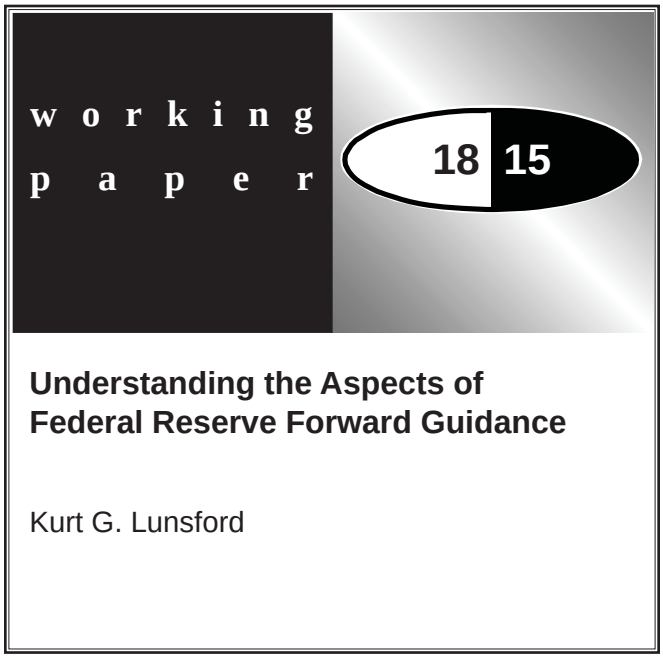

Understanding the Aspects of Federal Reserve Forward Guidance

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This paper studies the effects of Federal Open Market Committee (FOMC) forward guidance language. I estimate two policy surprises at FOMC meetings: a change in the current federal funds rate and an orthogonal change in the expected path of the federal funds rate. From February 2000 to June 2003, the FOMC only gave forward guidance about risks to the economic outlook, and a surprise increase in the expected federal funds rate path had expansionary effects. This is consistent with models of central bank information effects, where a positive economic outlook causes private agents to revise up their expectations for the economy. From August 2003 to May 2006, the FOMC also gave forward guidance about policy inclinations, and a surprise increase in the federal funds rate path had contractionary effects. These results are consistent with standard macroeconomic models of forward guidance. Overall, the effects of forward guidance depend on the FOMC's choice to use one or both of the economic-outlook and policy-inclination aspects of forward guidance.

Keywords: Central Bank Communication, Event Study, Federal Funds Futures, Information Effects, Monetary Policy.

JEL Codes: E43, E44, E52, E58, G14.

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1 Introduction

Central banks have increasingly used forward guidance – communication about the likely future course of interest rates and economic conditions – as a policy tool. Given its prominence, it is important to understand the effects of forward guidance.

Standard macroeconomic theory, where price stickiness is the primary economic friction, suggests that forward guidance influences current economic conditions by managing the expectations of private agents. Eggertsson and Woodford (2003) show that the entire path of expected future interest rates influences current economic activity and that lowering this path is expansionary. In this spirit, many researchers model forward guidance as future shifts in the central bank's policy rule that are announced in the present.[1] However, motivated by Romer and Romer's (2000) finding that the Federal Reserve has better inflation forecasts than private forecasters, an alternative theoretical literature treats information asymmetry as an important economic friction. In this literature, central bank policy has information effects that reveal information to private agents or coordinate dispersed information. In contrast to standard theory, Nakamura and Steinsson (2018) argue that a lower interest rate path causes lower expectations for output growth and produces a contraction.[2] They also note that central bank communication of lower future interest rates may be counterproductive at the zero lower bound (ZLB) on interest rates.

This paper provides empirical evidence to assess these theories of forward guidance. It uses an event-study approach to estimate the effects of Federal Open Market Committee (FOMC) statements from February 2000 to May 2006. I focus on this sample because it contains two relevant aspects of forward guidance language. From February 2000 to June 2003, FOMC statements included language about the "risks of heightened inflation pressures or economic weakness in the foreseeable future." Notably, these statements had *no* direct language about future policy inclinations. However, on August 12, 2003, the FOMC stated, "policy accommodation can be maintained for a considerable period." This marked a change in FOMC statements to include direct language about future policy inclinations, and this

[1] Krugman (1998) is a seminal paper in this literature. More recent papers in this literature are Levin et al. (2010), Laséen and Svensson (2011), Werning (2011), Campbell et al. (2012), Milani and Treadwell (2012), Carlstrom, Fuerst, and Paustian (2015), Del Negro, Giannoni, and Patterson (2015), Bundick and Smith (2016), Campbell et al. (2016), and McKay, Nakamura, and Steinsson (2016).

[2] Ellingsen and Söderström (2001), Frankel and Katrik (2015), Tang (2015), Gaballo (2016), Melosi (2017), Andrade et al. (2018), Jarociński and Karadi (2018), and Jia (2018) also provide models where central bank policy reveals private information or coordinates dispersed information.

direct language persisted until May 2006.

The premise of this paper is that FOMC forward guidance from February 2000 to June 2003 only had an "economic-outlook" aspect because the FOMC's forward-looking language was *only* about risks to the economic outlook. Thus, it was possible for forward guidance to have information effects. However, it could not shift expectations about future interest rates independently from the economic outlook as often modeled in standard macroeconomic theory. In contrast, forward guidance from August 2003 to May 2006 also included a "policy-inclination" aspect, allowing the FOMC to influence interest rate expectations independently from the outlook.[3] Hence, I use the February 2000 to June 2003 sample to study the FOMC's information effects and the August 2003 to May 2006 sample to study the importance of information effects relative to the standard theoretical effects of forward guidance.

The paper proceeds as follows. I begin by providing two forms of evidence that the August 2003 language change was a meaningful change in policy. First, in Section 2, I provide narrative evidence that the FOMC intended to communicate a break from prior policy in August 2003. Further, the FOMC's policy-inclination forward guidance was intended to lower expectations of future interest rates in the spirit of Eggertsson and Woodford (2003). Second, in Section 3, I describe the federal funds rate surprises that will be used in the event-study. They are changes in implied interest rates from federal funds futures contracts in narrow windows around FOMC meeting statements. I then provide empirical evidence that the magnitude of current federal funds rate surprises fell dramatically beginning in August 2003. This fall is a break in the data that is consistent with the FOMC beginning to communicate its policy inclinations. While Section 3 follows in the spirit of Swanson (2006) and Swanson and Williams (2014), the result showing a structural break in federal funds rate surprises in August 2003 is novel.

Section 4 provides the econometric model used to study the August 2003 policy change. The model is an event-study regression that uses the federal funds rate surprises from Section 3 to measure two policy surprises. The first policy surprise is a change in the current federal funds rate. The second is an orthogonal change in the expected path of the federal funds rate, which I use as the forward guidance surprise. To estimate the economic effects of forward guidance surprises, I regress changes in financial variables during FOMC meeting days and changes in Blue Chip consensus forecasts during FOMC meeting months on the

[3] I take the "economic-outlook" and "policy-inclination" terminology from Kohn and Sack (2003).

current federal funds rate surprise and the orthogonal surprise in the funds rate path.

Section 5 presents the main results of the paper. From February 2000 to June 2003, a surprise increase in the orthogonal path of the federal funds rate had expansionary effects. It caused increases in stock prices, Treasury yields, corporate bond yields, mortgage-backed securities (MBS) yields, and expected GDP growth while also causing decreases in term premia. The FOMC only used the economic-outlook aspect of forward guidance in this sample. Hence, these results support theoretical models of forward guidance that have information effects. This is because the FOMC's communication of its economic outlook caused private agents to revise their own expectations for the economic outlook and corresponding interest rates in the same direction.

From August 2003 to May 2006, a surprise increase in the orthogonal path of the federal funds rate had contractionary effects. It caused increases in Treasury yields, corporate bond yields, and MBS yields, but decreases in stock prices and increases in term premia, credit spreads, and the VIX. The FOMC was using both the economic-outlook and policy-inclination aspects of forward guidance in this sample. Hence, these results suggest that the standard theoretical effects of forward guidance coming from the policy-inclination aspect of forward guidance were more important than information effects coming from the economic-outlook aspect from August 2003 to May 2006.

Finally, Section 6 concludes.

This paper shows that market participants and private forecasters react differently to different aspects of forward guidance. Two implications for monetary policy follow. First, direct communication about policy inclinations can push the expected path of policy down while generating expansionary economic conditions as suggested by standard theory. This shows that FOMC statements about future policy are credible and suggests that forward guidance can help manage ZLB episodes. Second, language about the economic outlook reveals Federal Reserve information and may offset some effects of interest rate changes or policy-inclination language. While the standard theoretical effects of forward guidance dominated from August 2003 to May 2006, this might not always be the case.

This paper also addresses some puzzling results in the event-study literature. Similar to Gürkaynak, Sack, and Swanson (2005), I find that the orthogonalized path of the federal funds rate does not have a statistically significant effect on stock prices over the whole February 2000 to May 2006 sample. However, when I split the samples into February 2000

to June 2003 and August 2003 to May 2006 based on FOMC language, I find that the path of the funds rate has significant effects on stock prices that flip signs. In addition, similar to Campbell et al. (2012), Campbell et al. (2016), and Nakamura and Steinsson (2018), I find that an increase in the path of the funds rate increases private forecasts of inflation and GDP growth with decreases in forecasted unemployment rates in the February 2000 to May 2006 sample. Campbell et al. (2016) name these results the "event-study activity puzzle." In this paper, these results are driven entirely by the February 2000 to June 2003 sample when the FOMC only used economic-outlook forward guidance. I find no such puzzle from August 2003 to May 2006 when the FOMC also used policy-inclination forward guidance.

This paper joins the literature on central bank communication. Blinder et al. (2008) provide a broad survey, and Rudebusch and Williams (2008) discuss FOMC language from 1999 to 2006. More specifically, I contribute to the event-study literature focused on FOMC communication, which includes Kohn and Sack (2003), Bernanke, Reinhart, and Sack (2004), Gürkaynak, Sack, and Swanson (2005), Campbell et al. (2012), Del Negro, Giannoni, and Patterson (2015), Gilchrist, López-Salido, and Zakrajšek (2015), Hanson and Stein (2015), Sinha (2015), Campbell et al. (2016), Hattori, Schrimpf, and Sushko (2016), Bundick, Herriford, and Smith (2017), Swanson (2017), Lakdawala and Schaffer (2018), and Nakamura and Steinsson (2018).[4] In particular, I study Kohn and Sack's (2003) "economic-outlook" and "policy-inclination" aspects of forward guidance. Campbell et al. (2012) and Campbell et al. (2016) make a similar distinction between "Delphic" and "Odyssean" forward guidance: Delphic forward guidance forecasts economic performance and associated monetary policy actions and Odyssean forward guidance publicly commits the FOMC to a future policy action.[5] Distinct from all of the above papers, this paper's contribution is to use the FOMC's August 2003 language change to assess the different theories of forward guidance.

This paper also relates to the literature on textual analysis of FOMC statements. Lucca and Trebbi (2009) and Rosa (2011) classify the semantic orientation or tone of FOMC statements, which indicates whether the federal funds rate will increase or decrease in the future.

[4] Gertler and Karadi (2015), Bundick and Smith (2016), Miranda-Agrippino (2016), D'Amico and King (2017), Lakdawala (2017), and Jarociński and Karadi (2018) are part of a related literature that uses structural vector autoregressions. Rosa and Verga (2008) and Andrade and Ferroni (2016) study European monetary policy communication.

[5] I use Kohn and Sack's (2003) terminology because the forward guidance in my sample does not have the strong commitment characteristic that defines Odyssean forward guidance. In particular, the minutes of the August 12, 2003 FOMC meeting note that the FOMC "could not commit itself to a particular policy course." See https://www.federalreserve.gov/fomc/minutes/20030812.htm.

However, they do not separately classify that language into economic-outlook and policy-orientation aspects as in this paper. Hansen and McMahon (2016) classify FOMC language into topics, but not into economic-outlook and policy-orientation topics.

2 Discussion of FOMC Statements

This section provides narrative support for the premise that FOMC forward guidance from February 2000 to June 2003 only had an economic-outlook aspect and could only have information effects. In contrast, forward guidance from August 2003 to May 2006 also included a policy-inclination aspect, allowing it to influence interest rate expectations independently from the outlook. First, I document that the FOMC statements from both February 2000 to June 2003 and from August 2003 to May 2006 contained forward-looking language. Second, I argue that the forward-looking language from February 2000 to June 2003 was only about the economic outlook and specifically avoided direct comments on policy inclinations. Third, I show that the forward-looking language changed in August 2003 to include the FOMC's policy inclinations. Further, FOMC minutes and transcripts from this period indicate that this was a material change in policy intended to employ the standard theory of forward guidance. Fourth, I discuss my decision to end the sample in May 2006.

Beginning with its February 2000 meeting, the FOMC provided forward guidance about economic risks. Importantly, those risks cover a time frame that extends *beyond* the next FOMC meeting. The FOMC announced this change in communication on January 19, 2000:[6]

> [T]he FOMC changed its language describing its assessment of future developments. This new language will describe the FOMC's consensus about the balance of risks to the attainment of its long-run goals of price stability and sustainable economic growth and will be used in the announcement made after each meeting. More specifically, the announcement will indicate how the Committee assesses the

[6] See https://www.federalreserve.gov/boarddocs/press/general/2000/20000119/default.htm for the press release. I do not discuss forward guidance language prior to the February 2000 FOMC meeting because the the Federal Reserve states that the FOMC "began using forward guidance in its postmeeting statements in the early 2000s." See https://www.federalreserve.gov/faqs/what-is-forward-guidance-how-is-it-used-in-the-federal-reserve-monetary-policy.htm. Consistent with this, Rudebusch and Williams (2008) note that the FOMC's policy tilt in its 1999 statements only applied to "the approximately six-week interval until the next meeting." Prior to 1999, they note that the FOMC's views on future policy were closely guarded and "only rarely discussed even internally."

> risks of heightened inflation pressures or economic weakness in the foreseeable future. This time frame in the new language is intended to cover an interval extending beyond the next FOMC meeting.

Notably, the FOMC only provided this guidance about economic conditions and not about policy inclinations. The minutes of the December 21, 1999 FOMC meeting highlight this avoidance of the policy-inclination aspect of forward guidance:[7]

> A few [FOMC] members wanted to retain the current focus on the possible future stance of policy ... The consensus opinion, however, was to replace the Committee's judgment about the likelihood of an increase or decrease in the intended federal funds rate with a description of the Committee's perception of the risks in the foreseeable future to the attainment of its long-run goals of price stability and sustainable economic growth.

Rudebusch and Williams (2008) note that, beginning in February 2000, "avoiding any references to future policy actions appeared important" and that "the taboo against any direct forward-looking signals about policy" was established. Following this, I view FOMC forward guidance in February 2000 as only containing an economic-outlook aspect. Hence, changes in private-sector federal funds rate expectations would have to be endogenous to the FOMC's outlook communication and based on its past reaction function. That is, the FOMC was not announcing shifts in its future policy rule as in, for example, the models of Campbell et al. (2012), Del Negro, Giannoni, and Patterson (2015), and Campbell et al. (2016).

The FOMC used economic-outlook forward guidance from February 2000 to May 2006. However, on August 12, 2003, the FOMC stated, "policy accommodation can be maintained for a considerable period." This was the first time in the sample that direct language about future policy inclinations appeared in a statement. Because of this, I use August 2003 as the first period that includes the policy-inclination aspect of forward guidance.[8]

An important issue with this August 2003 language change is that it may not have actually reflected a shift in policy. If market participants and private forecasters had been expecting a considerable period of economic weakness, then a considerable period of policy accommodation may have been consistent with the FOMC's past reaction function. However,

[7] See https://www.federalreserve.gov/fomc/minutes/19991221.htm.

[8] Table A.1 in Appendix A provides the forward-looking language for each FOMC statement from February 2000 to June 2006. Rudebusch and Williams (2008) provide a similar table.

the August 2003 FOMC meeting minutes suggest otherwise by noting, "the Committee would want to keep policy accommodative for a longer period than had been the practice in past periods of accelerating economic activity."[9] Hence, the FOMC specifically intended to communicate a break from past practice. Further, a longer period of policy accommodation despite accelerating economic activity follows the spirit of Eggertsson and Woodford (2003) and makes the August 2003 language change particularly appealing for studying standard theories of forward guidance.[10]

Further evidence of this break from prior practice and this link to the standard theory of forward guidance can be found in the transcript of the September 15, 2003 FOMC meeting, which was the meeting that immediately followed the August 2003 language change.[11] With regard to the August 2003 language change, Donald L. Kohn said, "To me the 'considerable period' sentence is a different matter. There we did make more of a semi-commitment about policy for some future period of time, . . . I thought it was, in effect, a kind of nontraditional policy." Ben S. Bernanke followed-up by saying, "The words 'considerable period' were part of a nonstandard monetary policy. When we get close to the zero bound, we run out of traditional tools, and the only way that we can influence interest rates is by manipulating expectations." Hence, the FOMC was deviating from its standard policy and specifically attempting to employ recommendations from standard macroeconomic theory.

Even though the "considerable period" language was introduced as a nonstandard policy to support the economy, the policy-inclination aspect of forward guidance was not removed immediately once the economy strengthened. Rather, it evolved over time. On January 28, 2004, the FOMC stated that it "can be patient in removing its policy accommodation." On May 4, 2004, it stated, "policy accommodation can be removed at a pace that is likely to be measured." On December 13, 2005 it stated, "some further measured policy firming is likely to be needed." On January 31, 2006, it stated, "some further policy firming may be needed." Finally, on May 5, 2006, it stated, "some further policy firming may yet be needed."

[9] See https://www.federalreserve.gov/fomc/minutes/20030812.htm.

[10] FOMC meeting minutes are released with several weeks' delay. Hence, the private sector may not have immediately understood the intent of the FOMC's language change in August 2003. However, Alan Greenspan's July 2003 testimony laid the groundwork for this language change by using the "considerable period" language. See https://www.federalreserve.gov/boarddocs/hh/2003/july/testimony.htm. Speeches by Ferguson (2003) and Bernanke (2003) in June and July 2003 also discussed how committing to low short-term interest rates could expand economic activity. Further, Bernanke (2003) specifically cited Eggertsson and Woodford (2003), indicating that standard macroeconomic theory was guiding the thinking of some FOMC participants.

[11] See https://www.federalreserve.gov/monetarypolicy/files/FOMC20030915meeting.pdf.

The May 2004 change is particularly important because it signaled that the FOMC would begin raising the federal funds rate and because the "measured" language persisted for a large part of my sample. However, this change in language did not reflect a reversion to pre-August 2003 monetary policy. In the transcript of the May 2004 FOMC meeting, Vincent R. Reinhart said that the new language emphasized that the FOMC was "entering a tightening phase but one that likely will not be as aggressive as in prior episodes."[12]

At the June 29, 2006 meeting, the FOMC stated, "[t]he extent and timing of any additional firming that may be needed . . . will depend on the evolution of the outlook for both inflation and economic growth." It is not clear whether I can interpret this language as being direct about future policy developments. On the one hand, the FOMC is direct about the upward direction of possible rate changes by noting additional firming. On the other hand, the FOMC is indirect by tying that firming to the evolution of the economy. Rudebusch and Williams (2008) similarly note that direct interest rate guidance was removed from this meeting's statement, and some participants at the June 2006 FOMC meeting indicated that scaling back direct interest rate guidance was their goal.[13] Because of this lack of clarity about how to categorize this language, I end the sample in May 2006.

While my sample period of February 2000 to May 2006 is motivated by the above changes in FOMC statement language, it has several additional appealing features. First, FOMC statements were short and simple relative to the ZLB period of December 2008 to November 2015 (Wynne, 2013; Hernández-Murillo and Shell, 2014), making forward guidance language easier to interpret. Second, summaries of economic projections, which may include FOMC participants' statements about the appropriate monetary policy path or "dot plots" of the appropriate path, were not being released with FOMC statements and do not need to be interpreted. Third, the FOMC was not also announcing large-scale asset purchases with their forward guidance. Hence, my sample has few confounding factors, allowing for clear interpretation of FOMC language. In addition, my sample has periods where the target federal funds rate was low and constant. Thus, it provides evidence on how private agents react to forward guidance with pegged interest rates and is suggestive about the effects of

[12] See https://www.federalreserve.gov/monetarypolicy/files/FOMC20040504meeting.pdf.

[13] For example, see the comments by Donald L. Kohn on page 98 and the comments by Kevin Warsh on page 127 of the June 2006 FOMC meeting transcript: https://www.federalreserve.gov/monetarypolicy/files/FOMC20060629meeting.pdf.

forward guidance at the ZLB.[14]

3 Policy Surprises, the Data, and a Structural Break

I use an event-study approach to estimate the effects of FOMC forward guidance. Before describing the econometric model in Section 4, I measure changes in the expected federal funds rate path after an FOMC statement is released. These changes will be inputs in the econometric model. In Subsection 3.1, I define these changes in expectations and briefly describe the federal funds futures data that I use to measure them. Then in Subsection 3.2, I show that the magnitude of the changes in the current federal funds rate fell beginning in August 2003. This fall is a break in the data that is consistent with the FOMC providing direct communication about its policy inclinations, and it provides empirical evidence of a policy change in August 2003 to support the narrative evidence provided in the previous section.

3.1 Policy Surprises and Data

I begin with some notation. An FOMC meeting statement is released at moment t, r_t is the federal funds rate that is set in that statement, and $\mathbb{E}_{t-\Delta}(r_t)$ is the expectation of r_t that is formed shortly before the statement release. Then, the current federal funds rate surprise is

$$x_t^0 = r_t - \mathbb{E}_{t-\Delta}(r_t). \tag{1}$$

Next, I measure how the current FOMC meeting statement changes expectations about the future path of interest rates. Let $\mathbb{E}_{t-\Delta}(r_{t+1})$ be the expectation of the federal funds rate that will be set at the next FOMC meeting, where the expectation is formed shortly before the current FOMC meeting statement is released. Also, let $\mathbb{E}_t(r_{t+1})$ be the expectation of the federal funds rate that will be set at the next FOMC meeting, where the expectation is

[14]Table A.1 in Appendix A provides the target federal funds rate for each FOMC meeting in the sample. From December 2001 to November 2002, the target funds rate was 1.75 percent. From November 2002 to June 2003, the target funds rate was 1.25 percent. From June 2003 to June 2004, the target funds rate was 1 percent.

formed once the current FOMC meeting statement is released. Then,

$$x_t^1 = \mathbb{E}_t(r_{t+1}) - \mathbb{E}_{t-\Delta}(r_{t+1}) \tag{2}$$

is the change in expectations for the next FOMC meeting's interest rate caused by the current FOMC statement. Similarly, the change in expectations for the nth subsequent FOMC meeting's interest rate caused by the current FOMC statement is

$$x_t^n = \mathbb{E}_t(r_{t+n}) - \mathbb{E}_{t-\Delta}(r_{t+n}). \tag{3}$$

To measure these changes in expectations, I use tick data from the 30-day Fed Funds Futures data from the CME Group's Time & Sales data set. From February 2000 to October 2003, I use "rth" or regular trading hours data from the trading floor. Beginning in December 2003, the "eth" or electronic trading hours data from the electronic trading platform become available, and I merge the price ticks for the "rth" and "eth" data sets. I measure x_t^0, x_t^1, x_t^2, and x_t^3 following the methods used in Kuttner (2001), Gürkaynak (2005), and Gürkaynak, Sack, and Swanson (2005); Appendix B has additional details.

The three meetings following the current meeting typically occur within five or six months, so that x_t^1, x_t^2, and x_t^3 represent changes in expected rates with horizons out to six months. I choose this time horizon because price updates in the data occur at a relatively high frequency up to about six months out.[15] Further, Gürkaynak, Sack, and Swanson (2007) show that federal funds futures forecast the future path of the funds rate better than other financial instruments out to six months. Finally, FOMC participants viewed the horizon of their forward guidance to be roughly six months.[16]

As in Gürkaynak, Sack, and Swanson (2005), Gilchrist, López-Salido, and Zakrajšek (2015), and Nakamura and Steinsson (2018), I use a 30-minute window around the release of FOMC statements to compute x_t^0, x_t^1, x_t^2, and x_t^3. I set t to be 20 minutes following the statement release, and $t - \Delta$ is 10 minutes before the release. Given this narrow window, I assume that these changes in expectations can be attributed entirely to the statement. Gürkaynak, Sack, and Swanson (2005) also suggest that this 30-minute window provides sufficient time for participants in the federal funds futures market to trade based on their

[15] Early in the sample, a few observations of x_t^3 are measured with the previous day's closing price.

[16] For example, see William Poole's comments on page 19 of the September 15, 2003 FOMC meeting transcript: https://www.federalreserve.gov/monetarypolicy/files/FOMC20030915meeting.pdf.

reading of the statement and that a one-hour window yields very similar policy surprises.[17]

Following the discussion in Section 2, the main sample period in this paper is scheduled FOMC meeting days from February 2000 to May 2006. I do not use days with intermeeting rate changes or announcements.[18] One reason for this is pragmatic. The test for structural change in the following subsection uses Greenbook data that are not available for intermeeting changes. A second reason is conceptual. Faust, Swanson, and Wright (2004) and Barakchian and Crowe (2013) note that intermeeting moves are likely to be associated with other macroeconomic news and may not reflect exogenous changes to policy. I note, however, that including the January 3, 2001 and April 18, 2001 statements does not meaningfully change the results presented in Section 5.

3.2 Empirical Evidence of a Structural Break

Before moving on to the main econometric model and main results of the paper, I provide empirical evidence that the FOMC's language change in August 2003 was a material change in policy. I follow in the spirit of Swanson (2006) by showing that the magnitude of the current federal funds rate surprises, x_t^0, fell dramatically beginning in August 2003.

Figure 1 shows x_t^0 for each scheduled FOMC meeting from February 1994 to May 2006.[19] The grey region in Figure 1 covers the February 2000 to May 2006 sample studied in this paper, and the vertical dashed line separates the June 2003 and August 2003 FOMC meetings. Figure 1 shows that current federal funds rate surprises were much smaller in magnitude beginning with the August 2003 meeting. The average absolute value of x_t^0 from August 2003 to May 2006 was 0.6 basis points. In contrast, it was 4.6 basis points from February 2000 to June 2003, which was essentially the same as from February 1994 to December 1999. This large drop in current federal funds surprises is evidence that the policy-inclination aspect of the FOMC's forward guidance kept market participants informed of the FOMC's

[17] Following Gürkaynak, Sack, and Swanson (2005), I use the most recent trade price if there is no federal funds future trade exactly 10 minutes before an FOMC statement release. If there is no trade exactly 20 minutes following a statement release, I use the next available trade price. When there are multiple trades in the same minute, I average the prices within that minute to smooth out noise. Times for the releases of FOMC statements are taken from the appendix of Lucca and Moench (2015).

[18] There are three intermeeting rate changes in my sample. One is September 17, 2001, which was a change in response to the September 11, 2001 terrorist attacks and has been customarily excluded by other studies. The other two are January 3, 2001 and April 18, 2001.

[19] I use 1994 as the beginning of this sample because the FOMC began releasing statements with each policy change in 1994. My CME group data only extend back to 1995. For 1994, I use the monetary policy surprises from the appendix of Gürkaynak, Sack, and Swanson (2005).

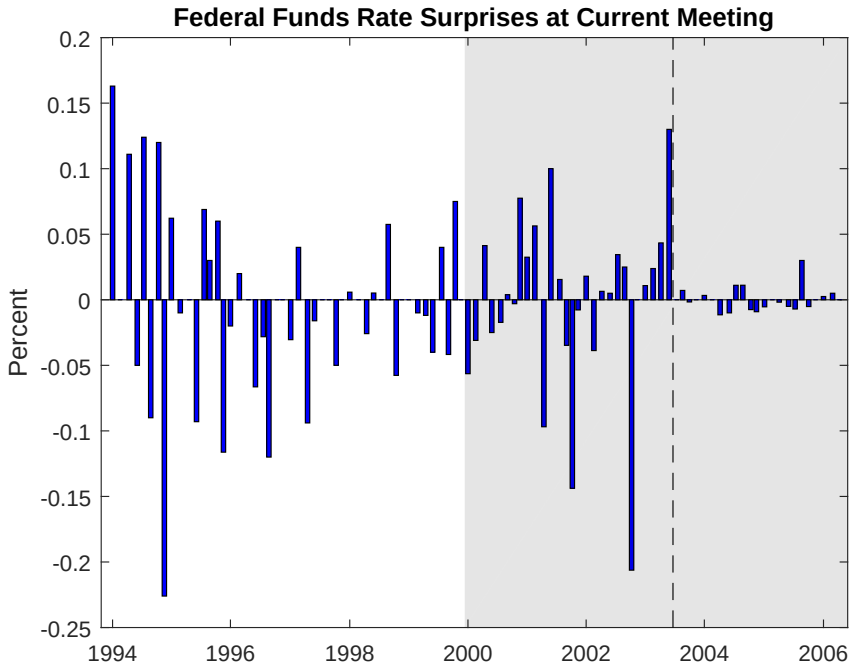

Figure 1: The value of x_t^0 at each scheduled FOMC meeting from February 1994 to May 2006. The shaded grey region covers the meetings with forward guidance that are studied in this paper. The dashed vertical line separates the June 2003 and August 2003 meetings.

actual policy inclinations. Further, no such drop occurred when the FOMC began using its economic-outlook forward guidance in February 2000, indicating that the policy-inclination aspect of forward guidance was fundamentally different than the economic-outlook aspect.

Of course, many factors other than FOMC communication may affect current federal funds rate surprises. To better isolate the effects of communication on x_t^0, I control for the following factors. First is the change in the target federal funds rate. Second, because recent changes in the federal funds rate may influence expectations for an upcoming change in the federal funds rate, I control for the change in the target funds rate from 90 days before an FOMC to the day before an FOMC meeting, which is similar in spirit to Swanson's (2006) "momentum" variable. The third factor is the state of the business cycle. The fourth factor is how much the state of the business cycle has changed from the previous FOMC meeting.[20]

[20]To measure the state of the business cycle, I use the target federal funds rate on the day before the FOMC meeting and the current quarter estimates of GDP growth, inflation measured with the GDP deflator, and the unemployment rate from the Greenbook of the corresponding FOMC meeting. To measure changes in the state, I use revisions to the current and previous quarter estimates of GDP growth and inflation measured with the GDP deflator from the Greenbook of the corresponding FOMC meeting. Greenbook data are from Yuriy Gorodnichenko's website, `https://eml.berkeley.edu/~ygorodni/`, for Coibion et al. (2017).

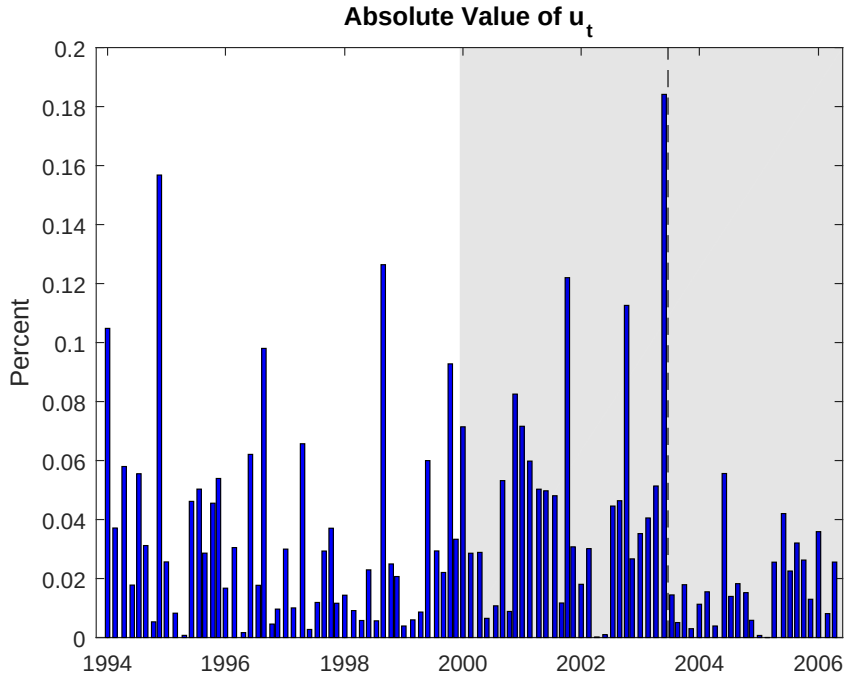

Figure 2: Estimates of $|u_t|$ for each scheduled FOMC meeting from February 1994 to May 2006. The shaded grey region covers the meetings with forward guidance that are studied in this paper. The dashed vertical line separates the June 2003 and August 2003 meetings.

To control for these factors and formally test for a structural break in x_t^0, I collect the relevant control variables into the vector w_t and estimate

$$x_t^0 = \delta_0 + w_t'\delta_1 + u_t. \tag{4}$$

I estimate Equation (4) from February 1994 to May 2006. I use data from before the main sample in the paper for two reasons. The first is to examine whether a break occurred when the FOMC announced its economic-outlook forward guidance at the beginning of 2000. The second is to provide for a sufficient number of observations given the 10 controls in Equation (4).

Figure 2 shows the absolute value of the regression errors from Equation (4). It shows that even after controlling for the above variables, current federal funds rate surprises were smaller beginning in August 2003. From February 1994 to June 2003, the average of $|\hat{u}_t|$ was 3.9 basis points. However, from August 2003 to May 2006, it was 1.8 basis points.

I test for a break in the absolute value of u_t as follows. For each period from January

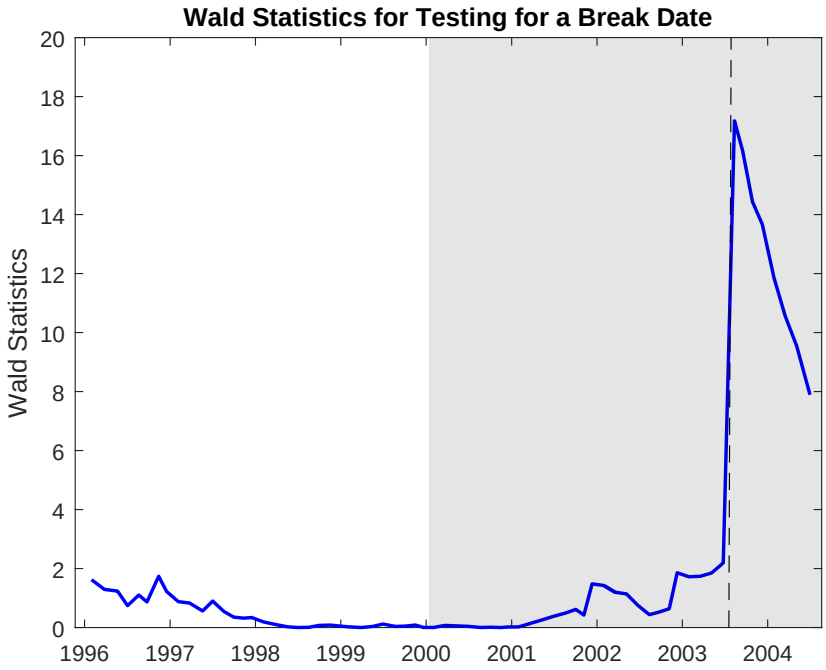

Figure 3: The Wald statistic for each scheduled FOMC meeting from January 1997 to June 2004. The shaded grey region covers the meetings with forward guidance that are studied in this paper. The dashed vertical line separates the June 2003 and August 2003 meetings.

1997 to June 2004, I estimate the average of $|\hat{u}_t|$ before that period and after that period. I then construct a Wald statistic to test the null hypothesis that the two averages are the same. Appendix C has additional details.

Figure 3 shows the sequence of Wald statistics, which has a sharp spike at August 2003. The sup-Wald statistic of 17.2 in August 2003 exceeds Andrews's (1993) 1 percent critical value, rejecting the null hypothesis of no break in the absolute value of u_t. That is, the fall in the average magnitude of current federal funds rate surprises in August 2003 is statistically significant, even if August 2003 is not treated as an *ex ante* break date. Hence, it is reasonable to treat the language change in August 2003 as a fundamental change in the FOMC's communication that kept market participants informed of the FOMC's actual policy inclinations.

The results here are similar to those in Swanson and Williams (2014). They found that 3-month Treasury yields and 1- to 2-quarters-ahead Eurodollar futures lost sensitivity to macroeconomic news, such as employment reports, during parts of 2002 to 2006. However, unlike the focus of this paper, they do not study the change in federal funds futures contracts

around FOMC announcements. Hence, the results presented in this section are novel. Further, they found that 3-month Treasury yields began to lose sensitivity to macroeconomic news as early as 2002. In contrast, the spike in Figure 3 shows that August 2003 was the clear break in the magnitude of current federal funds rate surprises at FOMC meetings.

4 The Econometric Model

This section provides the event-study econometric model. Following Gürkaynak, Sack, and Swanson (2005) and Gilchrist, López-Salido, and Zakrajšek (2015), I create two orthogonalized policy shocks. The first policy shock is simply the surprise in the current federal funds rate, x_t^0. The second policy shock is the forward guidance surprise. I estimate this shock in two steps. First, I use the simple average

$$x_t^{path} = \frac{1}{3}(x_t^1 + x_t^2 + x_t^3) \tag{5}$$

to measure the change in the expected path of the funds rate. Second, I regress this change in the expected federal funds rate path on the change in the current federal funds rate

$$x_t^{path} = \alpha_0 + \alpha_1 x_t^0 + m_t. \tag{6}$$

Here, m_t is the change in the expected path of the funds rate that cannot be predicted from and is orthogonal to the change in the current funds rate. I take m_t to represent the effects of forward guidance surprises on the path of the funds rate.

Given x_t^0 and estimates of m_t, my event-study estimates the effects of forward guidance surprises with

$$\Delta y_t = \beta_0 + \beta_1 x_t^0 + \gamma m_t + e_t, \tag{7}$$

where Δy_t is the change in the dependent variable of interest. Equations (6) and (7) compose the econometric model. Estimation and inference of this model uses generalized method of moments (Hansen, 1982). Five moments, $\mathbb{E}(m_t) = 0$, $\mathbb{E}(x_t^0 m_t) = 0$, $\mathbb{E}(e_t) = 0$, $\mathbb{E}(x_t^0 e_t) = 0$, and $\mathbb{E}(m_t e_t) = 0$, identify the five parameters of the model. Joint inference on Equations (6) and (7) accounts for m_t being a generated regressor, giving different standard errors than ordinary least squares but not different point estimates. Details are in Appendix D.

Given the change in FOMC communication in August 2003, I estimate (6) and (7) sepa-

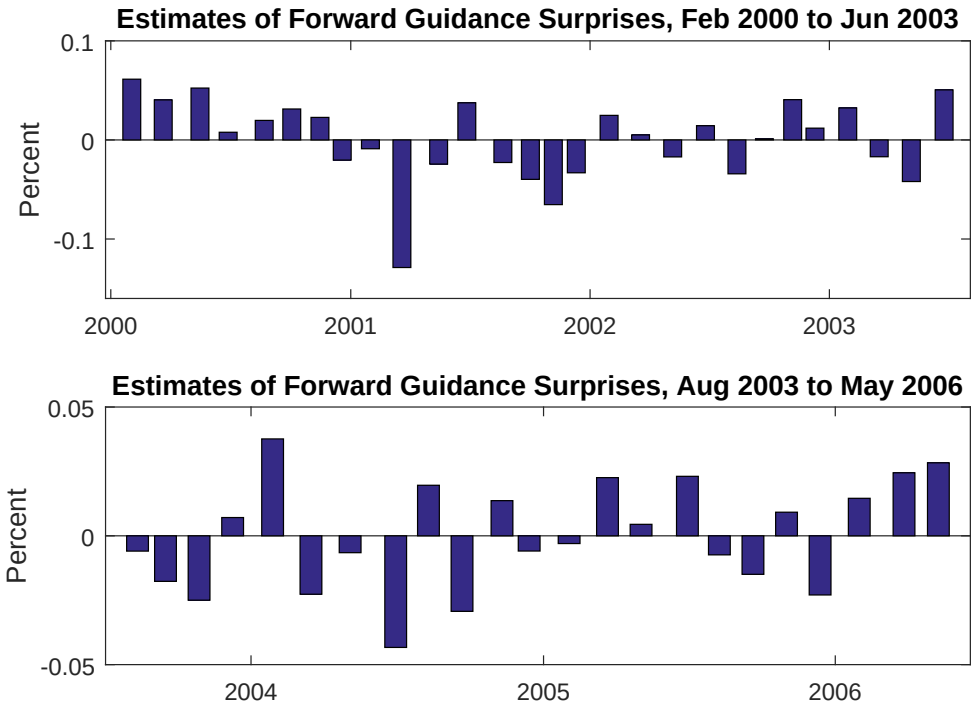

Figure 4: Estimates of m_t from Equation (6) estimated separately on the February 2000 to June 2003 and the August 2003 to May 2006 samples.

rately on the February 2000 to June 2003 sample and the August 2003 to May 2006 sample. The sample sizes are 28 and 23, respectively. Within each sample, estimates of m_t from Equation (6) are the same for every dependent variable Δy_t. Before presenting the estimates of Equation (7) in Section 5, I discuss these estimates of m_t and relate them to the FOMC's forward guidance language.[21] Readers who are interested only in the estimates of Equation (7) may jump directly to Section 5.

Before proceeding, I note that m_t is not a measure of the stance of forward guidance. Rather, it is a measure of market participants' surprise with forward guidance, and interpreting estimates of m_t may involve assessing market expectations immediately prior to the release of FOMC statements. With that said, the estimates of m_t generally correspond well to the FOMC's forward-looking language, providing reasonable measures of forward guidance surprises.

Figure 4 displays the estimates of m_t for the separate February 2000 to June 2003 and

[21] See Table A.1 in Appendix A for the FOMC's forward-looking language.

August 2003 to May 2006 samples. From February 2000 to June 2003, m_t is driven primarily by the economic outlook. For the first seven meetings of 2000, the FOMC stated that the economic outlook risks were weighted toward "heightened inflation." Given this, market participants naturally expected a higher path for the federal funds rate over and above what could be predicted from current funds rate changes, and m_t is positive for the first seven meetings of 2000. In December 2000, the FOMC switched the economic outlook risks to being weighted toward "weakness," and this assessment persisted through the January 2002 meeting. Correspondingly, estimates of m_t for these meetings are predominantly negative. The estimate at the March 2001 meeting is particularly large in magnitude. In that statement, the FOMC noted that excess productive capacity could continue for some time and that global economic weakness suggested substantial risks that demand and production could remain soft. The FOMC described the risks as "balanced" at the March, May, and June 2002 meetings, and m_t is small in magnitude for each of those meetings. At the August 2002 meeting, the FOMC switched back to describing the risks as weighted toward "weakness," giving a negative m_t. The remaining large values (in magnitude) of m_t for this early sample occur for the May and June 2003 meetings. At the May 2003 meeting, the FOMC stated that the balance of risks is "weighted toward weakness," with an emphasis on a potential fall in inflation, and m_t is negative. The FOMC used similar language in the June 2003 statement, yet m_t is positive. To understand this, *The Wall Street Journal* wrote that many market participants expected a 50 basis point cut in the funds rate, but the FOMC only delivered a 25 point cut (Ip, 2003). The federal funds futures market bears this out with a +13 basis point surprise in the current funds rate. Further, the FOMC "judged that a *slightly* more expansive monetary policy" [emphasis added] would support the economy. Together, the positive surprise in the current rate and the statement of only slightly more accommodative policy pulled up the funds rate path.

From August 2003 to May 2006, forward guidance surprises were generally smaller in magnitude than in the earlier sample. This is natural because the FOMC's policy-inclination forward guidance included words like "patient" and "measured" to describe potential policy changes. Hence, market participants did not expect large changes in the path of the funds rate, and the FOMC did not produce any.

Over this sample, forward guidance surprises respond to both economic-outlook and policy-inclination language. For the first four meetings of the sample, the FOMC stated that

"policy accommodation can be maintained for a considerable period," and m_t is negative for three of those four meetings. The exception is December 2003 when the FOMC stated that "[t]he probability of an unwelcome fall in inflation has diminished." In January 2004, the FOMC shifted its policy stance by stating that it "can be patient in removing its policy accommodation," producing a large value of m_t. The next big surprise occurred in June 2004 when the FOMC raised the funds rate by 25 basis points and kept its "measured" language despite recognizing "elevated" inflation data. This reduced expectations of future increases of 50 basis points, pushing m_t negative. In contrast, in the August 2004 statement the FOMC expected a "stronger pace of expansion" despite a recent weak employment report, pushing m_t positive. This was followed in September 2004 by a negative m_t when the FOMC noted that "inflation expectations have eased." The next big movements in March and June 2005 accompany statements that note upward pressure on inflation, yielding positive values of m_t. In December 2005, the FOMC changed its policy-inclination language to read "some further measured policy firming is likely to be needed." Markets took this as a sign that the tightening cycle was almost over (Ip, 2005), and m_t was negative. However, m_t was positive in January, March and May 2006 when the FOMC noted possible further policy firming, indicating that the tightening cycle was not over yet.

5 The Effects of Forward Guidance

This section presents the main results of the paper: empirical estimates of how financial markets and private forecasters reacted to forward guidance before and after the August 2003 language change. These results are from separate estimations of Equations (6) and (7) from February 2000 to June 2003 and from August 2003 to May 2006.[22] I also estimate these equations over the whole sample to provide results comparable to the previous literature that does not focus on subsamples. Subsection 5.1 presents the effects of forward guidance on the stock market. Subsection 5.2 gives the effects of forward guidance on Treasury yields and

[22]I note that estimating the model separately on the two subsamples does not separately identify the effects of the economic-outlook and policy-inclination aspects of forward guidance. Because the FOMC only used economic-outlook forward guidance from February 2000 to June 2003, the effects of this aspect are identified in this sample. However, the FOMC used both aspects of forward guidance from August 2003 to May 2006, so the model gives a combination of the economic-oulook and policy-inclination effects in this sample. In Appendix E, I discuss how separate identification of the effects may be achieved and the data limitation that prevents it.

Table 1: Responses of Stock Prices and Volatility to Funds Rate and Forward Guidance Changes

Dependent Variable	Feb 2000 to May 2006			Feb 2000 to Jun 2003			Aug 2003 to May 2006		
	Funds Rate	Forward Guid.	R^2	Funds Rate	Forward Guid.	R^2	Funds Rate	Forward Guid.	R^2
S&P 500	-7.88^{***}	4.08	0.18	-7.90^{***}	9.88^{**}	0.34	-8.08	-23.33^{***}	0.39
	(2.10)	(4.69)		(2.07)	(4.29)		(16.17)	(6.51)	
VIX	3.67^{**}	2.38	0.06	3.57^{**}	-2.22	0.09	9.53	20.78^{***}	0.30
	(1.70)	(4.55)		(1.72)	(3.99)		(14.75)	(5.87)	

Notes: The Funds Rate columns display the estimates of β_1 and the Forward Guidance columns display the estimates of γ from Equation (7). Standard errors are shown in parentheses. See the text and Appendix D for details about estimation and inference. The stars, *, **, and ***, denote statistical significance at the 10 percent, 5 percent and 1 percent levels, respectively.

term premia. Subsection 5.3 gives the effects of forward guidance on corporate bond rates and spreads as well as MBS rates and spreads. Finally, Subsection 5.4 shows the effects of forward guidance on Blue Chip forecasts.

5.1 The Stock Market

I first estimate the effects of current federal funds rate and forward guidance surprises on the stock market. While much of the related literature begins with the effects on Treasury yields, I begin with stock market results because they highlight the differences in the two subsamples most clearly. I present the effects of forward guidance on Treasury yields next.

I use 100 times the natural logarithm of the S&P 500 to measure equity prices in percent. I also use the VIX as a measure of expected stock market volatility.[23] Table 1 presents the estimates of β_1 and γ for stock prices and volatility. Standard errors are given in parentheses.

Across all samples, an increase in the current federal funds rate causes decreases in stock prices and increases in expected volatility. With regard to forward guidance for the whole sample, the effect on the stock market is smaller in magnitude than the effect of the current funds rate and is not statistically significant. Gürkaynak, Sack, and Swanson (2005) find a similar result, which they describe as "somewhat surprising." They hypothesize that it is driven by investors revising their assessments of expected output and inflation as in Romer and Romer (2000). My results show that this mechanism is indeed important. From February 2000 to June 2003, an increase in the orthogonalized funds rate path causes a large increase

[23]Daily S&P 500 prices are from the Wall Street Journal/Haver Analytics. The VIX is from the Federal Reserve Bank of St. Louis's FRED database with database code VIXCLS.

in stock prices, which is consistent with investors revising their expectations of output and inflation due to economic-outlook forward guidance. However, from August 2003 to May 2006, an increase in the orthogonalized funds rate path caused a large decrease in stock prices, which is consistent with investors revising their expectations for the future stance of monetary policy due to policy-inclination forward guidance. These results indicate that stock price reactions to forward guidance can change, driven by changes in FOMC language, and create somewhat surprising results in larger samples.[24]

Jarociński and Karadi (2018) also use differing responses of stock prices to separate information effects from traditional monetary policy shocks. While they do not focus explicitly on forward guidance, they measure surprises at FOMC meetings with the change in the 3-month federal funds futures contract, which accounts for near-term forward guidance. In a structural VAR, they find that an information shock that increases both interest rates and stock prices also causes an increase in GDP. In contrast, a standard monetary policy shock that increases interest rates while decreasing stock prices causes a decrease in GDP. When combined with the Jarociński and Karadi (2018) results, Table 1 suggests that an increase in the federal funds rate path from February 2000 to June 2003 is expansionary. In contrast, an increase in the federal funds rate path from August 2003 to May 2006 is contractionary. Indeed, this is consistent with the Blue Chip forecast results presented below.

Similar to the S&P 500, the VIX has different responses to forward guidance between the two samples. From February 2000 to June 2003, an increase in the orthogonalized funds rate path causes a decrease in the VIX, albeit small and not statistically significant. In contrast, from August 2003 to May 2006, an increase in the funds rate path causes a large increase in the VIX. Taken together, the responses of the S&P 500 and the VIX suggest that forward guidance that increases the funds rate path was expansionary from February 2000 to June 2003 and contractionary from August 2003 to May 2006.

[24] I test the differences between the February 2000 to June 2003 and the August 2003 to May 2006 samples in Appendix F. Following Gujarati (1970a,b), I use dummy variables to perform a Chow (1960) test. The dummy variable is 0 from February 2000 to June 2003 and 1 from August 2003 to May 2006. For both dependent variables in Table 1, the differences between the effects of forward guidance in the August 2003 to May 2006 and the February 2000 to June 2003 samples are statistically significant at the 1 percent level.

5.2 Treasury Yields

Next, I estimate the effects of current federal funds rate and forward guidance surprises on the Treasury yield curve. I use Gürkaynak, Sack, and Wright's (2007) continuously compounded zero-coupon yields as the measure of Treasury yields.[25] In addition, I use Adrian, Crump, and Moench's (2013b) decomposition of the yield curve into term premia and the expectations of the future path of short-term nominal rates.[26]

Table 2 presents the estimates of β_1 and γ for Treasury yields, term premia, and the expected path of short-term rates. All data are in percent so that a 1 percent change in the orthogonalized path of the funds rate causes a γ percent change in the dependent variable. Standard errors are given in parentheses. From February 2000 to June 2003, surprise changes in the current federal funds rate had an economically small and statistically insignificant effect on Treasury yields. However, forward guidance had a larger and statistically significant effect on 2-, 5-, and 7-year yields. From August 2003 to May 2006, changes in forward guidance had very large effects on the yield curve, and the current funds rate had some importance for shorter yields. These results suggest that using policy-inclination forward guidance in addition to economic-outlook forward guidance generates a larger response from the yield curve than using economic-outlook forward guidance alone.[27]

To gain further insight, I decompose the yield curve into term premia and the expectations of future short-term nominal rates. For the whole February 2000 to May 2006 sample, forward guidance has mostly small effects on term premia. However, as with the effects on stock prices, the whole sample hides important differences between the two subsamples. From February 2000 to June 2003, an increase in the orthogonalized funds rate path reduced term premia at longer horizons. In contrast, an increase in the orthogonalized funds rate path increased term premia at shorter horizons from August 2003 to May 2006. Adrian, Crump, and Moench (2013a) show that the 10-year term premium is countercyclical, and

[25] Data are from https://www.federalreserve.gov/pubs/feds/2006/200628/200628abs.html, collected on October 25, 2018.

[26] Term premia data are from https://www.newyorkfed.org/research/data_indicators/term_premia.html, collected on October 25, 2018. The expected future path of short-term yields is the Treasury yield at a given horizon less the corresponding term premium.

[27] Appendix F provides the tests of the differences between the February 2000 to June 2003 sample and the August 2003 to May 2006 sample. The differences between the effects of forward guidance on the expected path of short-term rates are statistically significant at the 10 percent level or lower for each horizon. For every other dependent variable in Table 2, the differences between the effects of forward guidance are statistically significant at the 5 percent level or lower.

Table 2: Responses of Treasury Yields and Term Premia to Funds Rate and Forward Guidance Changes

Dependent Variable	Feb 2000 to May 2006			Feb 2000 to Jun 2003			Aug 2003 to May 2006		
	Funds Rate	Forward Guid.	R^2	Funds Rate	Forward Guid.	R^2	Funds Rate	Forward Guid.	R^2
Treasury Yields:									
2-Year	0.26	1.23***	0.43	0.21	0.92***	0.37	3.15***	2.29***	0.68
	(0.23)	(0.25)		(0.24)	(0.21)		(1.10)	(0.42)	
5-Year	0.13	0.90***	0.30	0.10	0.61***	0.21	2.04**	2.05***	0.61
	(0.16)	(0.23)		(0.17)	(0.19)		(1.04)	(0.42)	
7-Year	0.11	0.70***	0.22	0.08	0.42**	0.12	1.43	1.83***	0.56
	(0.13)	(0.20)		(0.14)	(0.17)		(0.98)	(0.39)	
10-Year	0.10	0.48***	0.13	0.09	0.22	0.05	0.88	1.57***	0.49
	(0.11)	(0.18)		(0.12)	(0.16)		(0.91)	(0.37)	
Term Premia:									
2-Year	-0.08	0.11	0.05	-0.09	-0.02	0.05	0.55	0.74***	0.40
	(0.07)	(0.10)		(0.07)	(0.09)		(0.44)	(0.20)	
5-Year	-0.11	-0.15	0.06	-0.10	−0.27**	0.16	-0.51	0.48**	0.18
	(0.10)	(0.09)		(0.10)	(0.11)		(0.50)	(0.23)	
7-Year	-0.09	−0.26**	0.09	-0.08	−0.37***	0.20	-0.89	0.38	0.14
	(0.13)	(0.10)		(0.13)	(0.14)		(0.57)	(0.26)	
10-Year	-0.07	−0.34***	0.10	-0.05	−0.47***	0.21	−1.15*	0.32	0.13
	(0.16)	(0.12)		(0.16)	(0.16)		(0.65)	(0.30)	
Expected Path of Short-Term Rates:									
2-Year	0.34*	1.12***	0.61	0.30	0.95***	0.62	2.60***	1.56***	0.67
	(0.19)	(0.18)		(0.20)	(0.17)		(0.80)	(0.28)	
5-Year	0.23	1.05***	0.54	0.20	0.88***	0.53	2.56***	1.56***	0.65
	(0.19)	(0.18)		(0.20)	(0.17)		(0.79)	(0.31)	
7-Year	0.20	0.96***	0.53	0.16	0.80***	0.51	2.32***	1.45***	0.65
	(0.17)	(0.17)		(0.19)	(0.16)		(0.73)	(0.28)	
10-Year	0.17	0.82***	0.51	0.14	0.69***	0.50	2.03***	1.25***	0.64
	(0.16)	(0.15)		(0.17)	(0.14)		(0.62)	(0.26)	

See notes to Table 1.

the term premia at other horizons are highly correlated. Thus, these term premia results provide additional evidence that a surprise increase in the funds rate path was expansionary from February 2000 to June 2003 but contractionary from August 2003 to May 2006.

After removing the term premia to get the expectations of future short-term nominal rates, the effects of forward guidance become more similar across the subsamples. However, the yield curve still responded between 60 to 70 basis points more to forward guidance from August 2003 to May 2006 than from February 2000 to June 2003. For the February 2000 to June 2003 sample, I note that forward guidance has more persistent effects on the expected path of short-term Treasury yields than one might expect from looking at the Treasury yield results alone. This is because the effects of forward guidance on term premia are negative in this sample, hiding the expectation effects of forward guidance.

5.3 Corporate Bonds and Mortgage-Backed Securities

I next estimate the effects of federal funds rate and forward guidance surprises on private-sector borrowing costs. Using data from Gilchrist, López-Salido, and Zakrajšek (2015), I study the responses of corporate bond yields, MBS rates, and corporate bond and mortgage spreads.[28] As noted in Gilchrist, López-Salido, and Zakrajšek (2015), corporate bonds are often callable prior to maturity, and policy changes can affect the value of the call option. To abstract from this call option, I use their option-adjusted corporate bond yields based on the Bloomberg Fair Value model. I use yields for A- and BBB-rated firms for maturities of 3 and 10 years. I construct spreads by subtracting the A yields from the BBB yields of comparable maturity. For mortgage rates, I use Gilchrist, López-Salido, and Zakrajšek's (2015) yield on the 30-year current coupon agency MBS. I also use their option-adjusted spread (OAS) on the 30-year agency MBS. This spread is relative to the yield on comparable-duration Treasury securities and attempts to remove the option value of homeowners to prepay the mortgage in full. See Stroebel and Taylor (2012) for further discussion of these OASs.

Table 3 presents the estimates of β_1 and γ for private borrowing costs. All data are in percent so that a 1 percent change in the orthogonalized path of the funds rate causes a γ percent change in the dependent variable. Standard errors are given in parentheses. For the February 2000 to June 2003 sample, the response of three-year A-rated bonds to forward

[28]This data set is available from the American Economic Association at https://www.aeaweb.org/articles?id=10.1257/mac.20130324.

Table 3: Responses of Private-Sector Borrowing Costs to Funds Rate and Forward Guidance Changes

Dependent Variable	Feb 2000 to May 2006 Funds Rate	Feb 2000 to May 2006 Forward Guid.	Feb 2000 to May 2006 R^2	Feb 2000 to Jun 2003 Funds Rate	Feb 2000 to Jun 2003 Forward Guid.	Feb 2000 to Jun 2003 R^2	Aug 2003 to May 2006 Funds Rate	Aug 2003 to May 2006 Forward Guid.	Aug 2003 to May 2006 R^2
Corporate Bond Yields:									
A (3-Yr)	0.27	1.17***	0.40	0.23	0.91***	0.35	3.14***	1.98***	0.60
	(0.20)	(0.24)		(0.22)	(0.24)		(1.01)	(0.39)	
A (10-Yr)	0.19	0.70***	0.19	0.17	0.47**	0.14	1.41	1.44***	0.34
	(0.17)	(0.19)		(0.18)	(0.20)		(0.90)	(0.38)	
BBB (3-Yr)	0.34**	1.27***	0.45	0.30*	0.97***	0.47	2.35*	2.62***	0.61
	(0.17)	(0.24)		(0.18)	(0.17)		(1.42)	(0.55)	
BBB (10-Yr)	0.16	0.70***	0.17	0.15	0.42**	0.10	1.20	1.81***	0.38
	(0.16)	(0.22)		(0.17)	(0.21)		(1.13)	(0.48)	
Corporate Yield Spreads:									
BBB - A	0.07	0.10	0.03	0.08	0.05	0.04	-0.79	0.64**	0.31
(3-Yr)	(0.09)	(0.13)		(0.09)	(0.13)		(0.80)	(0.31)	
BBB - A	-0.02	0.01	0.00	-0.02	-0.06	0.01	-0.21	0.38**	0.24
(10-Yr)	(0.07)	(0.12)		(0.07)	(0.13)		(0.46)	(0.16)	
Mortgage-Backed Securities:									
MBS (30-Yr)	0.24*	0.85***	0.28	0.21	0.46***	0.22	1.53	2.16***	0.51
	(0.12)	(0.21)		(0.13)	(0.15)		(1.26)	(0.42)	
OAS	-0.03	0.12	0.04	-0.04	0.00	0.01	0.69**	0.54***	0.44
	(0.05)	(0.07)		(0.05)	(0.07)		(0.31)	(0.13)	

See notes to Table 1.

guidance is essentially the same as the response of two-year Treasuries, and the response of 10-year A-rated bonds to forward guidance is similar to the response of 7-year Treasuries.[29] As with Treasury yields, A-rated bonds are more responsive to forward guidance in the August 2003 to May 2006 sample than in the February 2000 to June 2003 sample.[30]

More important results for understanding the effects of forward guidance are the responses of BBB-rated bond yields and corporate yield spreads. In the February 2000 to June 2003 sample, BBB-rated bonds have essentially the same response as A-rated bonds to forward guidance, and the responses of corporate spreads are essentially zero. In contrast, BBB-rated bonds have a larger response to forward guidance than A-rated bonds in the August 2003 to May 2006 sample. The change in these spreads is economically large with a 1 percent increase in the orthogonalized funds rate path causing a 0.38 percent to 0.64 percent increase in spreads, depending on duration. This suggests that economic-outlook forward guidance has little effect on interest rate spreads. However, policy-inclination forward guidance that raises the path of the funds rate also increases interest rate spreads – a contractionary effect.

The MBS yields and spreads show a similar pattern of responses. From February 2000 to June 2003, forward guidance had essentially the same effect on 30-year MBS yields as on the 10-year A-rated corporate bond yield. In addition, the response of the OAS on the 30-year agency MBS to forward guidance was essentially zero. However, from August 2003 to May 2006, the response of MBS yields to forward guidance was much larger than in the February 2000 to June 2003 sample, and the OAS on the 30-year agency MBS had a positive and large response to orthogonalized increases in the funds rate path.

5.4 Blue Chip Forecasts

Lastly, I estimate the effects of federal funds rate and forward guidance surprises on Blue Chip forecasts of GDP growth, CPI inflation, and the unemployment rate. Specifically, the dependent variables are the changes in the consensus forecasts of a given quarter from the

[29] I compare responses of the 3-year and 10-year A-rated bonds to the responses of the 2-year and 7-year Treasuries because coupon-bearing corporate bonds have shorter durations than the zero-coupon Treasury yields discussed above. I am grateful to Eric Swanson for pointing this out.

[30] Appendix F provides the tests of the differences between the February 2000 to June 2003 sample and the August 2003 to May 2006 sample. For the three-year BBB - A spread, the difference between the effects of forward guidance in the August 2003 to May 2006 sample and the February 2000 to June 2003 sample is statistically significant at the 10 percent level. For every other dependent variable in Table 3, the differences are statistically significant at 5 percent levels or lower.

current month to the next month for every month with a scheduled FOMC meeting. At the beginning of the sample, the Blue Chip survey was conducted over three days, beginning on the first work day of each month. This was later shortened to two days. I remove observations where FOMC statements are released within these interview periods because I do not know if interview respondents observe the statement before responding.[31] This leaves 44 total observations with 25 observations from February 2000 to June 2003 and 19 observations from August 2003 to May 2006.

Table 4 presents the estimates of β_1 and γ for private forecasts. All data are in percent so that a 1 percent change in the orthogonalized path of the funds rate causes a γ percent change in the forecast. Standard errors are given in parentheses. Before discussing the results, I note that statistical significance in Table 4 is sporadic, which is distinct from the previous tables. This is natural as I observe changes in financial variables on FOMC meeting days, while I only observe changes in Blue Chip forecasts on FOMC meeting months. Hence, more macroeconomic events can influence the Blue Chip forecasts relative to the financial variables, leading to more noise and less statistical power. Campbell et al. (2016) have similarly sporadic statistical significance in their baseline regressions. However, with the understanding that the results in Table 4 are only suggestive, I still discuss the signs of the estimates in order to compare them to the previous literature and to my earlier results.

For the whole sample, an increase in the orthogonalized funds rate path causes increases in expected GDP growth and inflation and decreases in expected unemployment rates. The signs of these estimates are consistent with Campbell et al. (2012), Campbell et al. (2016), and Nakamura and Steinsson (2018) and suggest that forward guidance that increases the funds rate path is expansionary, not contractionary. Campbell et al. (2016) refer to these results as the "event-study activity puzzle." Campbell et al. (2012) and Campbell et al. (2016) explain these results similar to how Gürkaynak, Sack, and Swanson (2005) explain their surprising stock price results. They argue that Delphic forward guidance reveals the Federal Reserve's economic outlook and causes private forecasters to revise their own expectations. Based on Campbell et al.'s (2016) decomposition, the effects of this Delphic forward guidance appear to dominate the effects of Odyssean forward guidance, which publicly commits the FOMC to a future policy action. Nakamura and Steinsson (2018) have a similar story and provide a model where FOMC announcements affect expectations about both the

[31] Nakamura and Steinsson (2018) make a similar adjustment.

Table 4: Responses of Private Forecasts to Funds Rate and Forward Guidance Changes

Dependent Variable	Feb 2000 to May 2006 Funds Rate	Feb 2000 to May 2006 Forward Guid.	Feb 2000 to May 2006 R^2	Feb 2000 to Jun 2003 Funds Rate	Feb 2000 to Jun 2003 Forward Guid.	Feb 2000 to Jun 2003 R^2	Aug 2003 to May 2006 Funds Rate	Aug 2003 to May 2006 Forward Guid.	Aug 2003 to May 2006 R^2
GDP Growth:									
Current	-1.11	1.44	0.04	-1.01	1.59	0.05	-8.40^{*}	-0.93	0.07
Quarter	(1.20)	(1.32)		(1.18)	(1.66)		(4.53)	(2.20)	
Next	-0.27	1.79^{***}	0.12	-0.30	2.34^{***}	0.21	2.66	-1.40	0.08
Quarter	(0.41)	(0.57)		(0.39)	(0.60)		(5.08)	(1.26)	
2 Quarters	-0.15	0.81	0.07	-0.18	1.02^{*}	0.11	2.54	-0.66	0.09
Hence	(0.31)	(0.53)		(0.30)	(0.61)		(2.69)	(0.91)	
3 Quarters	0.28	0.73^{*}	0.11	0.25	0.92^{**}	0.17	2.82^{***}	-0.40	0.11
Hence	(0.24)	(0.38)		(0.25)	(0.42)		(0.95)	(0.83)	
CPI Inflation:									
Current	-0.29	3.30^{*}	0.12	-0.28	2.29	0.09	0.30	3.56	0.06
Quarter	(1.05)	(1.69)		(0.89)	(1.71)		(10.15)	(2.83)	
Next	-0.05	0.67	0.03	-0.02	0.53	0.04	-1.88	0.23	0.01
Quarter	(0.42)	(0.47)		(0.36)	(0.50)		(3.62)	(1.36)	
2 Quarters	0.05	0.02	0.00	0.09	0.26	0.02	-3.25^{***}	-0.46	0.21
Hence	(0.23)	(0.28)		(0.23)	(0.35)		(1.12)	(0.53)	
3 Quarters	-0.10	0.10	0.01	-0.08	0.23	0.02	-1.56	-0.96^{*}	0.18
Hence	(0.27)	(0.35)		(0.24)	(0.34)		(1.15)	(0.52)	
Unemployment Rate:									
Current	0.08	-0.37^{*}	0.04	0.04	-0.34	0.03	3.06^{***}	-0.61	0.34
Quarter	(0.13)	(0.20)		(0.12)	(0.25)		(0.99)	(0.44)	
Next	0.13	-0.49	0.04	0.14	-0.40	0.03	-0.77	0.13	0.02
Quarter	(0.26)	(0.34)		(0.24)	(0.43)		(1.07)	(0.57)	
2 Quarters	0.29	-0.40	0.05	0.28	-0.38	0.06	1.44	0.64	0.10
Hence	(0.32)	(0.25)		(0.26)	(0.26)		(0.88)	(0.63)	
3 Quarters	0.19	-0.78^{***}	0.12	0.19	-0.69^{***}	0.11	-0.45	0.12	0.01
Hence	(0.24)	(0.23)		(0.19)	(0.25)		(1.17)	(0.50)	

See notes to Table 1.

stance of policy and the economic outlook.

My results are consistent with these explanations. From February 2000 to June 2003, an increase in the orthogonalized funds rate path caused increases in expected GDP growth and inflation and decreases in expected unemployment rates. This suggests that the FOMC's economic-outlook forward guidance indeed causes private forecasters to revise their expectations in the same direction as the Federal Reserve's outlook. These results are also consistent with the results in Tables 1, 2, and 3, which show that forward guidance that increases the funds rate path is expansionary. Further, the sizes of the responses from February 2000 to June 2003 are similar to those in the whole February 2000 to May 2006 sample, suggesting that the February 2000 to June 2003 sample is dominating the results.

The results are quite different for the August 2003 to May 2006 sample. In this later sample, an increase in the orthogonalized funds rate path consistently causes decreases in expected GDP growth and generally causes increases in the unemployment rate. Results for CPI inflation are mixed. Campbell et al.'s (2016) event-study activity puzzle is not apparent from August 2003 to May 2006. Rather, the results for GDP growth suggest that an increase in the orthogonalized funds rate path is contractionary, which is consistent with the contractionary effects observed in Tables 1, 2, and 3. Taken together, these results indicate that policy-inclination forward guidance can have effects consistent with standard macroeconomic theory.

6 Conclusions

From February 2000 to June 2003, FOMC statements only included forward guidance about the economic outlook. In contrast, the statements from August 2003 to May 2006 also included forward guidance about the FOMC's policy inclinations. I use this language shift to empirically assess different theories of forward guidance. I estimate two policy surprises in narrow windows around each FOMC meeting. The first is a change in the current federal funds rate. The second is an orthogonal change in the path of the funds rate, which I use as the change in forward guidance. I find that a surprise increase in the orthogonalized funds rate path has expansionary effects in the February 2000 to June 2003 sample, causing a decrease in term premia, an increase in stock prices, and an increase in expected GDP growth. In contrast, from August 2003 to May 2006, I find that a surprise increase in

the orthogonalized funds rate path has contractionary effects, causing an increase in term premia, increases in credit spreads, a decrease in stock prices, and an increase in expected stock price volatility. Further, Campbell et al.'s (2016) event-study activity puzzle is not present in this later sample.

These results show that market participants and private forecasters react differently to different aspects of forward guidance. When the FOMC only uses the economic-outlook aspect, the effects of forward guidance are consistent with information effects: a positive economic outlook causes market participants to revise up their own expectations of the economy and has expansionary effects as interest rates rise. When the FOMC also uses the policy-inclination aspect, standard macroeconomic theory may apply: forward guidance that raises the funds rate path has contractionary effects. Overall, the effects of forward guidance depend on the FOMC's choice to use one or both of the economic-outlook and policy-inclination aspects of forward guidance.

While my sample period does not have a zero lower bound episode, it does have a period of low and mostly constant rates. Hence, these results shed light on how asset markets and private forecasters react to different aspects of forward guidance with pegged interest rates. Further, the results for the August 2003 to May 2006 sample show that the standard effects of forward guidance can apply to an interest rate peg and the subsequent lift-off, suggesting that forward guidance can be a useful tool for managing zero lower bound episodes.

Finally, the results of this paper are applicable to current policy discussions. The FOMC has continued to use forward-looking language about both the economic outlook and its policy inclinations. Further, the FOMC has begun releasing summaries of economic projections, which include FOMC participants' forecasts of macroeconomic variables as well as their views on the appropriate path of the federal funds rate, with its statements. While these projections provide a different means of communication than FOMC statement language, the theory underpinning their effects remains the same. Changes in FOMC forecasts of macroeconomic variables will operate through an information channel, causing interest rates, stock prices, and expected GDP growth to move in the same direction. In contrast, changes in projections of the appropriate federal funds rate path, the much watched "dots plots," can have effects more consistent with standard macroeconomic theory, causing interest rates to move in the opposite direction of stock prices without puzzling changes in inflation and GDP forecasts.

A Forward-Looking Language in FOMC Statements

Table A.1: Forward-Looking Language in FOMC Statements from Feb 2000 to Jun 2006

Date	Funds Rate	Forward-Looking Language
02-02-00	5.75	"The Committee remains concerned that over time increases in demand will continue to exceed the growth in potential supply, even after taking account of the pronounced rise in productivity growth. Such trends could foster inflationary imbalances ... [T]he risks are weighted mainly toward conditions that may generate heightened inflation pressures in the foreseeable future."
03-31-00	6.00	Similar to 02-02-00.
05-16-00	6.50	Similar to 02-02-00.
06-28-00	6.50	"[S]igns that growth in demand is moving to a sustainable pace are still tentative and preliminary, ... the risks continue to be weighted mainly toward conditions that may generate heightened inflation pressures in the foreseeable future."
08-22-00	6.50	Similar to 6-28-00.
10-03-00	6.50	"[T]he expansion of aggregate demand has moderated to a pace closer to the enhanced rate of growth of the economy's potential to produce. ... [T]he increase in energy prices ... poses a risk of raising inflation expectations. ... [T]he risks continue to be weighted mainly toward conditions that may generate heightened inflation pressures in the future."
11-15-00	6.50	Similar to 10-03-00.
12-19-00	6.50	"[E]conomic growth may be slowing further. While some inflation risks persist, they are diminished by the more moderate pace of economic activity and by the absence of any indication that longer-term inflation expectations have increased. ... [T]he risks are weighted mainly toward conditions that may generate economic weakness in the foreseeable future."
01-31-01	5.50	"The longer-term advances in technology and accompanying gains in productivity ... exhibit few signs of abating and these gains, along with the lower interest rates, should support growth of the economy over time. ... [T]the risks are weighted mainly toward conditions that may generate economic weakness in the foreseeable future."
03-20-01	5.00	"Although current developments do not appear to have materially diminished the prospects for long-term growth in productivity, excess productive capacity has emerged recently. The possibility that this excess could continue for some time and the potential for weakness in global economic conditions suggest substantial risks that demand and production could remain soft. ... [T]the risks are weighted mainly toward conditions that may generate economic weakness in the foreseeable future."

Table A.1 Continued

Date	Funds Rate	Forward-Looking Language
05-15-01	4.00	"[I]nflation is expected to remain contained. Although measured productivity growth stalled in the first quarter, the impressive underlying rate of increase that developed in recent years appears to be largely intact, supporting longer-term prospects. ... [T]he risks are weighted mainly toward conditions that may generate economic weakness in the foreseeable future."
06-27-01	3.75	Similar to 05-15-01.
08-21-01	3.50	Similar to 05-15-01.
10-02-01	2.50	"The terrorist attacks have significantly heightened uncertainty in an economy that was already weak. ... Nonetheless, the long-term prospects for productivity growth and the economy remain favorable and should become evident once the unusual forces restraining demand abate. ... [T]he risks are weighted mainly toward conditions that may generate economic weakness in the foreseeable future."
11-06-01	2.00	Similar to 10-02-01.
12-11-01	1.75	"Economic activity remains soft, with underlying inflation likely to edge lower from relatively modest levels. ... [W]eakness in demand shows signs of abating, but those signs are preliminary and tentative. ... [T]he risks are weighted mainly toward conditions that may generate economic weakness in the foreseeable future."
01-30-02	1.75	"With the forces restraining the economy starting to diminish, and with the long-term prospects for productivity growth remaining favorable and monetary policy accommodative, the outlook for economic recovery has become more promising. The degree of any strength in business capital and household spending, however, is still uncertain. Hence, ... the risks are weighted mainly toward conditions that may generate economic weakness in the foreseeable future."
03-19-02	1.75	"[T]he economy ... is expanding at a significant pace. Nonetheless, the degree of the strengthening in final demand over coming quarters ... is still uncertain. ... [F]or the foreseeable future ... the risks are balanced with respect to the prospects for both goals."
05-07-02	1.75	Similar to 03-19-02.
06-26-02	1.75	Similar to 03-19-02.
08-13-02	1.75	"The softening in the growth of aggregate demand that emerged this spring has been prolonged ... The current accommodative stance of monetary policy, coupled with still-robust underlying growth in productivity, should be sufficient to foster an improving business climate over time. Nonetheless, ... for the foreseeable future, ... the risks are weighted mainly toward conditions that may generate economic weakness."
09-24-02	1.75	Similar to 08-13-02.
11-06-02	1.25	"[A]n accommodative stance of monetary policy, coupled with still-robust underlying growth in productivity, is providing important ongoing support to economic activity. ... Inflation and inflation expectations remain well contained. ... [T]oday's additional monetary easing should prove helpful as the economy works its way through this current soft spot. With this action ... the risks are balanced with respect to the prospects for both goals in the foreseeable future."

Table A.1 Continued

Date	Funds Rate	Forward-Looking Language
12-10-02	1.25	Similar to 11-06-02.
01-29-03	1.25	Similar to 11-06-02.
03-18-03	1.25	"[T]he Committee does not believe it can usefully characterize the current balance of risks with respect to the prospects for its long-run goals of price stability and sustainable economic growth."
05-06-03	1.25	"[T]he ebbing of geopolitical tensions has rolled back oil prices, bolstered consumer confidence, and strengthened debt and equity markets. These developments, along with the accommodative stance of monetary policy and ongoing growth in productivity, should foster an improving economic climate over time. Although the timing and extent of that improvement remain uncertain, the Committee perceives that over the next few quarters the upside and downside risks to the attainment of sustainable growth are roughly equal. In contrast, over the same period, the probability of an unwelcome substantial fall in inflation, though minor, exceeds that of a pickup in inflation from its already low level. The Committee believes that, taken together, the balance of risks to achieving its goals is weighted toward weakness over the foreseeable future."
06-25-03	1.00	"[A]n accommodative stance of monetary policy, coupled with still robust underlying growth in productivity, is providing important ongoing support to economic activity. ... The economy, nonetheless, has yet to exhibit sustainable growth. With inflationary expectations subdued, the Committee judged that a slightly more expansive monetary policy would add further support for an economy which it expects to improve over time. The Committee perceives that the upside and downside risks to the attainment of sustainable growth for the next few quarters are roughly equal. In contrast, the probability, though minor, of an unwelcome substantial fall in inflation exceeds that of a pickup in inflation from its already low level. On balance, the Committee believes that the latter concern is likely to predominate for the foreseeable future."
08-12-03	1.00	"[A]n accommodative stance of monetary policy, coupled with still-robust underlying growth in productivity, is providing important ongoing support to economic activity. ... [T]he upside and downside risks to the attainment of sustainable growth for the next few quarters are roughly equal. In contrast, the probability, though minor, of an unwelcome fall in inflation exceeds that of a rise in inflation from its already low level. The Committee judges that, on balance, the risk of inflation becoming undesirably low is likely to be the predominant concern for the foreseeable future. In these circumstances, ... policy accommodation can be maintained for a considerable period."
09-16-03	1.00	Similar to 08-12-03.
10-28-03	1.00	Similar to 08-12-03.

Table A.1 Continued

Date	Funds Rate	Forward-Looking Language
12-09-03	1.00	"[A]n accommodative stance of monetary policy, coupled with robust underlying growth in productivity, is providing important ongoing support to economic activity. ... Increases in core consumer prices are muted and expected to remain low. ... [T]he upside and downside risks to the attainment of sustainable growth for the next few quarters are roughly equal. The probability of an unwelcome fall in inflation has diminished in recent months and now appears almost equal to that of a rise in inflation. However, with inflation quite low and resource use slack, ... policy accommodation can be maintained for a considerable period."
01-28-04	1.00	"[A]n accommodative stance of monetary policy, coupled with robust underlying growth in productivity, is providing important ongoing support to economic activity. ... Increases in core consumer prices are muted and expected to remain low. ... [T]he upside and downside risks to the attainment of sustainable growth for the next few quarters are roughly equal. The probability of an unwelcome fall in inflation has diminished in recent months and now appears almost equal to that of a rise in inflation. With inflation quite low and resource use slack, the Committee ... can be patient in removing its policy accommodation."
03-16-04	1.00	Similar to 01-28-04.
05-04-04	1.00	"[A]n accommodative stance of monetary policy, coupled with robust underlying growth in productivity, is providing important ongoing support to economic activity. ... [L]ong-term inflation expectations appear to have remained well contained. ... [T]he upside and downside risks to the attainment of sustainable growth for the next few quarters are roughly equal. Similarly, the risks to the goal of price stability have moved into balance. At this juncture, ... policy accommodation can be removed at a pace that is likely to be measured."
06-30-04	1.25	"[T]he stance of monetary policy remains accommodative and, coupled with robust underlying growth in productivity, is providing ongoing support to economic activity. ... [O]utput is continuing to expand at a solid pace ... Although incoming inflation data are somewhat elevated, a portion of the increase in recent months appears to have been due to transitory factors. ... [T]he upside and downside risks to the attainment of both sustainable growth and price stability for the next few quarters are roughly equal. With underlying inflation still expected to be relatively low, ... policy accommodation can be removed at a pace that is likely to be measured."
08-10-04	1.50	"[T]he stance of monetary policy remains accommodative and, coupled with robust underlying growth in productivity, is providing ongoing support to economic activity. ... The economy nevertheless appears poised to resume a stronger pace of expansion going forward. Inflation has been somewhat elevated this year, though a portion of the rise in prices seems to reflect transitory factors. ... [T]he upside and downside risks to the attainment of both sustainable growth and price stability for the next few quarters are roughly equal. With underlying inflation still expected to be relatively low, the Committee believes that policy accommodation can be removed at a pace that is likely to be measured."

Table A.1 Continued

Date	Funds Rate	Forward-Looking Language
09-21-04	1.75	"[T]he stance of monetary policy remains accommodative and, coupled with robust underlying growth in productivity, is providing ongoing support to economic activity. ... [O]utput growth appears to have regained some traction ... [I]nflation and inflation expectations have eased in recent months. ... [T]he upside and downside risks to the attainment of both sustainable growth and price stability for the next few quarters to be roughly equal. With underlying inflation expected to be relatively low, the Committee believes that policy accommodation can be removed at a pace that is likely to be measured."
11-10-04	2.00	Similar to 09-21-04.
12-14-04	2.25	Similar to 09-21-04.
02-02-05	2.50	Similar to 09-21-04.
03-22-05	2.75	"[T]he stance of monetary policy remains accommodative and, coupled with robust underlying growth in productivity, is providing ongoing support to economic activity. ... Though longer-term inflation expectations remain well contained, pressures on inflation have picked up in recent months and pricing power is more evident. ... [W]ith appropriate monetary policy action, the upside and downside risks to the attainment of both sustainable growth and price stability should be kept roughly equal. With underlying inflation expected to be contained, ... policy accommodation can be removed at a pace that is likely to be measured."
05-03-05	3.00	Similar to 03-22-05.
06-30-05	3.25	Similar to 03-22-05.
08-09-05	3.50	Similar to 03-22-05.
09-20-05	3.75	"Output appeared poised to continue growing at a good pace before the tragic toll of Hurricane Katrina. ... While these unfortunate developments have increased uncertainty about near-term economic performance, it is the Committee's view that they do not pose a more persistent threat. Rather, monetary policy accommodation, coupled with robust underlying growth in productivity, is providing ongoing support to economic activity. Higher energy and other costs have the potential to add to inflation pressures. However, ... longer-term inflation expectations remain contained. ... [W]ith appropriate monetary policy action, the upside and downside risks to the attainment of both sustainable growth and price stability should be kept roughly equal. With underlying inflation expected to be contained, ... policy accommodation can be removed at a pace that is likely to be measured."
11-01-05	4.00	"[M]onetary policy accommodation, coupled with robust underlying growth in productivity, is providing ongoing support to economic activity that will likely be augmented by planned rebuilding in the hurricane-affected areas. The cumulative rise in energy and other costs has the potential to add to inflation pressures; however, ... longer-term inflation expectations remain contained. ... [W]ith appropriate monetary policy action, the upside and downside risks to the attainment of both sustainable growth and price stability should be kept roughly equal. With underlying inflation expected to be contained, ... policy accommodation can be removed at a pace that is likely to be measured."

Table A.1 Continued

Date	Funds Rate	Forward-Looking Language
12-13-05	4.25	"[T]he expansion in economic activity appears solid ... and longer-term inflation expectations remain contained. Nevertheless, possible increases in resource utilization as well as elevated energy prices have the potential to add to inflation pressures. ... [S]ome further measured policy firming is likely to be needed to keep the risks to the attainment of both sustainable economic growth and price stability roughly in balance."
01-31-06	4.50	"[T]he expansion in economic activity appears solid ... and longer-term inflation expectations remain contained. Nevertheless, possible increases in resource utilization as well as elevated energy prices have the potential to add to inflation pressures. ... [S]ome further policy firming may be needed to keep the risks to the attainment of both sustainable economic growth and price stability roughly in balance.
03-28-06	4.75	Similar to 01-31-06.
05-10-06	5.00	"The Committee sees growth as likely to moderate to a more sustainable pace ... and inflation expectations remain contained. Still, possible increases in resource utilization, in combination with the elevated prices of energy and other commodities, have the potential to add to inflation pressures. ... The Committee judges that some further policy firming may yet be needed to address inflation risks but emphasizes that the extent and timing of any such firming will depend importantly on the evolution of the economic outlook as implied by incoming information."
06-29-06	5.25	"[E]conomic growth is moderating ... and inflation expectations remain contained. However, the high levels of resource utilization and of the prices of energy and other commodities have the potential to sustain inflation pressures. Although the moderation in the growth of aggregate demand should help to limit inflation pressures over time, ... some inflation risks remain. The extent and timing of any additional firming that may be needed to address these risks will depend on the evolution of the outlook for both inflation and economic growth, as implied by incoming information."

B Measuring Changes in Expectations with Federal Funds Futures

This appendix describes measuring the changes in federal funds rate expectations around FOMC meetings. Let $f^0_{t-\Delta}$ denote the implied funds rate of the current-month futures contract shortly before an FOMC statement release. Payouts in this market are based on the average effective federal funds rate in the calendar month of the contract. Thus,

$$f^0_{t-\Delta} = \frac{d_0}{D_0}\bar{r}_{t-1} + \frac{D_0 - d_0}{D_0}\mathbb{E}_{t-\Delta}(r_t) + \mu^0_{t-\Delta}, \tag{B.1}$$

where $\bar{r}_{t-1}$ is the average funds rate that has prevailed in the current month, $\mathbb{E}_{t-\Delta}(r_t)$ is the rate expected to prevail after the meeting, d_0 is the day in the month of the FOMC meeting, D_0 is the number of days in the month, and $\mu^0_{t-\Delta}$ is a term or risk premium. The FOMC statement gives the current federal funds rate, r_t, and I assume that market participants and private forecasters do not expect another funds rate change until the next scheduled meeting. Because there are never two scheduled meetings in the same month,

$$f^0_t = \frac{d_0}{D_0}\bar{r}_{t-1} + \frac{D_0 - d_0}{D_0}r_t + \mu^0_t \tag{B.2}$$

is the implied funds rate of the current-month contract immediately after the release of a statement. The current federal funds rate policy surprise is

$$x^0_t = r_t - \mathbb{E}_{t-\Delta}(r_t) = \frac{D_0}{D_0 - d_0}[(f^0_t - f^0_{t-\Delta}) - (\mu^0_t - \mu^0_{t-\Delta})].$$

Following the literature, I assume that the federal funds futures term premium does not respond to the FOMC statement, implying $\mu^0_t - \mu^0_{t-\Delta} = 0$ and

$$x^0_t = \frac{D_0}{D_0 - d_0}(f^0_t - f^0_{t-\Delta}). \tag{B.3}$$

To avoid amplifying noise in this measure, I follow Gürkaynak (2005) by using the next month's contract when $D_0/(D_0 - d_0)$ is greater than four. That is, I use $x^0_t = f^1_t - f^1_{t-\Delta}$ with no scaling factor. Kuttner (2001), Gürkaynak, Sack, and Swanson (2005), and Nakamura and Steinsson (2018) use similar approaches.

To measure the surprise in the expected path of the federal funds rate, I again follow Gürkaynak (2005) and Gürkaynak, Sack, and Swanson (2005). Define r_{t+1} to be the funds rate that is expected to prevail following the next scheduled FOMC meeting and $f^1_{t-\Delta}$ to be the average implied funds rate of the month in which that meeting is held. Then

$$f^1_{t-\Delta} = \frac{d_1}{D_1}\mathbb{E}_{t-\Delta}(r_t) + \frac{D_1 - d_1}{D_1}\mathbb{E}_{t-\Delta}(r_{t+1}) + \mu^1_{t-\Delta}, \tag{B.4}$$

where d_1 is the day in the month of the next FOMC meeting, D_1 is the number of days in that month, and $\mu^1_{t-\Delta}$ is the corresponding term premium. When r_t is announced,

$$f^1_t = \frac{d_1}{D_1}r_t + \frac{D_1 - d_1}{D_1}\mathbb{E}_t(r_{t+1}) + \mu^1_t. \tag{B.5}$$

Then, the expected rate change at the next FOMC meeting due to the current statement is

$$x^1_t = \mathbb{E}_t(r_{t+1}) - \mathbb{E}_{t-\Delta}(r_{t+1}) = \frac{D_1}{D_1 - d_1}\left[(f^1_t - f^1_{t-\Delta}) - \frac{d_1}{D_1}(r_t - \mathbb{E}_{t-\Delta}(r_t)) - (\mu^0_t - \mu^0_{t-\Delta})\right].$$

Again, I assume that the federal funds futures term premium does not respond to the FOMC statement. Then, using $x^0_t = r_t - \mathbb{E}_{t-\Delta}(r_t)$ yields

$$x^1_t = \frac{D_1}{D_1 - d_1}\left[(f^1_t - f^1_{t-\Delta}) - \frac{d_1}{D_1}x^0_t\right]. \tag{B.6}$$

Following this procedure, I can construct

$$x^n_t = \frac{D_n}{D_n - d_n}\left[(f^n_t - f^n_{t-\Delta}) - \frac{d_n}{D_n}x^{n-1}_t\right] \tag{B.7}$$

to measure the expected rate change at the nth subsequent FOMC meeting due to the current statement. As with x^0_t, x^n_t is measured from 10 minutes before the release of the FOMC statement to 20 minutes after. As with the current policy surprise, I use $x^n_t = f^{n+1}_t - f^{n+1}_{t-\Delta}$ if $D_n/(D_n - d_n)$ is greater than 4.

C Testing for a Structural Break in Current Federal Funds Rate Surprises

This appendix provides details for testing for a structural break in the current federal funds rate surprises. The vector w_t in Equation (4) has 10 variables. The first is the change in the target federal funds rate on the FOMC meeting day, where the target federal funds rate is pulled from the Federal Reserve Bank of St. Louis's FRED database. The series code is DFEDTAR. See https://fred.stlouisfed.org/series/DFEDTAR. The second variable is the change in the target federal funds rate from 90 days before the corresponding FOMC meeting to the day before the FOMC meeting. Variables three through six measure the current state of the economy. They are the target federal funds rate on the day before the FOMC meeting and the current quarter estimates of GDP growth, inflation measured with the GDP deflator, and the unemployment rate from the Greenbook of the corresponding FOMC meeting. The Greenbook data are from Yuriy Gorodnichenko's website, https://eml.berkeley.edu/~ygorodni/, for Coibion et al. (2017). Variables seven through ten measure the change in the state of the business cycle. They are revisions to the current and previous quarter estimates of GDP growth and inflation measured with the GDP deflator from the Greenbook of the corresponding FOMC meeting. These data are also from Yuriy Gorodnichenko's website.

As noted in the body of the paper, I estimate Equation (4) from February 1994 to May 2006. To formally test for a break in the mean of $|\hat{u}_t|$, I follow Andrews (1993). Let T denote the 99 observations in the total sample. Then, I estimate the average of $|\hat{u}_t|$ from $t = 1, \ldots, T_1 - 1$ and again from $t = T_1, \ldots, T$, where T_1 indicates the potential break date. I do this for $T_1 = 17, \ldots, 84$, ensuring that there are always 16 observations (two years) in each sample. With these indexes, I am searching for a break between January 1997 and June 2004.

Let V_1 denote the variance of $|\hat{u}_t|$ from $t = 1, \ldots, T_1 - 1$, and let V_2 denote the variance of $|\hat{u}_t|$ from $t = T_1, \ldots, T$. Then, $V = V_1[T/(T_1 - 1)] + V_2[T/(T - T_1 + 1)]$, and the Wald statistic associated with T_1 is given by

$$W(T_1) = T \left[\frac{1}{T_1 - 1} \sum_{t=1}^{T_1 - 1} |\hat{u}_t| - \frac{1}{T - T_1 + 1} \sum_{t=T_1}^{T} |\hat{u}_t| \right]^2 V^{-1}. \tag{C.1}$$

Figure 3 in the paper plots these Wald statistics from January 1997 and June 2004. The maximum Wald statistic or sup-Wald statistic is 17.2. Let $\pi_0 = 16/99 \approx 0.16$ be the fraction of the full sample where no testing occurs either at the beginning or the end of the sample. Given, $\pi_0 \approx 0.16$, this sup-Wald statistic exceeds Andrews's (1993) 1 percent critical value. Hence, I reject the null hypothesis of no break in the mean of $|u_t|$. Further, the Wald statistics take their maximum value when T_1 corresponds to August 2003. This indicates that the structural break occurs in August 2003.

D Details of Estimation and Inference

This appendix describes the estimation and inference of Equations (6) and (7) by generalized method of moments (Hansen, 1982). Define $z_t = [1, x_t^0]'$. Then, Equations (6) and (7) are

$$x_t^{path} = z_t'\alpha + m_t, \tag{D.1}$$

and

$$\Delta y_t = z_t'\beta + m_t\gamma + e_t, \tag{D.2}$$

where $\alpha = [\alpha_0, \alpha_1]'$ and $\beta = [\beta_0, \beta_1]'$. The moment conditions for identification are $\mathbb{E}(z_t m_t) = 0$, $\mathbb{E}(z_t e_t) = 0$, and $\mathbb{E}(m_t e_t) = 0$. These moments yield

$$\mathbb{E}[z_t(x_t^{path} - z_t'\alpha)] = 0, \tag{D.3}$$

$$\mathbb{E}[z_t(\Delta y_t - z_t'\beta - (x_t^{path} - z_t'\alpha)\gamma)] = 0, \tag{D.4}$$

and

$$\mathbb{E}[(x_t^{path} - \alpha' z_t)(\Delta y_t - z_t'\beta - (x_t^{path} - z_t'\alpha)\gamma)] = 0. \tag{D.5}$$

There are five parameters and five moments, so the model is just identified. Identification is as follows. Equation (D.3) implies

$$\alpha = [\mathbb{E}(z_t z_t')]^{-1}\mathbb{E}[z_t x_t^{path}], \tag{D.6}$$

Equations (D.4) and (D.6) imply

$$\beta = [\mathbb{E}(z_t z_t')]^{-1}\mathbb{E}[z_t \Delta y_t], \tag{D.7}$$

and Equations (D.5), (D.7) and (D.1) imply

$$\gamma = \{\mathbb{E}[(x_t^{path} - z_t'\alpha)^2]\}^{-1}\mathbb{E}[(x_t^{path} - z_t'\alpha)\Delta y_t] = [\mathbb{E}(m_t^2)]^{-1}\mathbb{E}[m_t \Delta y_t]. \tag{D.8}$$

For estimation, define $X = [x_1^{path}, \ldots, x_T^{path}]'$, $Z = [z_1, \ldots, z_T]'$, and $Y = [\Delta y_1, \ldots, \Delta y_T]'$. Then, the estimators are as follows: $\hat{\alpha} = (Z'Z)^{-1}Z'X$, $\hat{\beta} = (Z'Z)^{-1}Z'Y$, $\hat{M} = X - Z\hat{\alpha}$, and $\hat{\gamma} = (\hat{M}'\hat{M})^{-1}\hat{M}'Y$.

For inference, much of the notation follows chapter 14 of Hamilton (1994). First, collect the moments in Equations (D.3), (D.4) and (D.5) to define

$$h_t = \begin{bmatrix} z_t(x_t^{path} - z_t'\alpha) \\ z_t(\Delta y_t - z_t'\beta - (x_t^{path} - z_t'\alpha)\gamma) \\ (x_t^{path} - \alpha' z_t)(\Delta y_t - z_t'\beta - (x_t^{path} - z_t'\alpha)\gamma) \end{bmatrix} \tag{D.9}$$

so that $\mathbb{E}(h_t) = 0$. Define $g = T^{-1}\sum_{t=1}^{T} h_t$ and $\theta = [\alpha', \beta', \gamma]'$. Then, (D.9) implies

$$D' = \frac{\partial g}{\partial \theta'} = T^{-1}\begin{bmatrix} -Z'Z & \mathbf{0}_{2\times 2} & \mathbf{0}_{2\times 1} \\ Z'Z\gamma & -Z'Z & -Z'X + Z'Z\alpha \\ d_{3,1} & d_{3,2} & d_{3,3} \end{bmatrix} \tag{D.10}$$

where

$$d_{3,1} = -Z'Y + Z'Z\beta + 2(Z'X - Z'Z\alpha)\gamma \tag{D.11}$$

$$d_{3,2} = -Z'X + Z'Z\alpha \tag{D.12}$$

$$d_{3,3} = -X'X + 2X'Z\alpha - \alpha' Z'Z\alpha \tag{D.13}$$

Next, define S to be the long-run covariance matrix of h_t and define $V = (DS^{-1}D')^{-1}$. Then, define $\hat{\theta} = [\hat{\alpha}', \hat{\beta}, \hat{\gamma}]'$, $\hat{h}_t$ to be h_t evaluated at $\hat{\theta}$, and $\hat{D}$ to be D evaluated at $\hat{\theta}$. The above

estimates of $\hat{\alpha}$, $\hat{\beta}$, and $\hat{M}$ imply

$$\hat{D}' = T^{-1} \begin{bmatrix} -Z'Z & \mathbf{0}_{2\times 2} & \mathbf{0}_{2\times 1} \\ Z'Z\hat{\gamma} & -Z'Z & \mathbf{0}_{2\times 1} \\ \mathbf{0}_{1\times 2} & \mathbf{0}_{1\times 2} & -\hat{M}'\hat{M} \end{bmatrix}.$$

Finally, define $\hat{H} = [\hat{h}_1, \ldots, \hat{h}_T]'$. Because I use an event-study analysis, I assume that h_t has zero autocorrelation so that $\hat{S} = T^{-1}\hat{H}'\hat{H}$. Given this, $\hat{V} = (\hat{D}\hat{S}^{-1}\hat{D}')^{-1}$, and the standard errors of $\hat{\theta}$ are the square roots of the diagonal elements of $\hat{V}/T$.

E Separate Identification of Economic-Outlook and Policy-Inclination Forward Guidance

This appendix describes how the effects of the economic-outlook and policy-inclination aspects of forward guidance may be separately identified. In addition, it shows a data limitation that prevents this identification.

Rewrite Equations (6) and (7) as

$$x_t^{path} = \alpha_0 + \alpha_1 x_t^0 + m_{1,t} + m_{2,t} \tag{E.1}$$

and

$$\Delta y_t = \beta_0 + \beta_1 x_t^0 + \gamma_1 m_{1,t} + \gamma_2 m_{2,t} + e_t, \tag{E.2}$$

where $m_{1,t}$ is a measure of economic-outlook forward guidance and $m_{2,t}$ is a measure of policy-inclination forward guidance. I use the following moment assumptions for identification. First, $\mathbb{E}(x_t^0 m_{1,t}) = 0$, $\mathbb{E}(x_t^0 m_{2,t}) = 0$, and $\mathbb{E}(m_{1,t}m_{2,t}) = 0$. These assumptions impose mutual orthogonality of the monetary policy shocks. Second, I assume $\mathbb{E}(m_{1,t}) = 0$ and $\mathbb{E}(m_{2,t}) = 0$. Third, I assume $\mathbb{E}(x_t^0 e_t) = 0$, $\mathbb{E}(m_{1,t}e_t) = 0$ and $\mathbb{E}(m_{2,t}e_t) = 0$, which allows for identification of the parameters in Equation (E.2). Fourth, I assume $\mathbb{E}(m_{1,t}^2) = \sigma_{m_1}^2$, where $\sigma_{m_1}^2$ is the same in both the February 2000 to June 2003 sample and the August 2003 to May 2006 sample. Fifth, I assume that $m_{2,t} = 0$ from February 2000 to June 2003 so that $\mathbb{E}(m_{2,t}^2) = 0$ over this sample. Sixth, I assume that $\mathbb{E}(m_{2,t}^2) = \sigma_{m_2}^2 > 0$ from August 2003 to May 2006. Finally, in addition to these moment conditions, I assume that γ_1 is the same in

both the February 2000 to June 2003 sample and the August 2003 to May 2006 sample.

As in Appendix D, define $z_t = [1, x_t^0]'$. Then, $\alpha = [\mathbb{E}(z_t z_t')]^{-1}\mathbb{E}[z_t x_t^{path}]$. Note that α can be estimated over the whole February 2000 to May 2006 sample or separately on the February 2000 to June 2003 and on the August 2003 to May 2006 samples. Given α, $m_{1,t} = x_t^{path} - z_t'\alpha$ on the February 2000 to June 2003 sample. Then, $\sigma_{m_1}^2 = \mathbb{E}[(x_t^{path} - z_t'\alpha)^2]$ and

$$\gamma_1 = \frac{\mathbb{E}(\Delta y_t m_{1,t})}{\mathbb{E}(m_{1,t}^2)} = \frac{\mathbb{E}(\Delta y_t m_{1,t})}{\sigma_{m_1}^2}$$

on the February 2000 to June 2003 sample.

Next, given α, $m_{1,t} + m_{2,t} = x_t^{path} - z_t'\alpha$ on the August 2003 to May 2006 sample. Then, $\sigma_{m_1}^2 + \sigma_{m_2}^2 = \mathbb{E}[(x_t^{path} - z_t'\alpha)^2]$ on the August 2003 to May 2006 sample, and $\sigma_{m_2}^2$ can be estimated by subtracting $\sigma_{m_1}^2$ from the February 2000 to June 2003 sample. Next,

$$\gamma_2 = \frac{\mathbb{E}(\Delta y_t m_{2,t})}{\mathbb{E}(m_{2,t}^2)} = \frac{\mathbb{E}(\Delta y_t m_{2,t})}{\sigma_{m_2}^2}$$

on the August 2003 to May 2006 sample. However, $m_{2,t}$ cannot be directly observed or estimated. Because of this, I use the following approach. Rewrite (E.2) to be

$$\Delta y_t = \beta_0 + \beta_1 x_t^0 + \delta(m_{1,t} + m_{2,t}) + w_t, \tag{E.3}$$

where $w_t = \gamma_1 m_{1,t} + \gamma_2 m_{2,t} - \delta(m_{1,t} + m_{2,t}) + e_t$ and δ has a value such that $\mathbb{E}[(m_{1,t} + m_{2,t})w_t] = 0$. Then,

$$\begin{aligned}
\delta &= \frac{\mathbb{E}[\Delta y_t(m_{1,t} + m_{2,t})]}{\mathbb{E}[(m_{1,t} + m_{2,t})^2]} \\
&= \frac{\mathbb{E}(\Delta y_t m_{1,t})}{\mathbb{E}[(m_{1,t} + m_{2,t})^2]} + \frac{\mathbb{E}(\Delta y_t m_{2,t})}{\mathbb{E}[(m_{1,t} + m_{2,t})^2]} \\
&= \gamma_1 \frac{\sigma_{m_1}^2}{\sigma_{m_1}^2 + \sigma_{m_2}^2} + \gamma_2 \frac{\sigma_{m_2}^2}{\sigma_{m_1}^2 + \sigma_{m_2}^2},
\end{aligned}$$

which decomposes the joint effects of the two aspects of forward guidance into their separate effects scaled by their variance contributions to $m_{1,t} + m_{2,t}$. This implies

$$\gamma_2 = \frac{\sigma_{m_1}^2 + \sigma_{m_2}^2}{\sigma_{m_2}^2} \left[\delta - \gamma_1 \frac{\sigma_{m_1}^2}{\sigma_{m_1}^2 + \sigma_{m_2}^2} \right].$$

Hence, the effects of policy-inclination forward guidance are identified. Further, γ_1 and $\sigma^2_{m_1}$ are estimated from February 2000 to June 2003, δ and $\sigma^2_{m_1} + \sigma^2_{m_2}$ are estimated from August 2003 to May 2006, and $\sigma^2_{m_2}$ is the difference between $\sigma^2_{m_1} + \sigma^2_{m_2}$ and $\sigma^2_{m_1}$.

The data limitation that prevents the estimation of γ_2 is that the variance of $m_{1,t}$ from February 2000 to June 2003 is larger than the variance of $m_{1,t} + m_{2,t}$ from August 2003 to May 2006. I note this in Section 4 in reference to Figure 4. This result is problematic because it will give an estimate of $\sigma^2_{m_2}$ that is negative from August 2003 to May 2006. Hence, the moment conditions used for separate identification are violated in the data.

F The Chow Test via Dummy Variables

This appendix describes the Chow (1960) test via Gujarati (1970a,b) regressions with dummy variables. In addition, it presents the results of the tests.

Equations (6) and (7) become

$$x_t^{path} = z_t'\alpha + d_t z_t'\delta + m_t, \tag{F.1}$$

and

$$\Delta y_t = z_t'\beta + d_t z_t'\lambda + m_t\gamma + d_t m_t\phi + e_t, \tag{F.2}$$

where d_t is a dummy variable that takes the value 0 from February 2000 to June 2003 and the value 1 from August 2003 to May 2006. The moment conditions for identification are $\mathbb{E}(z_t m_t) = 0$, $\mathbb{E}(z_t d_t m_t) = 0$, $\mathbb{E}(z_t e_t) = 0$, $\mathbb{E}(z_t d_t e_t) = 0$, $\mathbb{E}(m_t e_t) = 0$, and $\mathbb{E}(m_t d_t e_t) = 0$. These moments yield

$$\mathbb{E}[z_t(x_t^{path} - z_t'\alpha - d_t z_t'\delta)] = 0,$$

$$\mathbb{E}[z_t d_t(x_t^{path} - z_t'\alpha - d_t z_t'\delta)] = 0,$$

$$\mathbb{E}[z_t(\Delta y_t - z_t'\beta - d_t z_t'\lambda - (x_t^{path} - z_t'\alpha - d_t z_t'\delta)\gamma - d_t(x_t^{path} - z_t'\alpha - d_t z_t'\delta)\phi)] = 0,$$

$$\mathbb{E}[z_t d_t(\Delta y_t - z_t'\beta - d_t z_t'\lambda - (x_t^{path} - z_t'\alpha - d_t z_t'\delta)\gamma - d_t(x_t^{path} - z_t'\alpha - d_t z_t'\delta)\phi)] = 0,$$

$$\mathbb{E}[(x_t^{path} - \alpha' z_t - \delta' z_t d_t)(\Delta y_t - z_t'\beta - d_t z_t'\lambda - (x_t^{path} - z_t'\alpha - d_t z_t'\delta)\gamma - d_t(x_t^{path} - z_t'\alpha - d_t z_t'\delta)\phi)] = 0,$$

and

$$\mathbb{E}[(x_t^{path}-\alpha' z_t-\delta' z_t d_t)d_t(\Delta y_t-z_t'\beta-d_t z_t'\lambda-(x_t^{path}-z_t'\alpha-d_t z_t'\delta)\gamma-d_t(x_t^{path}-z_t'\alpha-d_t z_t'\delta)\phi)]=0.$$

Using $d_t^2=d_t$, we have

$$\begin{bmatrix}\alpha\\ \delta\end{bmatrix}=\begin{bmatrix}\mathbb{E}(z_t z_t') & \mathbb{E}(d_t z_t z_t')\\ \mathbb{E}(d_t z_t z_t') & \mathbb{E}(d_t z_t z_t')\end{bmatrix}^{-1}\begin{bmatrix}\mathbb{E}(z_t x_t^{path})\\ \mathbb{E}(z_t d_t x_t^{path})\end{bmatrix},$$

$$\begin{bmatrix}\beta\\ \lambda\end{bmatrix}=\begin{bmatrix}\mathbb{E}(z_t z_t') & \mathbb{E}(d_t z_t z_t')\\ \mathbb{E}(d_t z_t z_t') & \mathbb{E}(d_t z_t z_t')\end{bmatrix}^{-1}\begin{bmatrix}\mathbb{E}(z_t \Delta y_t)\\ \mathbb{E}(z_t d_t \Delta y_t)\end{bmatrix},$$

and

$$\begin{bmatrix}\gamma\\ \phi\end{bmatrix}=\begin{bmatrix}\mathbb{E}(m_t^2) & \mathbb{E}(d_t m_t^2)\\ \mathbb{E}(d_t m_t^2) & \mathbb{E}(d_t m_t^2)\end{bmatrix}^{-1}\begin{bmatrix}\mathbb{E}(m_t \Delta y_t)\\ \mathbb{E}(m_t d_t \Delta y_t)\end{bmatrix}.$$

For estimation, use the definitions of X, Z, and Y in Appendix D. Define $\tilde{Z}=[d_1 z_1,\ldots,d_T z_T]'$ and $Z_+=[Z,\tilde{Z}]$. Then, the estimators are as follows: $[\hat{\alpha}',\hat{\delta}']'=(Z_+'Z_+)^{-1}Z_+'X$, $[\hat{\beta}',\hat{\lambda}']'=(Z_+'Z_+)^{-1}Z_+'Y$, and $\hat{M}=X-Z_+[\hat{\alpha}',\hat{\delta}']'$. Define $\tilde{M}=[d_1\hat{m}_1,\ldots,d_T\hat{m}_T]'$, where $\hat{m}_t$ is the tth element of $\hat{M}$, and $M_+=[\hat{M},\tilde{M}]$. Then, $[\hat{\gamma},\hat{\phi}]'=(M_+'M_+)^{-1}M_+'Y$.

For inference, define

$$h_t=\begin{bmatrix}z_t(x_t^{path}-z_t'\alpha-d_t z_t'\delta)\\ z_t d_t(x_t^{path}-z_t'\alpha-d_t z_t'\delta)\\ z_t(\Delta y_t-z_t'\beta-d_t z_t'\lambda-(x_t^{path}-z_t'\alpha-d_t z_t'\delta)\gamma-d_t(x_t^{path}-z_t'\alpha-d_t z_t'\delta)\phi)\\ z_t d_t(\Delta y_t-z_t'\beta-d_t z_t'\lambda-(x_t^{path}-z_t'\alpha-d_t z_t'\delta)\gamma-d_t(x_t^{path}-z_t'\alpha-d_t z_t'\delta)\phi)\\ (x_t^{path}-\alpha' z_t-\delta' z_t d_t)(\Delta y_t-z_t'\beta-d_t z_t'\lambda-(x_t^{path}-z_t'\alpha-d_t z_t'\delta)\gamma-d_t(x_t^{path}-z_t'\alpha-d_t z_t'\delta)\phi)\\ (x_t^{path}-\alpha' z_t-\delta' z_t d_t)d_t(\Delta y_t-z_t'\beta-d_t z_t'\lambda-(x_t^{path}-z_t'\alpha-d_t z_t'\delta)\gamma-d_t(x_t^{path}-z_t'\alpha-d_t z_t'\delta)\phi)\end{bmatrix}$$

so that $\mathbb{E}(h_t)=0$. Define $g=T^{-1}\sum_{t=1}^T h_t$, $\theta=[\alpha',\delta',\beta',\lambda',\gamma,\phi]'$, S to be the long-run covariance matrix of h_t, and $V=(DS^{-1}D')^{-1}$. Then, define $\hat{\theta}=[\hat{\alpha}',\hat{\delta}',\hat{\beta}',\hat{\lambda}',\hat{\gamma},\hat{\phi}]'$, $\hat{h}_t$ to be

h_t evaluated at $\hat{\theta}$, $\hat{D}$ to be D evaluated at $\hat{\theta}$. Then,

$$\hat{D}' = T^{-1} \begin{bmatrix} -Z_+'Z_+ & \mathbf{0}_{4\times4} & \mathbf{0}_{4\times2} \\ Z_+'Z_+\hat{\gamma} + (\mathbf{1}_{2\times2} \otimes \tilde{Z}'\tilde{Z})\hat{\phi} & -Z_+'Z_+ & \mathbf{0}_{4\times2} \\ \mathbf{0}_{2\times4} & \mathbf{0}_{2\times4} & -M_+'M_+ \end{bmatrix}.$$

Finally, define $\hat{H} = [\hat{h}_1, \ldots, \hat{h}_T]'$. Because I use an event-study analysis, I assume that h_t has zero autocorrelation so that $\hat{S} = T^{-1}\hat{H}'\hat{H}$. Given this, $\hat{V} = (\hat{D}\hat{S}^{-1}\hat{D}')^{-1}$, and the standard errors of $\hat{\theta}$ are the square roots of the diagonal elements of $\hat{V}/T$.

Tables F.1, F.2, F.3, and F.4 display the results. In these tables, the estimates of β and γ along with their standard errors are the same as the estimates for February 2000 to June 2003 presented in the body of the paper. This is because the dummy variable is 0 in the early sample and 1 in the late sample. Hence, in the tables, I refer to the estimates of β and γ as the "early sample" results. The coefficient estimates on the dummied variables, $\hat{\lambda}$ and $\hat{\phi}$, give the difference between the estimates for the February 2000 to June 2003 sample and the August 2003 to May 2006 sample presented in the body of the paper. That is, $\hat{\beta} + \hat{\lambda}$ and $\hat{\gamma} + \hat{\phi}$ are the same as the estimates for August 2003 to May 2006 presented in the body of the paper. Hence, I present $\hat{\lambda}$ and $\hat{\phi}$ along with their standard errors in the "dummy" columns of the tables. Proofs of these results for β and λ follow from $\tilde{Z}'Z = Z'\tilde{Z} = \tilde{Z}'\tilde{Z}$, the equation for a partitioned matrix, $Z'Z - Z'\tilde{Z}$ is the inner product of Z and Z for February 2000 to June 2003, $Z'Y - \tilde{Z}'Y$ is the inner product of Z and Y for February 2000 to June 2003, $Z'\tilde{Z}$ is the inner product of Z and Z for August 2003 to May 2006, $\tilde{Z}'Y$ is the inner product of Z and Y for August 2003 to May 2006, and

$$(Z'\tilde{Z} - Z'\tilde{Z}(Z'Z)^{-1}Z'\tilde{Z})^{-1} - (Z'Z - Z'\tilde{Z})^{-1} = (Z'\tilde{Z})^{-1}.$$

The proofs of these results for γ and ϕ are the same but with $\hat{M}$ and $\tilde{M}$ in place of Z and $\tilde{Z}$, respectively.

Table F.1: Responses of Stock Prices and Volatility to Funds Rate and Forward Guidance Changes

	Funds Rate		Forward Guidance	
Dependent Variable	Early Sample	Dummy	Early Sample	Dummy
S&P 500	-7.90^{***}	-0.18	9.88^{**}	-33.21^{***}
	(2.07)	(16.30)	(4.29)	(7.79)
VIX	3.57^{**}	5.96	-2.22	23.00^{***}
	(1.72)	(14.85)	(3.99)	(7.10)

Notes: The Funds Rate columns display the estimates of β_1 and λ_1 from Equation (F.2). The estimates of β_1 are in the early sample column and the estimates of λ_1 are in the dummy column. The Forward Guidance columns display the estimates of γ and ϕ from Equation (F.2). The estimates of γ are in the early sample column and the estimates of ϕ are in the dummy column. Standard errors are shown in parentheses. The stars, *, **, and ***, denote statistical significance at the 10 percent, 5 percent and 1 percent levels, respectively.

Table F.2: Responses of Treasury Yields and Term Premia to Funds Rate and Forward Guidance Changes

Dependent Variable	Funds Rate		Forward Guidance	
	Early Sample	Dummy	Early Sample	Dummy
Treasury Yields:				
2-Year	0.21	2.93***	0.92***	1.37***
	(0.24)	(1.13)	(0.21)	(0.47)
5-Year	0.10	1.95*	0.61***	1.43***
	(0.17)	(1.05)	(0.19)	(0.46)
7-Year	0.08	1.35	0.42**	1.40***
	(0.14)	(0.99)	(0.17)	(0.43)
10-Year	0.09	0.79	0.22	1.35***
	(0.12)	(0.92)	(0.16)	(0.41)
Term Premia:				
2-Year	-0.09	0.64	-0.02	0.76***
	(0.07)	(0.44)	(0.09)	(0.22)
5-Year	-0.10	-0.42	−0.27**	0.75***
	(0.10)	(0.51)	(0.11)	(0.26)
7-Year	-0.08	-0.81	−0.37***	0.75**
	(0.13)	(0.58)	(0.14)	(0.29)
10-Year	-0.05	-1.10	−0.47***	0.79**
	(0.16)	(0.67)	(0.16)	(0.34)
Expected Path of Short-Term Rates:				
2-Year	0.30	2.30***	0.95***	0.61*
	(0.20)	(0.83)	(0.17)	(0.33)
5-Year	0.20	2.36***	0.88***	0.68*
	(0.20)	(0.82)	(0.17)	(0.35)
7-Year	0.16	2.15***	0.80***	0.65**
	(0.19)	(0.75)	(0.16)	(0.33)
10-Year	0.14	1.89***	0.69***	0.56*
	(0.17)	(0.64)	(0.14)	(0.29)

See notes to Table F.1.

Table F.3: Responses of Private-Sector Borrowing Costs to Funds Rate and Forward Guidance Changes

Dependent Variable	Funds Rate		Forward Guidance	
	Early Sample	Dummy	Early Sample	Dummy
Corporate Bond Yields:				
A (3-Yr)	0.23	2.91***	0.91***	1.06**
	(0.22)	(1.03)	(0.24)	(0.45)
A (10-Yr)	0.17	1.25	0.47**	0.96**
	(0.18)	(0.92)	(0.20)	(0.43)
BBB (3-Yr)	0.30*	2.05	0.97***	1.66***
	(0.18)	(1.43)	(0.17)	(0.58)
BBB (10-Yr)	0.15	1.06	0.42**	1.40***
	(0.17)	(1.14)	(0.21)	(0.52)
Corporate Yield Spreads:				
BBB - A	0.08	-0.87	0.05	0.59*
(3-Yr)	(0.09)	(0.81)	(0.13)	(0.34)
BBB - A	-0.02	-0.19	-0.06	0.43**
(10-Yr)	(0.07)	(0.46)	(0.13)	(0.20)
Mortgage-Backed Securities:				
MBS (30-Yr)	0.21	1.32	0.46***	1.70***
	(0.13)	(1.26)	(0.15)	(0.45)
OAS	-0.04	0.74**	0.00	0.54***
	(0.05)	(0.32)	(0.07)	(0.15)

See notes to Table F.1.

Table F.4: Responses of Private Forecasts to Funds Rate and Forward Guidance Changes

Dependent Variable	Funds Rate		Forward Guidance	
	Early Sample	Dummy	Early Sample	Dummy
GDP Growth:				
Current	-1.01	-7.38	1.59	-2.51
Quarter	(1.18)	(4.68)	(1.66)	(2.76)
Next	-0.30	2.96	2.34***	−3.74***
Quarter	(0.39)	(5.09)	(0.60)	(1.40)
2 Quarters	-0.18	2.72	1.02*	-1.68
Hence	(0.30)	(2.71)	(0.61)	(1.10)
3 Quarters	0.25	2.56***	0.92**	-1.32
Hence	(0.25)	(0.99)	(0.42)	(0.93)
CPI Inflation:				
Current	-0.28	0.58	2.29	1.26
Quarter	(0.89)	(10.19)	(1.71)	(3.31)
Next	-0.02	-1.86	0.53	-0.31
Quarter	(0.36)	(3.63)	(0.50)	(1.45)
2 Quarters	0.09	−3.35***	0.26	-0.72
Hence	(0.23)	(1.15)	(0.35)	(0.64)
3 Quarters	-0.08	-1.48	0.23	−1.19*
Hence	(0.24)	(1.17)	(0.34)	(0.62)
Unemployment Rate:				
Current	0.04	3.02***	-0.34	-0.26
Quarter	(0.12)	(0.99)	(0.25)	(0.50)
Next	0.14	-0.91	-0.40	0.53
Quarter	(0.24)	(1.09)	(0.43)	(0.71)
2 Quarters	0.28	1.16	-0.38	1.02
Hence	(0.26)	(0.92)	(0.26)	(0.68)
3 Quarters	0.19	-0.64	−0.69***	0.82
Hence	(0.19)	(1.19)	(0.25)	(0.56)

See notes to Table F.1.

References

Adrian, Tobias, Richard K. Crump, and Emanuel Moench. 2013a. "Do Treasury Term Premia Rise around Monetary Tightenings?" *Liberty Street Economics*, April 15.

———. 2013b. "Pricing the Term Structure with Linear Regressions." *Journal of Financial Economics* 110 (1):110–138. URL https://doi.org/10.1016/j.jfineco.2013.04.009.

Andrade, Philippe and Filippo Ferroni. 2016. "Delphic and Odyssean Monetary Policy Shocks: Evidence from the Euro-Area." URL https://ideas.repec.org/p/sur/surrec/1216.html. University of Surrey, School of Economics Discussion Papers No. 1216.

Andrade, Philippe, Gaetano Gaballo, Eric Mengus, and Benoît Mojon. 2018. "Forward Guidance and Heterogeneous Beliefs." Bank for International Settlements Working Paper no. 750 URL https://EconPapers.repec.org/RePEc:bis:biswps:750.

Andrews, Donald W. K. 1993. "Tests for Parameter Instability and Structural Change With Unknown Change Point." *Econometrica* 61 (4):821–856. URL https://doi.org/10.2307/2951764.

Barakchian, S. Mahdi and Christopher Crowe. 2013. "Monetary Policy Matters: Evidence from New Shocks Data." *Journal of Monetary Economics* 60 (8):950–966. URL https://doi.org/10.1016/j.jmoneco.2013.09.006.

Bernanke, Ben S. 2003. "An Unwelcome Fall in Inflation?" Remarks before the Economics Roundtable, University of California, San Diego, July 23. URL https://www.federalreserve.gov/boarddocs/speeches/2003/20030723/default.htm.

Bernanke, Ben S., Vincent R. Reinhart, and Brian P. Sack. 2004. "Monetary Policy Alternatives at the Zero Bound: An Empirical Assessment." *Brookings Papers on Economic Activity* 2004 (2):1–78. URL https://doi.org/10.1353/eca.2005.0002.

Blinder, Alan S., Michael Ehrmannl, Marcel Fratzscher, Jakob De Haan, and David-Jan Jansen. 2008. "Central Bank Communication and Monetary Policy: A Survey of Theory and Evidence." *Journal of Economic Literature* 46 (4):910–45. URL https://doi.org/10.1257/jel.46.4.910.

Bundick, Brent, Trenton Herriford, and A. Lee Smith. 2017. "Forward Guidance, Monetary Policy Uncertainty, and the Term Premium." Federal Reserve Bank of Kansas City Working Paper No. 17-07. URL https://doi.org/10.18651/RWP2017-07.

Bundick, Brent and A. Lee Smith. 2016. "The Dynamic Effects of Forward Guidance Shocks." Federal Reserve Bank of Kansas City Working Paper No. 16-02. URL https://doi.org/10.18651/RWP2016-02.

Campbell, Jeffrey R., Charles L. Evans, Jonas D. M. Fisher, and Alejandro Justiniano. 2012. "Macroeconomic Effects of Federal Reserve Forward Guidance." *Brookings Papers on Economic Activity* 2012 (Spring):1–80. URL https://doi.org/10.1353/eca.2012.0004.

Campbell, Jeffrey R., Jonas D. M. Fisher, Alejandro Justiniano, and Leonardo Melosi. 2016. "Forward Guidance and Macroeconomic Outcomes since the Financial Crisis." *NBER Macroeconomics Annual* 31 (1):283–357. URL https://doi.org/10.1086/690242.

Carlstrom, Charles T., Timothy S. Fuerst, and Matthias Paustian. 2015. "Inflation and Output in New Keynesian Models with a Transient Interest Rate Peg." *Journal of Monetary Economics* 76:230–243. URL https://doi.org/10.1016/j.jmoneco.2015.09.004.

Chow, Gregory C. 1960. "Tests of Equality Between Sets of Coefficients in Two Linear Regressions." *Econometrica* 28 (3):591–605. URL https://doi.org/10.2307/1910133.

Coibion, Olivier, Yuriy Gorodnichenko, Lorenz Kueng, and John Silvia. 2017. "Innocent Bystanders? Monetary Policy and Inequality." *Journal of Monetary Economics* 88:70–89. URL https://doi.org/10.1016/j.jmoneco.2017.05.005.

D'Amico, Stefania and Thomas B. King. 2017. "What Does Anticipated Monetary Policy Do?" Federal Reserve Bank of Chicago Working Paper No. 2015-10. URL https://EconPapers.repec.org/RePEc:fip:fedhwp:wp-2015-10.

Del Negro, Marco, Marc Giannoni, and Christina Patterson. 2015. "The Forward Guidance Puzzle." Federal Reserve Bank of New York Staff Reports No. 574. URL https://ideas.repec.org/p/fip/fednsr/574.html.

Eggertsson, Gauti B. and Michael Woodford. 2003. "The Zero Bound on Interest Rates and Optimal Monetary Policy." *Brookings Papers on Economic Activity* 2003 (1):139–211. URL https://doi.org/10.1353/eca.2003.0010.

Ellingsen, Tore and Ulf Söderström. 2001. "Monetary Policy and Market Interest Rates." *American Economic Review* 91 (5):1594–1607. URL https://doi.org/10.1257/aer.91.5.1594.

Faust, Jon, Eric T. Swanson, and Jonathan H. Wright. 2004. "Identifying VARs Based on High Frequency Futures Data." *Journal of Monetary Economics* 51 (6):1107–1131. URL https://doi.org/10.1016/j.jmoneco.2003.11.001.

Ferguson, Roger W., Jr. 2003. "Uncertain Times: Economic Challenges Facing the United States and Japan." Remarks before the Japan Society, June 11. URL https://www.federalreserve.gov/boarddocs/speeches/2003/200306112/default.htm.

Frankel, Alex and Navin Katrik. 2015. "What Kind of Transparency." Working Paper. URL http://www.columbia.edu/~nk2339/Papers/FK-Transparency.pdf.

Gaballo, Gaetano. 2016. "Rational Inattention to News: The Perils of Forward Guidance." *American Economic Journal: Macroeconomics* 8 (1):42–97. URL https://doi.org/10.1257/mac.20130337.

Gertler, Mark and Peter Karadi. 2015. "Monetary Policy Surprises, Credit Costs, and Economic Activity." *American Economic Journal: Macroeconomics* 7 (1):44–76. URL https://doi.org/10.1257/mac.20130329.

Gilchrist, Simon, David López-Salido, and Egon Zakrajšek. 2015. "Monetary Policy and Real Borrowing Costs at the Zero Lower Bound." *American Economic Journal: Macroeconomics* 7 (1):77–109. URL https://doi.org/10.1257/mac.20130324.

Gujarati, Damodar. 1970a. "Use of Dummy Variables in Testing for Equality Between Sets of Coefficients in Linear Regressions: A Generalization." *The American Statistician* 24 (5):18–22. URL https://doi.org/10.1080/00031305.1970.10477220.

———. 1970b. "Use of Dummy Variables in Testing for Equality between Sets of Coefficients in Two Linear Regressions: A Note." *The American Statistician* 24 (1):50–52. URL https://doi.org/10.1080/00031305.1970.10477181.

Gürkaynak, Refet S. 2005. "Using Federal Funds Futures Contracts for Monetary Policy Analysis." URL https://doi.org/10.2139/ssrn.813225. Board of Governors of the Federal Reserve System, Finance and Economics Discussion Series, 2005-29.

Gürkaynak, Refet S., Brian Sack, and Eric T. Swanson. 2005. "Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements." *International Journal of Central Banking* 1 (1):55–93. URL http://www.ijcb.org/journal/ijcb05q2a2.htm.

Gürkaynak, Refet S., Brian Sack, and Jonathan H. Wright. 2007. "The U.S. Treasury Yield Curve: 1961 to the Present." *Journal of Monetary Economics* 54 (8):2291–2304. URL https://doi.org/10.1016/j.jmoneco.2007.06.029.

Gürkaynak, Refet S., Brian P. Sack, and Eric T. Swanson. 2007. "Market-Based Measures of Monetary Policy Expectations." *Journal of Business & Economic Statistics* 25 (2):201–212. URL https://doi.org/10.1198/073500106000000387.

Hamilton, James D. 1994. *Time Series Analysis*. Princeton, New Jersey: Princeton University Press.

Hansen, Lars Peter. 1982. "Large Sample Properties of Generalized Method of Moments Estimators." *Econometrica* 50 (4):1029–1054. URL https://doi.org/10.2307/1912775.

Hansen, Stephen and Michael McMahon. 2016. "Shocking Language: Understanding the Macroeconomic Effects of Central Bank Communication." *Journal of International Economics* 99 (Supplement 1):S114–S133. URL https://doi.org/10.1016/j.jinteco.2015.12.008.

Hanson, Samuel G. and Jeremy C. Stein. 2015. "Monetary Policy and Long-Term Real Rates." *Journal of Financial Economics* 115 (3):429–448. URL https://doi.org/10.1016/j.jfineco.2014.11.001.

Hattori, Masazumi, Andreas Schrimpf, and Vladyslav Sushko. 2016. "The Response of Tail Risk Perceptions to Unconventional Monetary Policy." *American Economic Journal: Macroeconomics* 8 (2):111–36. URL https://doi.org/10.1257/mac.20140016.

Hernández-Murillo, Rubén and Hannah Shell. 2014. "The Rising Complexity of the FOMC Statement." Federal Reserve Bank of St. Louis *Economic Synopses*, No. 23. URL https://doi.org/10.20955%2Fes.2014.23.

Ip, Greg. 2003. "Citing Deflation, Fed Cuts Rates by a Quarter Point." *The Wall Street Journal*, June 26.

———. 2005. "Fed Raises Rates, Modifies Its Tone." *The Wall Street Journal*, December 14.

Jarociński, Marek and Peter Karadi. 2018. "Deconstructing Monetary Policy Surprises - The Role of Information Shocks." CEPR Discussion Paper no. 12765.

Jia, Chengcheng. 2018. "The Informational Effect of Monetary Policy and the Case for Policy Commitment." Job Market Paper, Columbia University.

Kohn, Donald L. and Brian P. Sack. 2003. "Central Bank Talk: Does It Matter and Why?" URL https://doi.org/10.2139/ssrn.483524. Board of Governors of the Federal Reserve System, Finance and Economics Discussion Series, 2003-55.

Krugman, Paul R. 1998. "It's Baaack: Japan's Slump and the Return of the Liquidity Trap." *Brookings Papers on Economic Activity* 1998 (2):137–205. URL https://doi.org/10.2307/2534694.

Kuttner, Kenneth N. 2001. "Monetary Policy Surprises and Interest Rates: Evidence from the Fed Funds Futures Market." *Journal of Monetary Economics* 47 (3):523–544. URL https://doi.org/10.1016/S0304-3932(01)00055-1.

Lakdawala, Aeimit. 2017. "Decomposing the Effects of Monetary Policy Using an External Instruments SVAR." Working Paper, Michigan State University. URL https://doi.org/10.2139/ssrn.2950956.

Lakdawala, Aeimit and Matthew Schaffer. 2018. "Federal Reserve Private Information and the Stock Market." Working Paper, Michigan State University. URL https://doi.org/10.2139/ssrn.2950930.

Laséen, Stefan and Lars E. O. Svensson. 2011. "Anticipated Alternative Policy Rate Paths in Policy Simulations." *International Journal of Central Banking* 7 (3):1–35. URL http://www.ijcb.org/journal/ijcb11q3a1.htm.

Levin, Andrew, David López-Salido, Edward Nelson, and Tack Yun. 2010. "Limitations on the Effectiveness of Forward Guidance at the Zero Lower Bound." *International Journal of Central Banking* 6 (1):143–189. URL http://www.ijcb.org/journal/ijcb10q1a8.htm.

Lucca, David O. and Emanuel Moench. 2015. "The Pre-FOMC Announcement Drift." *Journal of Finance* 70 (1):329–371. URL https://doi.org/10.1111/jofi.12196.

Lucca, David O. and Francesco Trebbi. 2009. "Measuring Central Bank Communication: An Automated Approach with Application to FOMC Statements." NBER Working Paper No. 15367. URL https://doi.org/10.3386/w15367.

McKay, Alisdair, Emi Nakamura, and Jón Steinsson. 2016. "The Power of Forward Guidance Revisited." *American Economic Review* 106 (10):3133–3158. URL https://doi.org/10.1257/aer.20150063.

Melosi, Leonardo. 2017. "Signalling Effects of Monetary Policy." *Review of Economic Studies* 84 (1):853–884. URL https://doi.org/10.1093/restud/rdw050.

Milani, Fabio and John Treadwell. 2012. "The Effects of Monetary Policy 'News' and 'Surprises'." *Journal of Money, Credit and Banking* 44 (8):1667–1692. URL http://dx.doi.org/10.1111/j.1538-4616.2012.00549.x.

Miranda-Agrippino, Silvia. 2016. "Unsurprising Shocks: Information, Premia, and the Monetary Transmission." Working Paper. URL https://doi.org/10.2139/ssrn.2865585.

Nakamura, Emi and Jón Steinsson. 2018. "High-Frequency Identification of Monetary Non-Neutrality: The Information Effect." *Quarterly Journal of Economics* URL https://doi.org/10.1093/qje/qjy004.

Romer, Christina D. and David H. Romer. 2000. "Federal Reserve Information and the Behavior of Interest Rates." *American Economic Review* 90 (3):429–457. URL https://doi.org/10.1257/aer.90.3.429.

Rosa, Carlo. 2011. "Talking Less and Moving the Market More: Evidence from the ECB and the Fed." *Scottish Journal of Political Economy* 58 (1):51–81. URL http://dx.doi.org/10.1111/j.1467-9485.2010.00536.x.

Rosa, Carlo and Giovanni Verga. 2008. "The Impact of Central Bank Announcements on Asset Prices in Real Time." *International Journal of Central Banking* 4 (2):175–217. URL http://www.ijcb.org/journal/ijcb08q2a5.htm.

Rudebusch, Glenn D. and John C. Williams. 2008. "Revealing the Secrets of the Temple: The Value of Publishing Central Bank Interest Rate Projections." In *Asset Prices and Monetary Policy*, edited by John Y. Campbell, chap. 6. The University of Chicago Press, 247–284. URL https://doi.org/10.7208/chicago/9780226092126.003.0007.

Sinha, Arunima. 2015. "FOMC Forward Guidance and Investor Beliefs." *American Economic Review* 105 (5):656–61. URL https://doi.org/10.1257/aer.p20151123.

Stroebel, Johannes and John B. Taylor. 2012. "Estimated Impact of the Federal Reserve's Mortgage-Backed Securities Purchase Program." *International Journal of Central Banking* 8 (3):1–42. URL http://www.ijcb.org/journal/ijcb12q2a1.htm.

Swanson, Eric T. 2006. "Have Increases in Federal Reserve Transparency Improved Private Sector Interest Rate Forecasts?" *Journal of Money, Credit and Banking* 38 (3):791–819. URL https://doi.org/10.1353/mcb.2006.0046.

———. 2017. "Measuring the Effects of Federal Reserve Forward Guidance and Asset Purchases on Financial Markets." NBER Working Paper No. 23311. https://doi.org/10.3386/w23311.

Swanson, Eric T. and John C. Williams. 2014. "Measuring the Effect of the Zero Lower Bound on Medium- and Longer-Term Interest Rates." *American Economic Review* 104 (10):3154–3185. URL https://doi.org/10.1257/aer.104.10.3154.

Tang, Jenny. 2015. "Uncertainty and the Signaling Channel of Monetary Policy." Federal Reserve Bank of Boston Working Paper No. 15-8. URL https://econpapers.repec.org/paper/fipfedbwp/15-8.htm.

Werning, Iván. 2011. "Managing a Liquidity Trap: Monetary and Fiscal Policy." URL https://doi.org/10.3386/w17344. NBER Working Paper No. 17344.

Wynne, Mark A. 2013. "A Short History of FOMC Communication." Federal Reserve Bank of Dallas *Economic Letter*, 8 (8). URL https://ideas.repec.org/a/fip/feddel/y2013isepnv.8no.8.html.