follow Gertler and Karadi (2015) and Bauer and Swanson, (2023b) and report standard bootstrapped 90% standard-error bands around the estimated impulse response functions using 10,000 bootstrap simulations.

According to our estimates, a surprise forward guidance tightening that raises the 2-year Treasury yield 25bp on impact decays back to baseline over the next 4 years. In response, the GZ credit spread rises about 5bp over the next few months before returning to baseline after about 10 months. Commodity prices fall about 0.4 percent on impact and decline further before gradually returning to baseline over the next 4 years. These responses are all statistically significant. Output declines about 0.2 percent over the next eight months in response to the shock and declines a bit further over the next two years before gradually returning to baseline. The total CPI responds very sluggishly to the shock, with no significant decline for at least 3–4 years. Overall, these impulse responses are much more precisely estimated than in the first column and do not display any “puzzles” with respect to the theory.

Overall, our estimates in the second column of Figure 3 are much more precise and more reliable than those in the first column. A natural next step in this analysis would be to compare the effects of forward guidance to those of changes in the federal funds rate and/or long-term

statistic for the regression (*), because that would typically be a large number even if the instrument z_t^{fg} had zero relevance.

bond purchases, but that is beyond the scope of the present paper and is considered in Swanson (2024).

7. Conclusions

Previous studies of the effects of monetary policy using high-frequency interest rate changes have focused almost exclusively on FOMC announcements. However, there are only eight scheduled FOMC announcements per year, with a typical change in short-term interest rates around each announcement of just a few basis points. In this paper, we greatly expand the set of monetary policy announcement surprises to include interest rate changes around all FOMC announcements, post-FOMC press conferences, speeches and Congressional testimony by the Fed Chair and Federal Reserve Board Vice Chair, and FOMC meeting minutes releases from 1988 to 2023. This sample also extends farther back and farther forward in time than previous studies.

Our expanded set of monetary policy announcements leads to several important conclusions. First, previous studies using high-frequency interest rate changes around FOMC announcements have missed the most important source of variation in U.S. monetary policy: communication by the Fed Chair, including speeches, Congressional testimony, and press conferences. We find that for stock prices, Treasury yields, and longer-horizon interest rate futures, communication by the Fed Chair moves markets more each month. Only for the very shortest-maturity interest rates are FOMC announcements more important. However, very short-term interest rates have become gradually less important over time for the conduct of monetary policy as the Fed has increasingly turned to forward guidance and large-scale asset purchases to influence medium- and longer-term interest rates.

Second, we show that post-FOMC press conferences have gradually become much more important over time, and now rival FOMC announcements and Fed Chair speeches as a source of variation in U.S. monetary policy. FOMC minutes releases and speeches by the Fed Vice Chair were less important over our sample, but are still non-negligible, especially around recessions.

Third, we decompose each monetary policy announcement in our sample into federal funds rate, forward guidance, and LSAP components. The federal funds rate is only changed when there is an accompanying FOMC announcement, but we show that forward guidance and LSAPs both have effects that are consistent across monetary policy announcement types and can be pooled together into single measures of forward guidance and LSAPs. Our results thus suggest that

researchers who want to study the effects of forward guidance or LSAPs would benefit greatly from considering all five types of monetary policy announcements considered here.

Fourth, we demonstrate some of the benefits of our expanded set of monetary policy announcements in a monetary policy VAR. A few previous authors have attempted to estimate the effects of forward guidance on the economy in a VAR using FOMC announcements alone, and have had problems with weak instruments, a lack of robustness, and puzzling impulse response functions. In contrast, our instrument for forward guidance—using all of our monetary policy announcements—has a dramatically higher first-stage F -statistic and produces much more precise and less puzzling results.

Going forward, empirical research using high-frequency monetary policy surprises should strive to include all five types of monetary policy announcements above, instead of focusing on FOMC announcements alone. Bauer and Swanson (2023b), Graves, Huckfeldt, and Swanson (2024), and Swanson (2024) all use data from the present paper to help estimate the effects of monetary policy on the economy and obtained substantially more precise and less biased estimates by doing so. We believe these improvements are representative of gains that any empirical analysis of the effects of monetary policy on macroeconomic variables using high-frequency data could realize from making use of our extended high-frequency data set.

An open question for future research is the importance of other FOMC members' speeches for financial markets. Our results for the Federal Reserve Board Vice Chair suggest that other FOMC members' speeches are likely to be much less important than those of the Fed Chair, but the New York Fed President is a potential exception. As discussed above, the New York Fed President is the Vice Chair of the FOMC, votes at every FOMC meeting, and is generally more well informed than other FOMC members about financial market conditions on Wall Street. We did not consider speeches by the New York Fed President in our analysis here due to difficulties obtaining the dates and times of those speeches, but we view this as an interesting and important question for future research.

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