

# Forward Guidance under Disagreement

## Evidence from the Fed's Dot Projections

Gunda-Alexandra Detmers \*

Freie Universität Berlin

Department of Economics

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This paper compares the effectiveness of date- and state-based forward guidance issued by the Federal Reserve since mid-2011 accounting for the influence of disagreement within the FOMC. Effectiveness is investigated through the lens of interest rates' sensitivity to macroeconomic news and I find that the Fed's forward guidance reduces the sensitivity and therefore crowds out other public information. The sensitivity shrinkage is stronger in the case of date-based forward guidance due to its unconditional nature. Yet, high levels of disagreement among monetary policy makers as published through the FOMC's dot projections since 2012 partially restore sensitivity to macroeconomic news. Thus, disagreement appears to lower the information content of forward guidance and to weaken the Fed's commitment as perceived by financial markets. The dot projections are therefore able to reduce the focal point character of forward guidance.

*Keywords:* Forward guidance, central bank communication, central bank interest rate projections, monetary policy committee, disagreement.

*JEL classification:* E52, E58

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[Freie Universität Berlin, School of Business and Economics, Boltzmannstrasse 20, 14195 Berlin, Germany; E-mail: gunda-alexandra.detmers@fu-berlin.de]

# 1 Introduction

Forward guidance has become a key instrument in central banking over the past years as the need to manage expectations about the future path of monetary policy has increased. According to e.g. (7), forward guidance is essential for an effective monetary policy when policy rates are very low and uncertainty is high. Since the Federal Reserve (Fed) and other central banks (as e.g. the European Central Bank and the Bank of Canada) adopted this measure as a consequence of the financial crisis, the term *forward guidance* has come to be interpreted as a promise to keep interest rates low for an extended or explicit period of time or until a certain condition is met.<sup>1</sup> Yet, forward guidance had already been used before the crisis in conjunction with other macroeconomic projections as a measure of expectations management and central bank transparency.

The Fed's forward guidance has experienced different designs, especially since the eruption of the financial crisis.<sup>2</sup> In December 2008, the Fed started off with a qualitative open-ended forward guidance which was then extended to include explicit time and state dimensions. Specifically, from August 2011, the Fed provided unconditional forward guidance in the form of a date-based commitment to keep interest rates low for an explicit period of time. This horizon was adjusted in subsequent monetary policy meetings. In December 2012, the Fed then adopted state-based forward guidance by linking a future rise in the federal funds rate to certain outcomes in unemployment and inflation.<sup>3</sup> This step conditioned forward guidance on macroeconomic developments and thus made it less rigid. In January 2012, the participants of the Federal Open Market Committee (FOMC)<sup>4</sup> began to provide their individual assessments of the appropriate future policy rate path in order to enhance the public's understanding of monetary policy decisions that depend on the Committee's assessment of macroeconomic conditions, see (18). Before, the FOMC had already published a tendency of

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<sup>1</sup>For a review of forward guidance strategies at the zero lower bound by the Fed, the Bank of England, the ECB and the Bank of Japan, see (23), (9) and (10). For research on the effects on expectations by committing to a future policy path in the context of low interest rates, see e.g. (14).

<sup>2</sup>This paper concentrates on the Fed's forward guidance issued since 2008. For literature on the Fed's communication and forward guidance beforehand - including the period between 2003-2005, see e.g. (40) and (27).

<sup>3</sup>Date- and state-based forward guidance are sometimes also referred to as calendar- and threshold-based forward guidance, compare (21).

<sup>4</sup>In fact, not only the members of the FOMC but also the non-voting Reserve Bank presidents provide their assessments within the Summary of Economic Projections. Hereinafter, if not explicitly stated, the term "participants" comprises all those who participate in the assessment that is published by the FOMC. For further details, see Chapter 3 and Appendix A.

macroeconomic projections based on individuals' assessments of the appropriate future policy rate. Yet, a clear communication of the latter with all individual projections conveying the Committee's disagreement is expected to influence market expectations about future monetary policy. However, it is still unclear how and to what extent markets react to this kind of forward interest rate publications.

This paper is the first to comprehensively compare the effectiveness of date- and state-based forward guidance and to consider the impact of disagreement within the FOMC thereon. Specifically, this paper builds on (39) and (35) and investigates effectiveness through the lens of interest rates' sensitivity to macroeconomic news. Macroeconomic models suggest that macroeconomic news do not persistently impact short-term interest rates. Therefore long-term rates that represent the expected future path of short rates should not be affected. However, (25) find that interest rates along the term-structure move upon a macroeconomic surprise. This reaction pattern can be used in order to analyze the effect of central banks' expectations management on the yield curve. For conditional and unbinding forward guidance, one would wish sensitivity to either stay constant or even rise (compare 29) as the central bank projection just increases the information set of market participants and should not crowd out other signals. Market participants would thus understand the conditional nature of forward guidance. By contrast, forward guidance that conveys sort of a commitment would result in a lower responsiveness of interest rates of respective maturities if the promise is perceived as credible. This rather unconditional forward guidance would constitute a focal point in the financial market such that interest rates would be less affected by macroeconomic news. Forward guidance thus crowds out other information that market participants would typically use to form expectations. While date-based forward guidance can be considered as being purely unconditional, state-based forward guidance is conditional and still contains some commitment character. Therefore, one would expect the sensitivity of interest rates to macroeconomic news to be higher than in the unconditional case.

The sample of this paper covers a base period from December 2008 until August 2011 and I allow for an altered sensitivity change due to date- and state-based forward guidance respectively thereafter. I find that both date- and state-based forward guidance are effective in lowering the sensitivity of Treasury yields to macroeconomic news. Yet, the impact of date-based forward guidance is stronger. This is due to its unconditional character which induces market participants to be less attentive to other

macroeconomic developments. As credibility is crucial for the effectiveness of forward guidance, this implies that financial market participants believe in the promise by the central bank to keep interest rates low, despite a potential time-inconsistency problem. By contrast, under state-based forward guidance, the sensitivity shrinkage is less pronounced as market expectations are steered to account for macroeconomic developments.

A key contribution of this paper is to let these effects differ with the level of disagreement on the future policy path that is provided in the quarterly dot projections of the FOMC. These projections reveal that policy makers do not entirely agree on future monetary policy. Thus, if the central bank provides information on disagreement, this could be detrimental to the impact of forward guidance. In line with this intuition, I find that high levels of disagreement among policy makers result in a higher sensitivity of interest rates to macroeconomic news especially during the date-based forward guidance period for the medium- to longer-run. Thus, the publication of dot projections as a measure to heighten transparency is able to reduce the focal point character of forward guidance and somehow responds to the criticism of (30).

This analysis arrives at the result that financial market participants attached credence to the Fed's forward guidance since the financial crisis erupted in 2008. The findings further support that conditioning forward guidance and publishing dot projections conveying the disagreement among monetary policy makers helps to consolidate financial market participants' attentiveness to information.

This paper contributes to a strand of literature that examines the effectiveness of forward guidance by means of sensitivity analysis and is therefore closely related to e.g. (39), (35) as well as (29). It further contributes to the literature on decision making of monetary policy committees and the communication of those decisions. While some literature is in favor of communicating only the consensus view of committee members (15), (36) argue that dissenting votes help to better anticipate future monetary policy decisions.

The rest of the paper is organized as follows. In the next chapter, I summarize the evolution of the Fed's forward guidance since 2008 and link it to the literature. In Chapter 2.3.1 the empirical model is introduced and the empirical results on date- and state-based forward guidance are presented. Chapter 3 discusses the FOMC's dot projections as well as several measures of disagreement. In Chapter 4, the empirical model

is augmented by measures of disagreement. It will further present some robustness checks where I control for policy uncertainty and then allow for asymmetric effects due to interest rates' proximity to the zero lower bound. Finally, Chapter 5 concludes.

## 2 The FOMC's Forward Guidance since 2008

The Federal Open Market Committee (FOMC) is responsible for the conduct of monetary policy at the U.S. Federal Reserve (Fed). The FOMC meets regularly eight times a year to review the current target level for the federal funds rate and to steer market expectations about its future level, for instance through issuing economic projections.

While monetary policy decisions at the Fed were not announced at all before 1994 (see ? ), policy makers have moved to making concrete statements and now even provide forward guidance in their monetary policy statements (see 43).<sup>5</sup> The FOMC already issued forward guidance from 2003 to 2005 when the federal funds rate was at 1%, affirming that “policy accommodation can be maintained for a considerable period” (17). As the policy rate approached the zero lower bound in December 2008, the Fed again started projecting future levels of the federal funds rate. Traditional monetary policy was bounded and forward guidance therefore became an essential tool (see 7).

Forward guidance was adopted by several other central banks already before the financial crisis in order to manage financial markets' expectations and to make the public learn about the central bank's reaction function.<sup>6</sup> This expectations management was further intended to lower interest rate uncertainty and thus financial market volatility, and represented a significant increase in central bank transparency. However, monetary policy makers always tried to emphasize the conditional character of these future paths. The influence of these projections on long-term interest rates was therefore rather limited (compare 11). By contrast, unconditional projections about the future policy path may serve as a commitment device to steer longer-term rates, especially when policy rates are already very low.<sup>7</sup> (8) define this assurance to stick to

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<sup>5</sup>For a historical review of the Fed's forward guidance, see also (9).

<sup>6</sup>The Reserve Bank of New Zealand was the first central bank to publish quantitative interest rate projections in 1997 (see 11). Other central banks followed in providing forward guidance, as for example the Bank of Norway in 2005 and Sveriges Riksbank in 2007.

<sup>7</sup>The Bank of Japan introduced this kind of forward guidance already in 1999, when the policy rate was 0.15% (see 10).

accommodative monetary policy as “Odyssean forward guidance”. In contrast, the projection of a presumable path conditional on the future economy represents a non-binding forward guidance that the authors refer to as “Delphic forward guidance”. All the different designs of forward guidance implemented by the Fed since 2008 can be classified as Odyssean forward guidance. In the following, the terms *conditional* and *unconditional* will therefore signify the different degrees of the Fed’s Odyssean forward guidance.

## 2.1 Date- and State-based Forward Guidance

In December 2008, together with the most recent rate cut, the FOMC initially committed itself to a low future level of the federal funds rate in a verbal statement. At that time, expected inflation was too low to be consistent with the Fed’s mandate and standard monetary policy tools had lost their effectiveness. The FOMC stated that “weak economic conditions are likely to warrant exceptionally low levels of the federal funds rate for some time” (see ? ).<sup>8</sup> This warranty got strengthened in the March 2009 statement by spanning “an extended period of time”.

In August 2011, the FOMC surprisingly<sup>9</sup> introduced an explicit horizon which was renewed and prolonged in the January and September 2012 statements (see Table 1). The horizon always covered the next 2 to 3 years over which the FOMC expected to not increase the target for the federal funds rate. This *date-based forward guidance* comes close to an unconditional commitment to keep the policy rate at the current level and is thus the most binding forward guidance ever issued. However, FOMC participants expressed their concern that the press misinterpreted the date as a full commitment (see 19).

There are advantages and disadvantages to the concept of committing to low policy rates. On the one hand, such commitment might serve as an extensive economic stimulus, especially if the commitment period is longer than expected by market participants (compare 41).<sup>10</sup> On the other hand, by committing to low future policy rates, the cen-

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<sup>8</sup>In line with e.g. (21), exceptionally low levels are construed as the current level or range respectively of the target federal funds rate.

<sup>9</sup>See (35) and (21).

<sup>10</sup>While the Fed’s policy could be viewed as an extended commitment following (41), (9) suggest that date-based forward guidance may have also signaled either a weaker economic outlook or a change in the policy rule of the Federal Reserve.

**Table 1** Forward Guidance at the Federal Reserve since December 2008

Dec 16, 2008	The Fed <b>starts to provide forward guidance</b> and projects low levels of the federal funds rate “for some time”.
March 18, 2009	The Fed <b>prolongs the horizon</b> to “an extended period of time”.
Aug 9, 2011	<b>Date-based</b> forward guidance (= unconditional forward guidance) Aug 9, 11: “at least through mid-2013” Jan 25, 12: “at least through late-2014” Sep 13, 12: “at least through mid-2015”
Jan 25, 2012	Publication of <b>dot projections</b> revealing disagreement among FOMC participants
Sep 13, 2012	Committee expects that a highly accommodative stance of monetary policy will remain appropriate for a <b>considerable time after</b> the economic recovery strengthens.
Dec 12, 2012	<b>State-based</b> forward guidance (= conditional forward guidance linked to actual unemployment rate and inflation projections)
March 19, 2014	Extension of time horizon of forward guidance; low interest rate levels <b>even after</b> employment and inflation are near mandate-consistent levels.

*Notes:* This table summarizes the most important changes in forward guidance at the U.S. Federal Reserve through FOMC Statements between December 2008 and March 2015. This paper focuses on the shaded entries. Source: Federal Reserve System.

tral bank loses flexibility and might run into a time-inconsistency problem (see also 41): At the time when improved economic conditions would allow a rise in the policy rate despite a still valid promise of low levels, the central bank either risks to lose credibility by deviating from its promise or an overshooting in inflation and output above the levels consistent with the bank’s target. (32) shows that despite this overshooting the decline in output and inflation is less extreme during crisis periods due to a re-anchoring of inflation expectations. Furthermore, an overshooting is relatively easy to cope with as conventional monetary policy is effective again. Yet, knowing about the time-inconsistency, the public might not believe in the central bank’s commitment in the first place, lowering the stimulating effect of forward guidance on the economy. Thus, effective forward guidance is mostly a matter of central bank credibility and public understanding (see 23).<sup>11</sup>

Soon, FOMC statements additionally became more explicit about the economic con-

<sup>11</sup>(23) further suggest that forward guidance is potentially useful if there is a commitment that is clearly communicated and interpreted in the intended way.

ditions warranting low future rates (see for instance the FOMC's statement on September 13, 2012). As a consequence of such a policy, the public may learn about the central bank's reaction function, helping policy makers to regain flexibility.

In December 2012, the date-based forward guidance was then succeeded by a *state-based forward guidance* that had already been discussed in January 2012 (see (19), page 14). Instead of being explicit about the horizon, the FOMC started to link a future rise in the federal funds rate to numerical economic conditions, i.e. thresholds in unemployment and projected inflation.<sup>12</sup> In the same statement, the FOMC emphasized that these thresholds are consistent with the date-based forward guidance issued before. Yet, no statement has since specified or prolonged an explicit horizon. The unconditional and therefore inflexible date-based forward guidance was thus somehow replaced by a rather conditional state-based forward guidance.<sup>13</sup>

In order to provide further economic stimulus, the FOMC started in September 2012 to repeatedly affirm that the federal funds rate target would stay low "for a considerable time after the economic recovery strengthens". Since March 2014, this statement has become more explicit as the FOMC now anticipates low policy rates even after unemployment and inflation have reached levels consistent with the Fed's mandate (see 41).

## 2.2 Literature on the Effects of Forward Guidance

According to theory, central bank disclosures about future monetary policy might become a focal point and crowd out private information, see (30). This might be detrimental to social welfare, especially when the public signal is wrong. However, (38) shows that if public and private signals are of the same precision, welfare is higher with a central bank providing information about its projected future policy. This strand of the literature focuses on conditional forward guidance applied before the financial crisis. For binding forward guidance, however, economic stimulus triggered by the central bank can only be achieved when forward guidance translates into financial

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<sup>12</sup>Specifically, unemployment should decline to 6.5 %, inflation projections at the one and two year horizon should be between 2 - 2.5% and longer-run inflation expectations should be well-anchored before a rise in policy rates would be appropriate.

<sup>13</sup>For comparison, the (16) distinguishes four categories of forward guidance, namely pure qualitative forward guidance, qualitative forward guidance conditional on narrative, calendar-based and outcome-based forward guidance.



markets' expectations as forward guidance partially replaces standard monetary policy tools. The public forward guidance signal is therefore *intended* to reduce the relevance of other macroeconomic information.

The empirical analysis of forward guidance typically concentrates on its level and volatility effects on interest rate expectations, as well as on its impact on the sensitivity of interest rates to other news. There is evidence that central bank interest rate projections conditional on the economic outlook influence market expectations and interest rates, at least for short to medium horizons (see e.g. 29). Yet, the effect diminished after the outbreak of the financial crisis in 2008 (11). (23) show that the level effect of the Fed's commitment to low future policy rates on interest rates and expectations up to an horizon of 10 years was highest for the qualitative open-ended forward guidance issued in December 2008 ("for some time") and March 2009 ("extended period of time"). However, these statements coincided with a the most recent rate cut and the announcement of asset purchases. The response of interest rates to the introduction of date-based forward guidance in August 2011 was quite large, especially for the two year horizon. On the day state-based forward guidance was first issued, the effect was quite small or even positive. Yet, the authors ascribe effectiveness to state-based forward guidance as there were also announcements on the reduction of asset purchases. Furthermore, (42) find that extending the expected period of exceptionally low policy rates by one year has a macroeconomic effect comparable to a rate cut by 15 basis points. This suggests that forward guidance can substitute conventional monetary policy at the zero lower bound at least to some extent.

Interest rate projections should persistently affect market expectations and lower financial market volatility. An immediate effect on the policy day with a retraction in the following days is viewed as volatility-increasing and contradicts the spirit of central bank transparency (see ? 11). Fresh central bank announcements on the projected future path potentially lower interest rate uncertainty. Stale projections, by contrast, may lead to increased volatility (see e.g. 12). Furthermore, in the case of the Fed's binding forward guidance, (23) show that volatility of rate expectations was lower during date- and state-based forward guidance periods than in the period with only qualitative forward guidance, especially for horizons up to two years. In particular, date-based forward guidance results in lower volatility for the medium-term while volatility at the shorter horizon is even lower in the state-based forward guidance period.

### 2.2.1 The Sensitivity of Interest Rates to Macroeconomic News as a Measure of Monetary Policy Effectiveness

(25) show that the reaction of longer-term rates to macroeconomic shocks is at odds with macroeconomic models. These predict that short-term rates would move upon a macroeconomic surprise but rapidly return to their steady state values afterwards. Therefore, macroeconomic surprises should not affect long-term rates at all as long as expectations are well anchored. In contrast to theory, the authors find evidence that macroeconomic news also impact long-term interest rates and argue that surprises must have led to an adjustment of the expected steady state level of inflation. The empirical literature builds on this reaction pattern to identify the effectiveness of forward guidance. In particular, if forward guidance reduces the sensitivity to macroeconomic news, this suggests that market participants perceive forward guidance as unconditional and are less attentive to other developments.

(29) find no evidence that forward guidance lowers the market's reaction to other news. In particular, they detect increased responsiveness of futures rates to macroeconomic surprises in the period from August 2003 until December 2005, when it was announced that policy accommodation potentially would be maintained for a considerable period. The authors welcome this result as it shows that market participants are not inattentive to developments outside the Fed.<sup>14,15</sup> In this period, although the federal funds rate was quite low at 1%, it was still above the zero lower bound. Forward guidance in this period was substantially weaker and more of an open-ended design as there was still room for standard monetary policy instruments. This is different for the forward guidance issued after reaching the zero lower bound in December 2008 when the central bank mostly relied on forward guidance as its monetary policy tool.

(39) show that interest rates along the yield curve should be less sensitive to macroeconomic news at the zero lower bound. This especially applies for short-term interest rates that are insensitive to both positive and negative shocks, as long as the zero lower bound is strongly binding with a negative shadow rate.<sup>16</sup> The authors argue that only large positive shocks would be able to generate a rise in the short-term rate. Thus,

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<sup>14</sup>By contrast, (39) show that sensitivity of Treasury yields of three and six months significantly shrinks during the same period.

<sup>15</sup>In the same vein, (28) find that the forward guidance of the Sveriges Riksbank did not significantly impact the sensitivity of interest rates as market participants understood its conditionality.

<sup>16</sup>(28) support this finding for Sweden.

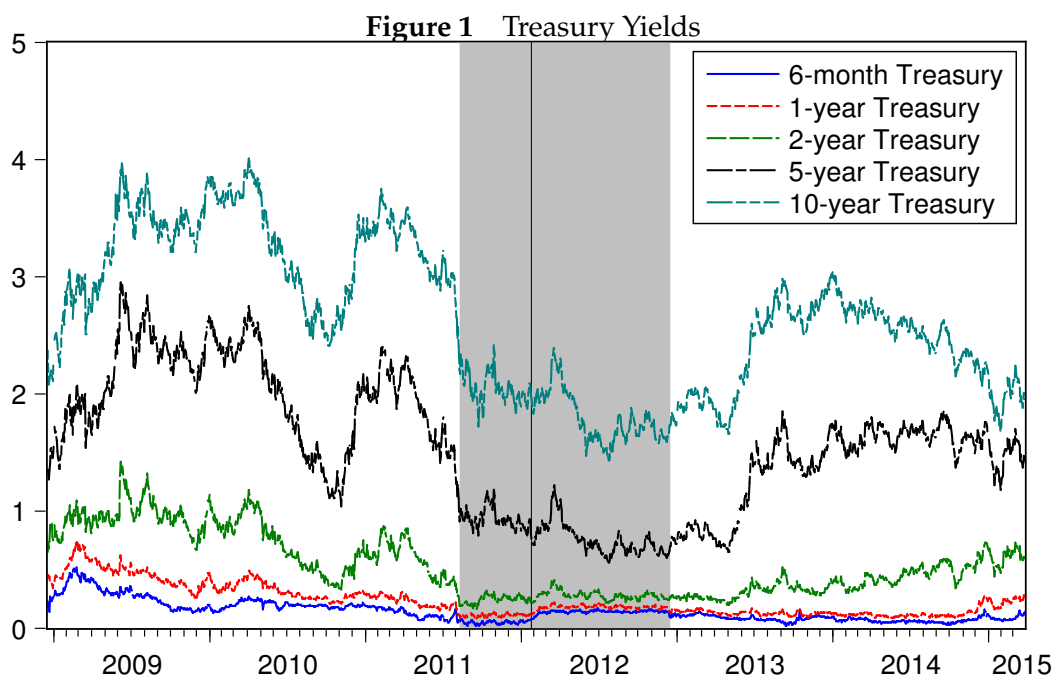
when the central bank publicly commits to keep policy rates at the zero lower bound for a certain period, expected short-term rates within this horizon should not move upon a shock. As longer-term rates average the actual short-term rate and the expected future path of short-term rates, this effect should spread along the yield curve. (39) find decreased responsiveness of Treasury yields to macroeconomic surprises at the short end of the yield curve during the zero lower bound period. While sensitivity to macro news is highest in the beginning of 2008, it significantly declines for 3- and 6-month horizons around March 2009, when the wording “extended period of time” expanded the horizon of presumably low interest rates and therefore strengthened forward guidance.

## **2.3 The Relevance of Forward Guidance for the Sensitivity of Treasury Yields**

According to both theoretical and empirical literature, macroeconomic surprises should lead to at least a short-lasting move in short-term interest rates. By contrast, long-term interest rates should not move significantly upon macroeconomic news if expectations are well anchored. Yet, at the zero lower bound, the reaction of short-term rates should be reduced or not happen at all, see (39).

In the empirical analysis, I use U.S. government Treasury yields available at the Federal Reserve Board at multiple horizons from 6 months to 20 years. Figure 1 depicts the evolution of a set of Treasury yields over the sample period from December 2008 until March 2015. The dark shaded area represents the date-based forward guidance period, while the state-based period begins thereafter. Short-term interest rates are rather low and close to the zero lower bound that prevails throughout the whole sample. During the date-based forward guidance period, interest rates of medium- to long-run maturities were lower than before. Committing to low interest rates for an explicit horizon therefore seems to be an effective forward guidance strategy to steer longer-term interest rates. Yet, Figure 1 does not allow inferences about the impact of introducing state-based forward guidance. However, longer-term rates rise in mid-2013, suggesting that economic data indicated an upcoming lift-off. In fact, the Fed at that time announced to reduce its asset purchase programs which led to the “2013-taper tantrum”.

For analyzing the sensitivity of Treasury yields to macroeconomic news, I use actual



*Notes:* Treasury yields at maturities 6m, 1y, 2y, 5y, 10y. Dark shaded area represents the time period of date-based forward guidance from August 9, 2011 onwards. State-based forward guidance started in the period thereafter, i.e. on December 12, 2012. Vertical line represents the introduction of dot projections on January 25, 2012.

releases together with the median forecast of the RTR poll from Datastream. I compute surprises as the difference between forecast and actual releases and normalize them by their historical standard deviations. Following the literature (e.g. 25; 39; 35), the regressions include economic surprises on output, prices and labor specifically capacity utilization, consumer confidence, core CPI, GDP (advance), ISM manufacturing index, leading indicators, new home sales, nonfarm payrolls, core PPI, retail sales ex. autos and the unemployment rate. Panel A in Table 8 in the Appendix summarizes some statistics on the set of macroeconomic surprises. While there are only 25 observations for the quarterly release of the GDP (advance), there are 72 to 76 observations of all other macroeconomic variables due to a monthly release schedule. As some releases are communicated at the same day, there are 603 announcement days in the sample.

Binding forward guidance, whether conditional or unconditional, should result in financial market participants becoming less attentive to macroeconomic news. If forward guidance does not reduce sensitivity to macroeconomic news at all, this could have three reasons. First, the central bank or the issued forward guidance may not

be credible from market participants' point of view. Second, this could imply a bad transparency scheme of the central bank. Markets then would be unable to correctly process the provided information (see e.g. 23). Third, markets might have already priced in the prolonged period of low interest rates. Yet, this would involve no reason for the Fed to insist on forward guidance as intensively as done in this period since binding forward guidance is costly due to a loss in flexibility. In order to analyze the effectiveness of the different strategies, I will consider the following hypotheses in the empirical model. The first hypothesis to be tested in the model therefore reads:

**Hypothesis 1:** *Credible binding central bank forward guidance should lead to a decreased sensitivity of Treasury yields to macroeconomic surprises.*

The sample period allows to investigate whether a potential sensitivity decreasing effect differs between date- and state-based forward guidance. Date-based forward guidance as pursued by the Fed is an unconditional commitment such that Treasury yields should not be affected by any surprising macroeconomic developments if the guidance is credible, compare (39) and (35). Specifically, if the central bank commits itself to keep interest rates at the actual level for an explicit horizon, interest rates that match this maturity should not significantly move upon a macroeconomic surprise. By contrast, state-based forward guidance is a conditional commitment and linked to unemployment and inflation projections. If a commitment is conditional on macroeconomic developments, market participants should be attentive to macroeconomic surprises for the formation of expectations. Consequently, the sensitivity shrinkage should be higher under date-based than under state-based forward guidance due to a different level of conditionality. This is a refined approach which translates into the second hypothesis:

**Hypothesis 2:** *Due to its unconditionality, the sensitivity-lowering effect of date-based forward guidance should be more pronounced than in the state-based forward guidance regime when markets are more attentive to macroeconomic developments.*

### 2.3.1 Empirical Model and Results

Advancing on (39) and (35), I analyze the sensitivity of Treasury yields to macroeconomic news by letting the sensitivity depend on the prevailing forward guidance design. For Treasury yields of maturities  $j = 6$  months, 1, 2, 3, 5, 10, 20 years, I estimate the empirical model on all macroeconomic release dates  $t$  from December 16, 2008 until March 30, 2015:<sup>17</sup>

$$\Delta r_t^j = \alpha^j + \sum_k \beta^{k,j} s_t^k (1 + \gamma^{d,j} D_t^{date} + \gamma^{s,j} D_t^{state}) + \varepsilon_t^j \quad (1)$$

where  $s^k$  are the macroeconomic surprises introduced above.  $D_t^{date}$  and  $D_t^{state}$  represent step dummies that equal 1 in the respective time periods, see Table 1 and Figure 1. The  $\gamma$ 's then determine the overall change in the yield's sensitivity to macroeconomic news during the date-based and state-based forward guidance period respectively.

I expect sensitivity of Treasury yields to macroeconomic news to shrink when binding forward guidance is issued, especially for the short- to medium-run. In line with Hypothesis 1, this implies that the coefficients of date- and state-based forward guidance dummies should be negative, i.e.  $\gamma < 0$ . Yet, as short-term rates are bounded, one could also expect this sensitivity shrinkage to be absent in the very short-run. Since there should be a higher importance of macroeconomic news in times of state-based forward guidance following Hypothesis 2, the effects of the two concepts of forward guidance are allowed to differ. Specifically I expect  $|\hat{\gamma}^{d,j}| > |\hat{\gamma}^{s,j}|$  and a significant estimate of  $\gamma^{d,j}$  for longer maturities  $j$  than of  $\gamma^{s,j}$ .

Table 2 summarizes the results from estimating Equation 1. All significant responses are plausibly signed. In line with (35), surprises in nonfarm payrolls and retail sales excluding autos significantly affect interest rates along the yield curve. Note that the base period from December 2008 until August 2011 is already a period in which short-term interest rates are no longer sensitive to the whole set of macroeconomic news (compare 39). Here, for instance, nonfarm payrolls significantly affect Treasury yields except for the very short-run. Yet, there are significant effects of the ISM manufacturing index and the advance release of GDP along the yield curve as well as of core PPI for medium-term rates. Yet, as the period from December 2008 onwards is a period with

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<sup>17</sup>The estimation results are robust to whether only announcement days or all business days are covered in the sample.

**Table 2** The Sensitivity-Lowering Effect of Date- and State-based Forward Guidance on Treasury Yields to Macroeconomic News

	6months	1year	2years	3years	5years	10years	20years
Capacity utilization	0.17 (0.20)	-0.20 (0.20)	0.33 (0.39)	0.43 (0.43)	0.02 (0.53)	-0.53 (0.49)	-0.63 (0.45)
Consumer confidence	0.01 (0.14)	-0.04 (0.33)	0.38 (0.59)	0.54 (0.56)	0.72 (0.65)	0.85 (0.54)	1.12** (0.57)
Core CPI	-0.29 (0.28)	-0.19 (0.40)	-0.70 (0.78)	-0.71 (0.78)	-0.89 (0.90)	-0.96 (0.83)	-0.86 (0.67)
GDP advance	0.38** (0.18)	0.09 (0.15)	1.13* (0.66)	1.73* (1.03)	2.16* (1.12)	2.42** (1.19)	2.43** (1.14)
ISM index	0.36* (0.18)	0.00 (0.24)	0.28 (0.65)	0.69 (0.61)	1.25* (0.73)	1.57* (0.81)	1.57** (0.74)
Leading indicators	-0.11 (0.22)	0.01 (0.15)	0.50 (0.48)	0.59 (0.69)	0.40 (1.00)	0.21 (1.09)	-0.21 (0.95)
New homes	0.19 (0.22)	-0.02 (0.21)	0.02 (0.41)	-0.05 (0.48)	-0.15 (0.52)	-0.15 (0.40)	-0.09 (0.38)
Nonfarm payrolls	0.83* (0.45)	2.57*** (0.86)	6.03*** (2.02)	5.64*** (1.92)	5.76*** (1.69)	3.63*** (1.13)	3.10*** (0.98)
Core PPI	0.18 (0.15)	0.48 (0.40)	1.70** (0.71)	2.17** (0.86)	2.25** (0.98)	1.31 (1.00)	1.39 (1.08)
Retail sales ex. autos	0.21 (0.14)	0.36* (0.20)	0.54 (0.43)	1.25** (0.57)	1.88** (0.84)	2.13*** (0.79)	2.15*** (0.80)
Unemployment	0.19 (0.24)	0.16 (0.47)	0.31 (1.03)	0.61 (0.95)	0.79 (1.02)	0.77 (0.79)	0.77 (0.72)
Date-based FG: $\gamma^d$	-0.75*** (0.14)	-0.86*** (0.05)	-0.94*** (0.03)	-0.83*** (0.07)	-0.67*** (0.14)	-0.17 (0.38)	-0.05 (0.46)
State-based FG: $\gamma^s$	-1.26*** (0.22)	-0.65*** (0.19)	-0.33 (0.28)	0.08 (0.4)	0.32 (0.42)	0.55 (0.49)	0.55 (0.46)
$H_0 : \beta = 0$	0.11	0.13	0.02	0.04	0.05	0.13	0.09
$R^2$	0.05	0.14	0.16	0.13	0.11	0.08	0.08

Notes: Estimations for Equation 1 for all announcement days between December 16, 2008 and March 30, 2015. i.e. 603 observations for each horizon.  $\Delta r_t^j = \alpha^j + \sum_k \beta^{k,j} s_t^k (1 + \gamma^{d,j} D_t^{date} + \gamma^{s,j} D_t^{state}) + \varepsilon_t^j$ , Newey-West standard errors in parentheses; \*\*\* (\*\*) [\*] denotes significance at the 1% (5%) [10%] level.  $H_0 : \beta = 0$  tests for all  $\beta$ s being jointly zero and states the respective  $p$ -value.

rather low sensitivity to macroeconomic news, some results have to be interpreted with caution. Specifically, the test on joint significance of all  $\beta$ s cannot be rejected for horizons of 6 months, 1 and 10 years; still, the  $R^2$  is just as high as in comparable studies.

The shaded area in Table 2 shows the main coefficients of interest, namely the effect of forward guidance on the sensitivity of Treasury yields. With  $\gamma^d < 0$  for all horizons, there is a sensitivity-lowering effect of date-based forward guidance throughout the yield curve. The reaction of Treasury yields to macroeconomic surprises is thus lower under date-based forward guidance. This effect is statistically significant for horizons up to 5 years. Thus date-based forward guidance has a rather expansive influence as the announced horizons only covered the next 2 or 3 years. Reasons for this could be further announcements that low interest rates would prevail even after the economic recovery has strengthened (41) or a strong correlation between Treasury yields of different maturities. The Fed's forward guidance thus seems to be rather credible as the public does not expect the Fed to deviate from its promise despite a time-inconsistency problem.

State-based forward guidance only results in a sensitivity shrinkage at the short end of the yield curve. Market participants seem to consider low policy rates as guaranteed for the very short-run but are attentive to macroeconomic developments for the formation of medium- to longer-run expectations. The discrepancy in the strength of reactions to date- and state-based forward guidance confirms their different conditionality. In fact, (5) find evidence that the degree of commitment decreases in December 2012. Financial market participants observe this decline in commitment and become more attentive to macroeconomic news. The results affirm the hypotheses proposed above and show that different forward guidance strategies represent some scope for effective expectations management even at the zero lower bound.

### 3 The FOMC's Dot Projections and Disagreement

In January 2012, the FOMC started to disclose participants' individual assessments of the appropriate future policy rate. These publications aim to enhance the transparency of the Federal Reserve System and potentially increase the public's understanding of monetary policy (see 18). Yet, FOMC participants might disagree in their view of the



appropriate future path. Through the regularly published dot projections, this disagreement becomes public information and might affect financial markets' perception of the Fed's forward guidance and impair its effectiveness. Specifically, the reaction of interest rates to macroeconomic surprises may become stronger in the presence of disagreement.

After a short review of literature on disagreement within monetary policy committees, this chapter presents and discusses the FOMC's dot projections. I further measure the enclosed disagreement that will (in Chapter 4) augment the empirical model of Chapter 2 in order to investigate the disagreement's effect on interest rates' sensitivity and on the effectiveness of other forward guidance.

### **3.1 Disagreement within Monetary Policy Committees: Literature and Background**

Monetary policy committees primarily decide on the current policy rate. Yet, they might disagree on the appropriate monetary policy. Disagreement is treated differently depending on whether decisions are taken on a majority or consensus approval. In the first case, as for the FOMC, dissenting committee members do not prevent decision making. Dissenting votes might even help to predict future policy decisions (see (24) for the Bank of England and (36) for the Sveriges Riksbank and the Federal Reserve).<sup>18</sup> In contrast to (36), (15) find that central bank communication enhances the predictability of monetary policy decisions and lowers market uncertainty if the consensus or majority view is communicated rather than the individualistic views of committee members. In line with this finding, there is little information about disagreement among monetary policy makers although central banks have tended to increase their transparency in recent decades.<sup>19</sup>

It seems obvious that committee members disagree not only on current monetary policy but also on its appropriate future path. This is particularly observable in the case of the FOMC already before the crisis. (6) classifies the FOMC's structure as collegial; however, its communication tends to be individualistic with differing views

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<sup>18</sup>In a committee with consensus-rule, in contrast, the role of dissenting votes differs as it involves more discussion, an intense debate about the different opinions and efforts of persuasion.

<sup>19</sup>This particularly applies to disagreement about appropriate future monetary policy. Furthermore, there are central banks, as for instance the RBNZ, that only have one governor and therefore full agreement by definition.

across members (see 7). While the collegial character is apparent in the actual monetary policy decision, the individualistic communication essentially matters for expectations management through speeches and is especially reflected in the individual assessments. The FOMC already published projections for GDP, CPI and unemployment before 2012, though in a restricted way with only range and central tendency<sup>20</sup> rather than individual forecasts. These projections were conditioned on each member's assessment of the monetary policy path, but the FOMC did not incorporate these in the Summary of Economic Projections until January 2012. An underlying reason is that the public might misinterpret these publications as specific intended policy paths. This concern was also voiced in the discussions surrounding the introduction of dot projections when some members suggested to refrain from this kind of projections at this time or to rather decide on a common interest rate path (see 18). Yet, to date, other central banks as e.g. the Bank of Canada do not disclose their members' views about the future path at all and are therefore insufficiently transparent according to (33).

### **Reasons for Disagreement**

There may be different reasons for FOMC participants to disagree on the appropriate future interest rate path. First, participants may have a different outlook on the economy as suggested by their economic projections. Regional Reserve Bank presidents may especially be biased in decision-making towards the economic situation in their own region. Second, the participants' individual future interest rate paths might depend on their voting status. As (4) outline, participants' assessments may differ depending on their voting status. If Reserve Bank presidents are voting members, they might change their assessment of appropriate monetary policy with a bias towards the situation in the region of the respective Reserve Bank. Third, their individual policy reaction functions may differ. In this context, (13) examines a set of projected variables of each participant in the Survey of Professional Forecasters in order to investigate whether forecasters disagree on the model or on the particular scenario that will materialize. There might be further characteristics that influence participants' view on the appropriate current and future monetary policy. (37) show that e.g. the FOMC member's time spent at the Federal Reserve System is an important factor in the committee's decision making process.

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<sup>20</sup>Central tendency is a trimmed range excluding the extreme values, i.e. the three highest and lowest projections respectively.

In the present study, however, these aspects cannot be covered due to the anonymity of dot projections.<sup>21</sup> It is not possible to link rate projections to participants' economic outlook or their voting status. Similarly, projections neither reveal the individual projected paths nor their adjustments from one publication to the next. One might be concerned that the data are noisy due to participating non-voting Reserve Bank presidents that cannot be distinguished from decision-making members. However, within the horizon of projections, all members (or at least their representatives or successors) will eventually enter the decision-making circle of the FOMC.<sup>22</sup>

(33) state different risks for monetary policy decision making by committees that might partially apply to the assessments. They list a free rider problem and information cascades as a variant where committee members ignore independent signals and simply agree with other members for convenience. Furthermore, polarized committee members might tend to extreme assessments that are either extremely cautious or risk-taking. Therefore, actual disagreement might differ from the published dot projections. However, it is the communicated and perceived disagreement that should matter for the effectiveness of the Fed's forward guidance.

Different aspects of the Fed's dot projections have been analyzed and used in only some studies as of yet. (?) compared the median policy rate path to market expectations. (5) use the FOMC's dot projections to extract the degree of commitment. In particular, they find a decrease in commitment after December 2012 when state-based forward guidance was issued. (Morris, Stephen D.) determines which monetary policy rule can explain FOMC's rate projections best. Yet, this paper is the first to consider the impact of FOMC's disagreement about the future policy path on the effectiveness of forward guidance and therefore closes an important gap.

## 3.2 The Dot Projections

At the end of 2011, the FOMC decided to incorporate individual members' projections of appropriate monetary policy into its Summary of Economic Projections from 2012.<sup>23</sup> Projections would be published after every second monetary policy meeting, i.e. in

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<sup>21</sup>There is a publication lag of several years for the detailed projection information.

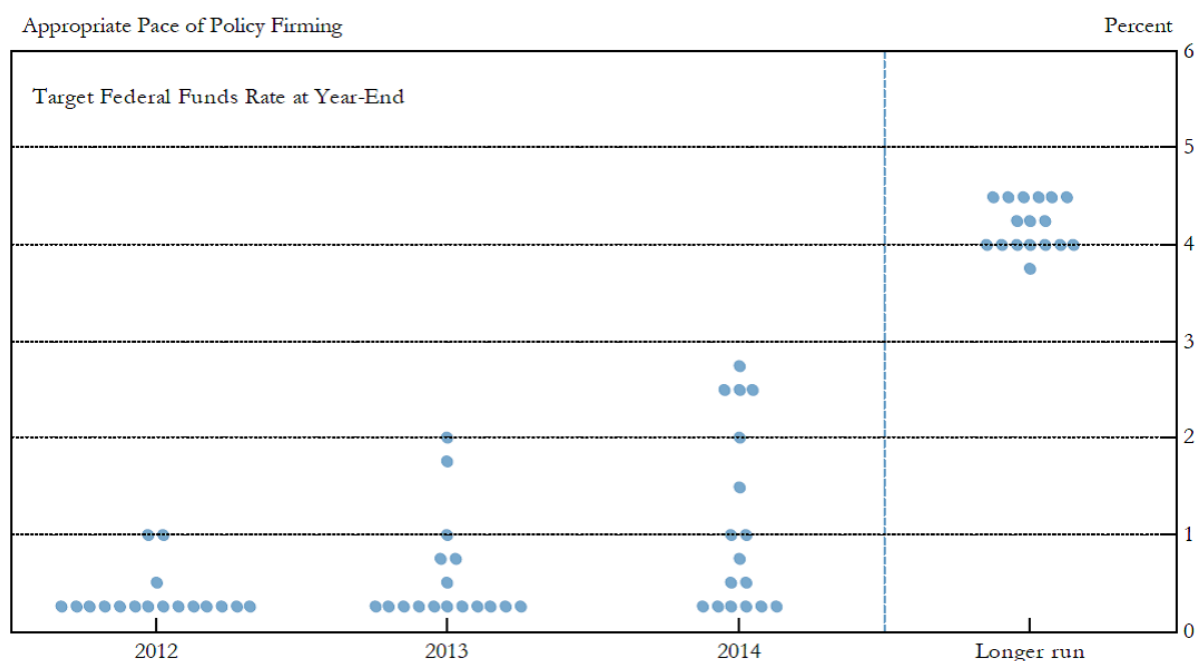
<sup>22</sup>For some background information on the composition of participants in the quarterly projections, refer to Appendix A.

<sup>23</sup>See (18).

general four times a year.<sup>24</sup>

There are generally 17 participants in the regular assessment of the economy and policy options. This number is subject to changes in the Board of Governors, see Appendix A that offers some institutional background of the composition of FOMC participants. In the assessments covered by this paper's sample, there are 16 to 19 participants in each assessment.

**Figure 2** FOMC Participants' Assessments of Appropriate Monetary Policy Issued on January 25, 2012



*Notes:* Each dot indicates an FOMC participant's assessment of the appropriate federal funds rate target level or midpoint of target range at the end of the specified calendar year and for the longer-run. Data is rounded to the nearest 0.25%. Source: Federal Reserve System - FOMC Summary of Economic Projections.

Figure 2 depicts the first publication of individual assessments issued in January 2012. In every assessment, participants are asked about the appropriate pace of policy firming. Dots indicate the appropriate target level or midpoint of the target range for the federal funds rate at the end of the respective year and for the longer-run according to the assessment of every individual participant. The longer-run projections assume

<sup>24</sup>In general, assessments are provided after monetary policy meetings in March, June, September and December; except for 2012 when there were five publications in January, April, June, September and December.

that the federal funds rate will converge to this rate under appropriate monetary policy and that no further shocks hit the economy. They can thus be interpreted as the interest rate that is believed to prevail in the steady state.

While all participants viewed a future rise in the policy rate as appropriate (see longer-run), 6 out of 17 participants preferred to not increase the federal funds rate target until at least late 2014. 11 participants regarded low levels of 1% and below as adequate to the projected economic situation within this horizon. This is somehow in line with the date-based forward guidance issued on the same day which projects exceptionally low interest rates through late 2014. None of the FOMC participants expected a return to normal conditions in the very near future. Especially in due consideration of gradualism in the adjustment of interest rates, Figure 2 suggests that steady state conditions will not be achieved before 2016 in the opinion of participants.

## **Disagreement**

While dots are quite dense for the shortest horizon, they spread out over time. Reasons for rather little disagreement about the appropriate level at the end of the current year may include gradualism and in particular the commitment to a low federal funds rate that was supported by nearly all decision-making members at this meeting.<sup>25</sup> While the bulk of dots is located between 0.25% and 1% for the next three years, some participants expected that a substantial rise in future interest rates is already reasonable within this horizon. Specifically, 6 participants seem to not agree on the date-based forward guidance. If this promise means to stay at the current policy rate level, only 6 will fully agree with the issued date-based forward guidance.

In contrast, disagreement on the longer-run path of interest rates seems to be less pronounced. Thus, participants have rather similar views on the steady state level of the policy rate. Yet, there is still some disagreement on how to achieve policy goals in the longer-run. Their individual policy reaction functions may differ and there is also some disagreement among FOMC participants on the optimal longer-run values of output and unemployment (see FOMC Summary of Projections).

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<sup>25</sup>In fact, Jeffrey M. Lacker voted against the FOMC monetary policy action on January 25, 2012 as he did not agree with providing the explicit time period (“through late 2014”) of an exceptionally low federal funds rate, see (19).

## Development of projections over time

In the period between January 25, 2012 and March 30, 2015, there were 14 assessments, 6 of which (September and December projections) include a prolonged horizon of up to 4 years (see Figure 5 in Appendix). The (dis)agreement pattern observed in Figure 2 is in general consistent with subsequent dot projection publications; i.e. there is lower disagreement in the short-term (end of current year) as well as in the longer-run while disagreement is larger at intermediate horizons. This partly contrasts with private sector forecasters that also rather agree on the policy rate in the near term, while there is high disagreement about average short-term rates at long horizons for 6 to 11 years, see (1). Yet, their understanding of those long-run expectations may rather differ from the longer-run or steady state level that policy makers are asked to assess in their projections.

In the respective *December projections* (Panels d, h, l in Figure 5), there is no disagreement on the rate at the end of the current year indicating that there is no other review of the federal funds rate target scheduled for the rest of the year. The end-of-this-year target is therefore seen as guaranteed, aside from unscheduled decisions that could be taken. Yet, participants could still see a higher interest rate as appropriate implying that they disagree with the decision on the current policy rate.<sup>26</sup> Another striking feature of Figure 5 is that in 2013 there is no disagreement about the respective end-of-year rate already in the September projection. FOMC participants potentially felt committed to the unconditional forward guidance that had been issued or foresaw the targeted variables as far from mandate-consistent levels and thus somehow already agreed on the next monetary policy step.

The *longer run projections* refer to normal economic conditions and thus to the steady state that FOMC participants have in mind. In the first half of 2012, the longer-run seems to correspond to an uncertain point in time (or at least far ahead) for all participants. However, already from September 2012 on, there is an overlap of projected rates for the end of 2015 and for the longer-run. Thus, some participants viewed late-2015

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<sup>26</sup>One could attempt to draw conclusions from the voting and the minutes. For instance, in the September 2012 projection, 18 of the 19 participants agree on an end-of-2012 target rate of 25 basis points while one person views an end-of-year rate of 50 basis points as appropriate. In the December 2012 decision on the target rate, one person voted against the Fed action to leave the target rate unchanged. However, a direct conclusion cannot be drawn, since participants might change their mind and the participant that disagreed in September might have been a non-voting participant. At least, the composition of participants did not change in the meantime.

as constituting a return to longer-run conditions.<sup>27</sup> Thenceforward, there is in general an overlap of dots at explicit and longer-run horizons implying that the steady state is expected to be achieved within that explicit time frame.

I now examine the *evolution of the median projected path over time*.<sup>28</sup> In the following,  $eo y_0$  refers to the current projection for end of this year,  $eo y_1$  for the end of next year and  $eo y_2$  as well as  $eo y_3$  for the end of subsequent years, respectively.  $lr$  represents the longer-run or steady state projection. Panel (a) in Figure 3 displays the evolution of median projections at the different horizons. There are four continuous lines for the horizons  $eo y_0$ ,  $eo y_1$ ,  $eo y_2$  and  $lr$ . FOMC participants' assessments appear to be consistent over time. The projection for the end of the current year  $eo y_0$  continuously lies at 25 basis points until September 2014, when the median FOMC participant projects the federal funds rate to even decline to 12.5 basis points.<sup>29</sup> Yet, in March 2015, the median short-term projection increases to 62.5 basis points. This is in line with the  $eo y_1$  projections that has been issued earlier: the median of  $eo y_1$  already increases in March 2014. Similarly, the median of the  $eo y_2$  projection starts to increase already in March 2013. The  $eo y_2$  projection is further characterized by some seasonality with projected rates declining in the assessments at the end of the year. The median participant seems to revise his projection downwards, possibly because the current economic outlook has worsened.

### Subsidiary observations about the longer-run

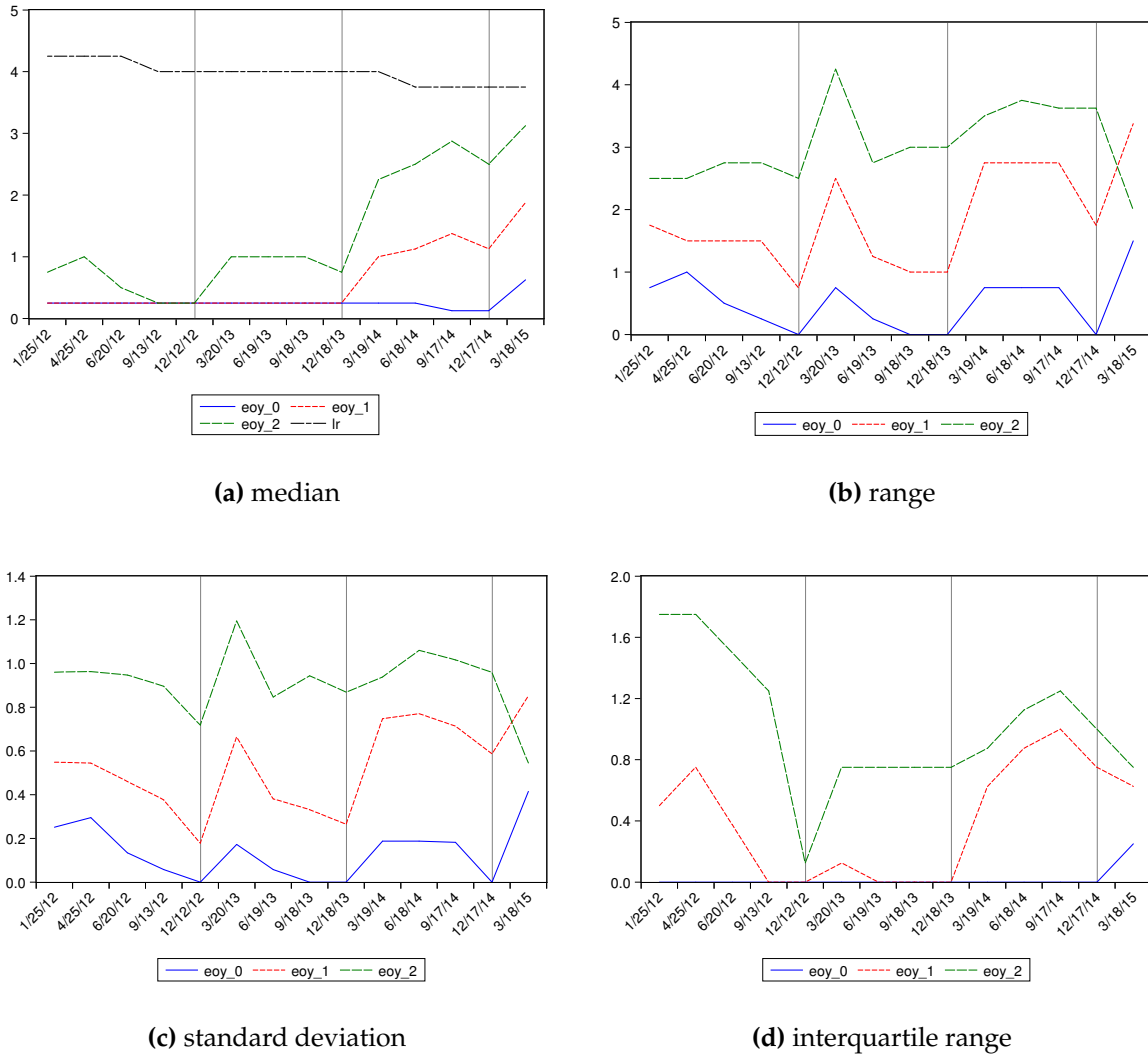
Both Figure 5 in the Appendix as well as Panel (a) in Figure 3 indicate that the perceived appropriate longer-run or steady state level of the target federal funds rate changes over time. Between mid-2012 and mid-2014, the median for  $lr$  declines from 4.25% to 3.75%. This could be due to participants modifying their policy reaction function or adjusting their long-term goals for output and unemployment. As longer-run projections for inflation remained at 2%, this implies a decline in the equilibrium real rate that is in line with other official forecasts, compare (? ).

<sup>27</sup>In the projection issued in June 2012, one end-of-2014 projection coincides with a longer-run projection. However, these dots could refer to different participants.

<sup>28</sup>As the decision-making process in the committee is rather collegial (see 6) and due to typical interest rate cuts and rises by multiple of 25 basis points, votes for the current policy rate target would always end up in a choice for the median rather than the mean.

<sup>29</sup>An important reason for this downward move is that the FOMC rounds projections to the nearest 0.125% instead of 0.25% starting with the September 2014 meeting, see Figure 5.

**Figure 3** Statistical Properties of Dot Projections



*Notes:* (a) Median, (b) standard deviation, (c) range and (d) interquartile range for dot projections at horizons  $eoy_0$ ,  $eoy_1$ ,  $eoy_2$  as well as for the longer-run,  $lr$  for the sample period from January 25, 2012 until March 18, 2015. Vertical lines represent the last projection in each calendar year. Source: Federal Reserve System - FOMC Summary of Economic Projections and author's calculations.

As projections ask for the appropriate path of monetary policy rates, one would expect that future rates gradually adjust until the steady state level is reached. Yet, in the September 2014 projection, it is certain that one participant's assessment of the appropriate policy rate was higher for 2017 than for the longer-run.<sup>30</sup> This participant

<sup>30</sup>This could have been the case as well between September 2012 and June 2016 (except for the June 2013 projection), but one cannot infer this from the dots.



seems to favor the policy suggested by (41). This policy implies keeping interest rates at low levels for horizons longer than necessary, while accepting an overshooting in inflation and output that has to be corrected for by a policy rate target above the steady state rate.

Interestingly, there is at least some overlap of longer-run interest rates projections and the longest definite projection horizon from September 2012 on, signaling an improvement of economic conditions. Yet, it is astonishing that there is a single exception for the June 2013 projection as the Fed signaled greater optimism in its statement of the respective meeting (see 20) and a possible tapering of quantitative easing. Yet, it was emphasized that the “highly accommodative stance of monetary policy will remain appropriate for a considerable time after the asset purchase program ends”<sup>31</sup>.

### 3.3 Measuring Disagreement

The heterogeneity in dot projections can be interpreted as the aggregate disagreement among FOMC participants and can be measured in different ways. Due to the anonymity of dots, disagreement is measured within each cross-section at each point in time.<sup>32</sup> This gives one value of disagreement for each horizon after every second meeting. Although some FOMC participants might reveal changes in opinion through speeches in the meantime, one can hardly infer a change in the overall disagreement from them. Thus, I assume disagreement to be constant between two disclosures of projections and financial markets to perceive this current level of disagreement to be still valid.

The *range* provides a plain measure of disagreement. However, it gives a disproportionate role to outliers while there is no information about the disagreement among the remaining members. Dissenting votes in current monetary policy decisions are quite usual (see 36), yet they do not prevent decisions from being taken if adopted by majority approval as in the case of the FOMC. Second moments such as the cross-sectional *standard deviation* are a comprehensive measure of all votes and assign the same weight to all dots. Yet, the standard deviation describes the distribution of votes around the

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<sup>31</sup>See (20).

<sup>32</sup>By contrast, (4) use the degree of disagreement by individual members instead of the aggregate disagreement as the full data set for FOMC projections on GDP, CPI and unemployment for the period between 1992 and 1998 got disclosed with a lag of ten years.

mean while monetary policy makers would rather base their decision on the median. Therefore, quantile-based measures such as the *interquartile range* as for instance used in (26) and (2) seem to be more adequate. The interquartile range is defined as the difference between the 75<sup>th</sup> and the 25<sup>th</sup> percentiles of a distribution,  $Q_{0.75}$  and  $Q_{0.25}$ , thus  $IQR = Q_{0.75} - Q_{0.25}$ . This measure is centered around the median and trims extreme votes that are likely to dissent in upcoming policy decisions.

**Table 3** Disagreement Pattern along the Horizon

	<i>eo</i> $y_0$	<i>eo</i> $y_1$	<i>eo</i> $y_2$	<i>eo</i> $y_3$	<i>longer run</i>
Obs.	14	14	14	6	14
Horizon in months ( <i>min</i> - <i>max</i> )	0.5 - 11	12.5 - 23	24.5 - 35	36.5 - 39.5	-
avg. std. dev.	0.14	0.53	0.92	0.98	0.30
avg. range	0.52	1.87	3.04	3.44	1.09
avg. <i>IQR</i>	0.02	0.40	1.03	1.13	0.30

*Notes:* This table summarizes the average evolution of participants' assessments along the horizon for the period between January 25, 2012 until March 18, 2015 covering 14 disclosures of dot projections.

Table 3 shows some summary statistics about the dot projections for the different horizons. Aside from *eo* $y_3$ , all horizons are disclosed in the 14 regular projections that were issued over the sample period. The shortest projected horizon is half a month (mid-December projection for the end of the year, *eo* $y_0$ ); the longest projection horizon is almost 40 months and is covered in every September issue, when the horizon of dot projections is extended by another calendar year. Since FOMC participants project the target rate for the end of the following calendar years, the horizon of projections is not constant and depends on the date of each monetary policy meeting within a year. Thus, for instance horizon *eo* $y_0$  varies from half a month to 11 months.

### Disagreement increases along horizons

Table 3 further lists the average disagreement based on the three measures along the horizons for the publications between January 2012 and March 2015. Confirming the

observations of Figure 5, disagreement is small in the short-run ( $eo y_0$ )<sup>33</sup> and increases with the horizon for all three measures. Yet, for the longer-run assessment, disagreement is again lower. The increase of disagreement along the horizon is also revealed in panels (b) to (d) of Figure 3 that depict the evolution over time of the three disagreement measures for horizons  $eo y_0$ ,  $eo y_1$  and  $eo y_2$ . Measures seem to be characterized by some seasonality with disagreement decreasing towards the end of the year. This is particularly apparent for range and standard deviation of projections over short horizons. The most likely reason for this is that the actual horizon of projections varies over the year, see Table 3. In general, the disagreement pattern of range and standard deviation looks quite similar while the evolution of *IQR* over time differs. This is also supported by the respective correlations between disagreement measures at different horizons (see Table 4).

**Table 4** Correlation of Disagreement Measures

	<i>eo y<sub>0</sub></i>			<i>eo y<sub>1</sub></i>			<i>eo y<sub>2</sub></i>		
	<i>sd</i>	<i>range</i>	<i>iqr</i>	<i>sd</i>	<i>range</i>	<i>iqr</i>	<i>sd</i>	<i>range</i>	<i>iqr</i>
std. dev.	1.00			1.00			1.00		
range	0.99	1.00		0.96	1.00		0.80	1.00	
<i>IQR</i>	0.62	0.62	1.00	0.79	0.68	1.00	0.38	-0.09	1.00

*Notes:* Correlation between different disagreement measures (standard deviation *sd*, range and interquartile range *iqr*) at the three horizons,  $eo y_0$ ,  $eo y_1$  and  $eo y_2$ .

There is no disagreement on the policy rate for the end of the current year in each December policy meeting for all measures. The interquartile range for that horizon ( $eo y_0$ ) is actually continuously equal to zero until 2014. This illustrates that at least half of the policy makers agree on the future policy path in the short-run while standard deviation and range reveal the presence of some outliers. Those participants favor an increase in the target federal funds rate within the current year. Furthermore, the interquartile range for  $eo y_1$  is rather low during the 2013 policy meetings while it is substantially higher in the meetings at the beginning of 2012 and since 2014. Therefore, assuming that participants' policy reaction functions did not change substantially within that period and were fairly similar across participants, this implies rather close economic outlooks of participants from September 2012 until December 2013.

<sup>33</sup>This is in line with (4) who investigate FOMC projections on GDP, CPI and unemployment for the period from 1992 until 1998.

A vast difference in measures becomes apparent in March 2013. While the range of the projected federal funds rate target almost 3 years ( $ey_2$ ) ahead is 4.25, the interquartile range is only 0.75. In fact, most of the participants agreed on a projected target between 0.5% and 1.25% while some participants viewed an increase of the target to up to 4.5% as appropriate (see also Figure 5 Panel (e) in the Appendix).

### Choice of horizons studied

Due to the absence of disagreement for  $ey_0$  in the December and some September projections as well as the infrequent publication of  $ey_3$  horizons, the analysis in Chapter 4 will provide the results for horizons  $ey_1$  and  $ey_2$ . This is also in line with the time dimensions of forward guidance issued within the FOMC Statement, as  $ey_1$  and  $ey_2$  mostly cover the date-based forward guidance horizon of 2 - 3 years.<sup>34</sup> As demonstrated in Chapter 2, date-based forward guidance foresaw low interest rates through late 2014, when dot projections were first provided in January 2012. This horizon was prolonged to mid-2015 in the statement of September 2012. When state-based forward guidance came into effect in December 2012, the FOMC emphasized that this was in line with the mid-2015 horizon. Indeed, with date-based forward guidance succeeded by state-based forward guidance, the FOMC never redeemed this explicit horizon. As  $ey_2$  is only covered by the date-based horizon for the data until 2013, it seems best to measure disagreement based on participants' projections for the end of next year,  $ey_1$ .

The next chapter augments the empirical model of Chapter 2 by the interquartile range for  $ey_1$  in order to investigate the impact of disagreement on the effectiveness of forward guidance. The analysis thus examines the impact of disagreement on the policy rate target at the end of next year on the information content and credibility of forward guidance. Results for horizon  $ey_2$  as well as for range and standard deviation are provided in the appendix and will serve as robustness checks.

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<sup>34</sup>In September and December 2012, the date-based horizon is also covered by  $ey_3$ . Furthermore, in March 2015, the mid-2015 horizon is only covered by  $ey_0$ .

## 4 Forward Guidance under Disagreement

Finally, I augment the empirical model from Chapter 2 with a measure of disagreement and analyze the consequences of disagreement for the Fed's forward guidance. Specifically, this chapter investigates the influence of disagreement among FOMC participants on the sensitivity of Treasury yields to macroeconomic news and allows this effect to be different for date- and state-based forward guidance.

### 4.1 Empirical Model and Results

(23) point out that monetary policy committees such as the FOMC might impair the effectiveness of forward guidance as compromises on a future interest rate track might weaken the credibility and clarity of the central bank's commitment. However, if the public explicitly gets to know about the FOMC's actual disagreement on the future policy path, the information content of binding forward guidance should decline likewise. As observed in Figure 2, on the day when date-based forward guidance in the FOMC's statement was extended to late-2014, only 6 participants agreed on the current level of the target federal funds rate to be appropriate within that horizon. This could impair the strength and effectiveness of forward guidance. Market participants might perceive the commitment character of central bank's projections as less credible and therefore use other information to form expectations. For the period since January 2012, when the Federal Reserve started to publish the dot projections, forward guidance should therefore be investigated in connection with this disagreement information.<sup>35</sup>

If disagreement impairs the effectiveness of forward guidance, market participants should again be more attentive to other information such as macroeconomic news. While this paper found a sensitivity shrinkage during the forward guidance periods, the sensitivity should rise again when policy makers do not agree on that specific forward guidance. Therefore, I propose the third hypothesis:

**Hypothesis 3:** *The sensitivity of Treasury yields to macroeconomic news should depend on the level of disagreement and increase with higher levels thereof.*

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<sup>35</sup>The Fed only started disclosing dot projections within the period of date-based forward guidance, such that part of this period (August 2011 - January 2012) goes without information on disagreement.

As shown in Chapter 2, the two forward guidance strategies of different strengths have different effects on the sensitivity of Treasury yields. Similarly to the rationale behind Hypothesis 2, one expects this effect to differ with the commitment character of forward guidance. Disagreement should especially impair the effectiveness of unconditional forward guidance, i.e. heighten sensitivity in times of date-based forward guidance. The fourth hypothesis thus reads:

**Hypothesis 4:** *The sensitivity shrinkage of Treasury yields to macroeconomic news should be less pronounced the higher the disagreement among policy makers. Due to different effectiveness of forward guidance strategies, sensitivity should particularly be restored during the date-based forward guidance period.*

In order to account for the impact of disagreement, I allow the sensitivity of Treasury yields to further depend on a disagreement measure introduced above. Specifically, I use the interquartile range from FOMC dot projections at the end of next year,  $eo y_1$ . Due to the quarterly publication scheme of projections, this horizon varies from 12 to 23 months and is covered by date-based forward guidance at least until the end of 2014 (compare Table 1). I augment the empirical model from Chapter 2.3.1 by this disagreement measure and continue to allow for different effects for date- and state-based forward guidance.<sup>36</sup>

$$\Delta r_t^j = \alpha^j + \sum_k \beta^{k,j} s_t^k (1 + \gamma^{d,j} D_t^{date} + \gamma^{s,j} D_t^{state} + \delta^{d,j} DA_t \cdot D_t^{date} + \delta^{s,j} DA_t \cdot D_t^{state}) + \varepsilon_t^j \quad (2)$$

where  $DA_t$  is the disagreement measure of dot projections published at every second monetary policy meeting.  $DA_t$  equals zero before the introduction of dot projections and is assumed to be constant until the next publication. Hypothesis 3 implies that the respective coefficients should be positive ( $\delta > 0$ ) as a high level of disagreement should lower the impact of forward guidance. In other words, the sensitivity of Treas-

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<sup>36</sup>Including the non-interacted variables following (34) does not alter the main results of this analysis.

sury yields to macroeconomic news should be higher under disagreement on the appropriate future path than in the case of forward guidance under full agreement. Yet, Hypothesis 4 suggests that the effect of disagreement is different under the two forward guidance schemes. Specifically, disagreement should be more detrimental when date-based forward guidance is issued, i.e.  $|\delta^{d,j}| > |\delta^{s,j}|$ .

Accounting for disagreement in Equation 2 hardly alters the  $\beta$  coefficients for the sensitivity to macroeconomic news in a significant way, see Table 9 in the Appendix.<sup>37</sup> Table 5 shows the estimation results for the forward guidance and disagreement parameters of Equation 2. In the case of no disagreement the impact of forward guidance is fully captured by the  $\gamma$ -coefficients in the upper panel of the table.<sup>38</sup> If there is disagreement, the effect of forward guidance on the sensitivity of interest rates is composed of  $\gamma$  plus  $\delta$  multiplied by the actual level of disagreement,  $DA_t$ .

In the short- to medium-run, results for the  $\gamma$ -coefficients do not qualitatively change compared to Table 2. For the longer-run, however, date-based forward guidance still has a significant effect that does not even decline with maturity. Thus, if there is no disagreement on the appropriate future policy within the FOMC, date-based forward guidance is highly credible and affects the whole yield curve.<sup>39</sup> The fact that coefficients do not decline for longer-term maturities also points to a rather high correlation in longer-term rates. For the same period, if disagreement is high, the sensitivity shrinkage is less pronounced than in the case of no disagreement. For the short-run (up to one year maturity), however, disagreement about the appropriate rate at end of next year does not impair the credibility of the short-run commitment to low interest rates. Markets seem to take the actual low policy rate as guaranteed for up to one year and are hardly attentive to macroeconomic news. Disagreement in case of the date-based forward guidance especially matters for the medium- to long-run. If FOMC members disagree about the future appropriate path (IQR between 0 and 0.75), this may lead market participants to be even more attentive to news compared to the base period (see longer-term horizons from 5 years on).

In the case of state-based communication, forward guidance under full agreement

<sup>37</sup>Merely news in core producer prices do now significantly impact Treasury yields of also longer horizons.

<sup>38</sup>As there were no dot projections before January 2012,  $DA_t$  is assumed to be zero. Measuring  $DA_t$  by the interquartile range, there is full agreement during 2012 Q4 and 2013 Q3, Q4.

<sup>39</sup>This result also applies for the period between August 2011 and January 2012, when dot projections were not provided.

**Table 5** The Sensitivity Shrinkage Effect of Forward Guidance under Disagreement

	6months	1year	2years	3years	5years	10years	20years
Date-based FG: $\gamma^d$	-0.82*** (0.13)	-0.86*** (0.05)	-0.97*** (0.02)	-0.89*** (0.04)	-0.82*** (0.08)	-0.72*** (0.18)	-0.76*** (0.16)
State-based FG: $\gamma^s$	-1.63*** (0.37)	-0.79*** (0.12)	-0.64*** (0.21)	-0.24 (0.34)	0.19 (0.43)	0.53 (0.47)	0.56 (0.44)
Date-FG*DA: $\delta^d$	1.21 (0.83)	0.06 (0.20)	0.40** (0.18)	0.92** (0.42)	2.14*** (0.80)	4.12*** (1.33)	4.61*** (1.38)
State-FG*DA: $\delta^s$	0.99 (0.60)	0.51 (0.49)	1.02** (0.48)	1.21* (0.63)	0.64 (0.56)	0.17 (0.56)	-0.07 (0.56)
$H_0 : \beta = 0$	0.14	0.18	0.03	0.06	0.05	0.04	0.02
$R^2$	0.06	0.14	0.17	0.14	0.11	0.10	0.10

*Notes:* Estimations for Equation 2 for all announcement days between December 16, 2008 and March 30, 2015. i.e. 603 observations for each horizon.  $\Delta r_t^j = \alpha^j + \sum_k \beta^{k,j} s_t^k (1 + \gamma^{d,j} D_t^{date} + \gamma^{s,j} D_t^{state} + \delta^{d,j} DA_t \cdot D_t^{date} + \delta^{s,j} DA_t \cdot D_t^{state}) + \epsilon_t^j$ ; Newey-West standard errors in parentheses; \*\*\* (\*\*) [\*] denotes significance at the 1% (5%) [10%] level.  $H_0 : \beta = 0$  tests for all  $\beta$ s being jointly zero and states the respective  $p$ -value. The whole set of results is reported in Table 9 in the Appendix.



especially matters for horizons up to 2 years. Yet, disagreement increases the sensitivity of Treasury yields for the medium-run (2 and 3 year maturity). For the 3 year maturity, this means that disagreement also leads to increased sensitivity, as becomes clear from the lack of a significant effect of state-based forward guidance,  $\gamma_{s,3y}$ . The results are in line with Hypothesis 3, especially for the date-based forward guidance period, and therefore in turn confirm Hypothesis 4.

My results are robust to the choice of the disagreement measure (see Chapter 3.3) as well as of the horizon ( $eo y_1$  and  $eo y_2$ ). For comparison, the whole set of results for range, standard deviation and the different horizons is reported in Tables 9 to 14 in the Appendix. In line with my main findings, disagreement affects interest rates of medium to longer maturities in the date-based forward guidance period. In the state-based forward guidance period, by contrast, the impact of disagreement only applies for a horizon of 6 months or none when using alternative measures of disagreement.

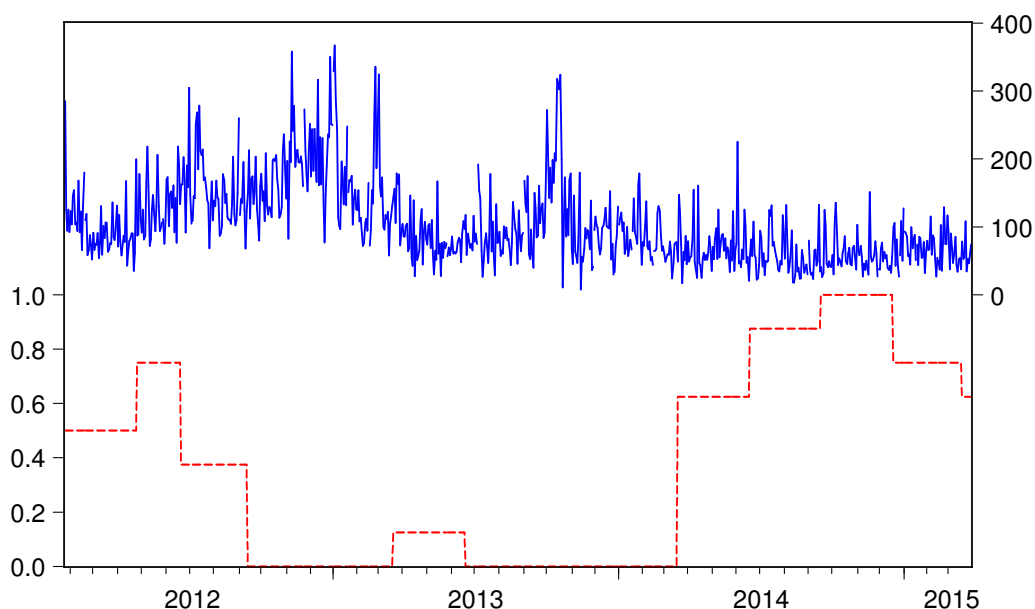
The analysis above shows that including disagreement is important for considering the credibility of forward guidance and the corresponding effect on the sensitivity of Treasury yields to macroeconomic news. While the  $\beta$  coefficients throughout the yield curve and the  $\gamma_s$  at least for the short-run are robust to the inclusion of disagreement, it can have detrimental effects for medium- to longer-term rates. Furthermore, disagreement in times of binding forward guidance might impede forward guidance at horizons above one year. Although disclosing dot projections may help the public understand the FOMC's reaction function, this measure of forward guidance is costly for other types of issued forward guidance and their credibility.

Increased transparency in form of the dot projections reduces the information content of forward guidance if policy makers disagree. Yet, the interpretation of this result is twofold. On the one hand, disagreement weakens the credibility and strength of forward guidance and therefore might harm this policy measure that the Fed relies on in times of exceptionally low policy rates. On the other hand, market participants learn about the central bank's policy reaction function and rationally form interest rate expectations by considering available information on macroeconomic developments. Furthermore, the Fed was able to attenuate its strong commitment by the issuance of dot projections and the disagreement therein. This will be crucial if the economic situation leads the Fed to deviate from its promise and the public demands accountability.

## 4.2 The Role of Policy Uncertainty

As argued by (39) and (35), monetary policy uncertainty may affect the sensitivity of interest rates to macroeconomic news. One could raise concern that disagreement within the FOMC merely reflects general monetary policy uncertainty or in a broader sense economic policy uncertainty. Therefore, I check the robustness of the above results to including a news-based index of economic policy uncertainty for the U.S. This index follows the methodology developed by (3) and quantifies the number of newspaper articles on a given day that contain specific terms as for instance *economy*, *uncertainty* or *federal reserve*.<sup>40</sup>

**Figure 4** Policy Uncertainty and Disagreement



Notes: Policy uncertainty index and disagreement measured by the interquartile range of dot projections for the end of next year (dashed line),  $eo y_1$ , for the sample period from January 25, 2012 until March 30, 2015. Source: [http://www.policyuncertainty.com/us\\_daily.html](http://www.policyuncertainty.com/us_daily.html) and own calculations from Chapter 3.3.

Figure 4 depicts the evolution of the index together with disagreement as measured by the interquartile range of dot projections at the end of next year,  $eo y_1$ . The uncertainty index reveals higher values between spring 2012 and spring 2013 and is generally lower in the period thereafter. Specifically, policy uncertainty is highest around

<sup>40</sup>The index is taken from [http://www.policyuncertainty.com/us\\_daily.html](http://www.policyuncertainty.com/us_daily.html).

the introduction of state-based forward guidance in December 2012. By contrast, disagreement about the future monetary policy was zero at that time. Thus, policy makers seem to agree more on keeping interest rates low when economic uncertainty is high, especially in these times of exceptionally low policy rates. While policy uncertainty decreases over the whole sample, disagreement is highest in the last year of the dataset. Actually, policy uncertainty is negatively correlated with all disagreement measures. Disagreement should therefore not result from policy uncertainty according to this index.

In order to check the robustness of the results in Chapter 4.1 to the inclusion of policy uncertainty, I now augment the model in Equation 2 by the above index for the dot projections period and let the sensitivity of interest rates jointly depend on this index  $p_t$  that was standardized beforehand.

$$\Delta r_t^j = \alpha^j + \sum_k \beta^{k,j} s_t^k (1 + \gamma^{d,j} D_t^{date} + \gamma^{s,j} D_t^{state} + \delta^{d,j} D A_t \cdot D_t^{date} + \delta^{s,j} D A_t \cdot D_t^{state} + \eta^j p_t \cdot D_t^{dots}) + \varepsilon_t^j \quad (3)$$

where  $D^{dots} = 1$  in the sample period starting on January 25, 2012 and zero in the previous period.

Table 6 shows the estimation results for the main coefficients of interest in Equation 3.<sup>41</sup> For all horizons but 6 months,  $\eta$  is statistically insignificant and explanatory power remains rather constant. Consequently, there are only slight numerical changes in the estimated coefficients which do not harm the main results from the previous subsection. The estimates for both the effects of forward guidance ( $\gamma$ ) and disagreement ( $\delta$ ) are in line with the previous findings for all maturities.

Yet, policy uncertainty influences the sensitivity of treasury yields in the short-run. Although one would expect higher uncertainty to lead to increased sensitivity,  $\eta$  features a negative sign. Thus, market participants seem to believe in guaranteed low interest rates even more strongly in times of high economic uncertainty, at least for the very short-run. As forward guidance and dot projections are in fact meant to influence the medium- to long-run expectations, this particular result is of rather little

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<sup>41</sup>  $\beta$  coefficients are virtually the same for all maturities and can be reviewed in Table 15 in the Appendix.

**Table 6** The Role of Policy Uncertainty

	6months	1year	2years	3years	5years	10years	20years
Date-based FG: $\gamma^d$	-0.74*** (0.16)	-0.86*** (0.05)	-0.96*** (0.02)	-0.88*** (0.04)	-0.82*** (0.08)	-0.71*** (0.17)	-0.75*** (0.16)
State-based FG: $\gamma^s$	-2.03*** (0.49)	-0.72*** (0.17)	-0.69*** (0.25)	-0.34 (0.37)	0.19 (0.51)	0.72 (0.58)	0.78 (0.54)
Date-FG*DA: $\delta^d$	1.32 (1.18)	0.04 (0.19)	0.41** (0.18)	0.95** (0.40)	2.14*** (0.81)	3.91*** (1.26)	4.39*** (1.30)
State-FG*DA: $\delta^s$	0.28 (0.52)	0.54 (0.48)	0.98** (0.45)	1.11* (0.58)	0.63 (0.52)	0.24 (0.52)	0.02 (0.52)
policy uncertainty: $\eta$	-1.01* (0.59)	0.11 (0.14)	-0.09 (0.16)	-0.19 (0.25)	-0.01 (0.33)	0.39 (0.40)	0.46 (0.39)
$H_0 : \beta = 0$	0.20	0.17	0.03	0.06	0.06	0.04	0.02
$R^2$	0.07	0.14	0.17	0.14	0.11	0.10	0.10

Notes: Estimations for Equation 3 for all announcement days between December 16, 2008 and March 30, 2015. i.e. 603 observations for each horizon. Disagreement is measured by the interquartile range of dot projections for the end of next year,  $eoyn_1$ .  $\Delta r_t^j = \alpha^j + \sum_k \beta^{k,j} s_t^k (1 + \gamma^{d,j} D_t^{date} + \gamma^{s,j} D_t^{state} + \delta^{d,j} D A_t \cdot D_t^{date} + \delta^{s,j} D A_t \cdot D_t^{state} + \eta^j p_t \cdot D_t^{dots}) + \varepsilon_t^j$ ; Newey-West standard errors in parentheses; \*\*\* (\*\*) [\*] denotes significance at the 1% (5%) [10%] level.  $H_0 : \beta = 0$  tests for all  $\beta$ s being jointly zero and states the respective  $p$ -value. Refer to Table 15 in the Appendix for the whole set of results.

importance to this analysis.

Overall, the core findings about the impact of disagreement on the effectiveness of forward guidance are robust to the inclusion of economic policy uncertainty. Thus, disagreement about the future course of monetary policy should not be mistaken for policy uncertainty. Disagreement among policy makers in contrast is an important factor when investigating the information content of forward guidance.

### 4.3 Asymmetric Sensitivity at the Zero Lower Bound

With interest rates close to the zero lower bound, the sensitivity may differ with the sign and size of macroeconomic surprises. Specifically, surprises that are expected to decrease interest rates might result in rather weak reactions, or none at all, when interest rates are already close to zero and a lower bound is a binding constraint. Rate-increasing macroeconomic surprises, by contrast, would still lead to an increase in interest rates. Forward guidance - as issued by the FOMC since the crisis - is intended to keep interest rates low along the yield curve and is thus particularly oriented towards reducing the sensitivity to rate-increasing surprises. Consequently, the effects of forward guidance and disagreement among policy makers on the sensitivity of interest rates to news could be different. This asymmetry may thus impact the results in Chapter 4.1.<sup>42</sup> While forward guidance in general shrank and policy makers' disagreement restored sensitivity, I expect forward guidance and disagreement to be especially influential in case of rate-increasing surprises.

I therefore distinguish between surprises that are expected to lead to either a rate increase or a decrease, i.e.  $s^{k+}$  and  $s^{k-}$ , and allow for different influences of forward guidance ( $\gamma^+$  and  $\gamma^-$ ) and disagreement ( $\delta^+$  and  $\delta^-$ ) on the sensitivity of interest rates.<sup>43</sup> The effect of forward guidance and disagreement on the sensitivity of interest rates should differ with the sign of surprises due to rates' proximity to the zero lower bound.

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<sup>42</sup>As (39) emphasize, the sensitivity of short-term interest rates to macroeconomic news can still be symmetric if the shadow rate is negative (compare 42) in presence of a strongly binding zero lower bound. Only large rate-increasing surprises would then result in a response of interest rates.

<sup>43</sup>Essentially, in this dataset, all positive macroeconomic surprises short of unemployment are expected to involve a rate increase. There are 275 announcement days with only surprises that would imply a rate increase and 244 days with rate-decreasing surprises; the remaining 84 represent days with both rate-increasing and -decreasing surprises.

Table 7 shows the results for the differentiated  $\gamma$ - and  $\delta$ -coefficients based on Equation 2. As noted above, the base-period until mid-2011 is already a period with low sensitivity to macroeconomic news. This is essentially true for the rate-decreasing surprises, as can be seen in the test result on joint significance of those surprises while the rate-increasing surprises are jointly significant throughout the yield curve. Differentiating between rate-increasing and -decreasing surprises also results in higher explanatory power for all horizons.

In line with intuition, the main results of this paper (see 4.1) are especially valid for the rate-increasing surprises (see upper panel of Table 7). Date-based forward guidance significantly reduces sensitivity of interest rates across all maturities, while the more conditional state-based forward guidance only matters for horizons up to the medium-term. Disagreement is mainly important for the medium- to longer-term rates for the sample under date-based forward guidance.

As expected, the results for the rate-decreasing surprises contrast with the results of Chapter 4.1 (see lower panel of Table 7). Results for the short- to medium-run became generally less significant. The slightly significant effects of date-based forward guidance,  $\gamma^{d-}$ , and disagreement during that period,  $\delta^{d-}$ , in the longer-run estimations reveal wrong signs; yet, as the  $\beta^-$ s are only slightly significant, one should not draw conclusions from this.

This chapter therefore concludes that forward guidance and thus also policy makers' disagreement thereon essentially matter for rate-increasing surprises.

## 5 Conclusion

Forward guidance is an essential tool for the effectiveness of monetary policy. Especially since the crisis, the importance of managing financial market expectations has increased due to the presence of the zero lower bound. Yet, for forward guidance to be effective, a central bank's credibility is crucial, especially if the guidance conveys a commitment. If a central bank's forward guidance does not affect financial markets' expectations, this could either mean that markets already expect what the central bank projects<sup>44</sup>, that markets do not believe in those projections or that the guidance lacks

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<sup>44</sup>See also the "follow the markets" principle discussed in (6).

**Table 7** Asymmetric Sensitivity Changes

	6months	1year	2years	3years	5years	10years	20years
for rate-increasing surprises $s^{k+}$							
Date-based FG: $\gamma^{d+}$	-0.90*** (0.05)	-0.89*** (0.03)	-0.97*** (0.01)	-0.93*** (0.02)	-0.93*** (0.05)	-0.94*** (0.06)	-0.96*** (0.03)
State-based FG: $\gamma^{s+}$	-1.10*** (0.17)	-0.89*** (0.11)	-0.61*** (0.14)	-0.47*** (0.18)	-0.07 (0.29)	0.08 (0.33)	-0.04 (0.33)
Date-FG*DA: $\delta^{d+}$	-0.06 (0.17)	-0.21 (0.23)	0.10 (0.10)	0.68** (0.35)	1.64*** (0.41)	2.85*** (0.60)	3.21*** (0.70)
State-FG*DA: $\delta^{s+}$	0.58* (0.33)	0.55* (0.32)	0.46** (0.23)	0.36 (0.27)	-0.11 (0.36)	-0.67 (0.45)	-0.68 (0.49)
for rate-decreasing surprises $s^{k-}$							
Date-based FG: $\gamma^{d-}$	-1.00 (0.83)	-0.74*** (0.21)	-0.34 (0.92)	-1.11** (0.55)	0.87 (1.06)	2.72* (1.53)	3.39** (1.57)
State-based FG: $\gamma^{s-}$	-2.47*** (0.91)	-0.93*** (0.17)	-0.38 (-0.69)	-0.10 (0.60)	0.05 (0.57)	0.33 (0.60)	0.47 (0.57)
Date-FG*DA: $\delta^{d-}$	5.35** (2.66)	0.53 (0.53)	0.77 (1.57)	1.78 (1.30)	-0.54 (1.36)	-2.77 (1.76)	-3.77* (2.06)
State-FG*DA: $\delta^{s-}$	-1.67 (1.59)	0.13 (0.39)	3.50 (2.14)	2.51* (1.50)	1.19 (1.04)	-0.07 (0.89)	-0.65 (0.85)
$H_0 : \beta^+ = 0$	0.01	0.04	0.00	0.00	0.00	0.00	0.00
$H_0 : \beta^- = 0$	0.51	0.04	0.25	0.03	0.02	0.12	0.07
$R^2$	0.12	0.21	0.24	0.20	0.15	0.14	0.15

Notes: Estimations for all announcement days between December 16, 2008 and March 30, 2015. i.e. 603 observations for each horizon.  $\Delta r_t^j = \alpha^j + \sum_k \beta^{k+,j} s_t^{k+} (1 + \gamma^{d+,j} D_t^{date} + \gamma^{s+,j} D_t^{state} + \delta^{d+,j} DA_t \cdot D_t^{date} + \delta^{s+,j} DA_t \cdot D_t^{state}) + \sum_k \beta^{k-,j} s_t^{k-} (1 + \gamma^{d-,j} D_t^{date} + \gamma^{s-,j} D_t^{state} + \delta^{d-,j} DA_t \cdot D_t^{date} + \delta^{s-,j} DA_t \cdot D_t^{state}) + \epsilon_t^j$ ; Newey-West standard errors in parentheses; \*\*\* (\*\*) [\*] denotes significance at the 1% (5%) [10%] level.  $H_0 : \beta = 0$  tests for  $\beta$ s being jointly zero and states the respective  $p$ -value.

clarity.

This paper shows that forward guidance as issued by the Federal Reserve since 2011 was an effective tool to influence interest rates. Financial markets believed in the central bank's promise to keep interest rates at low levels and were therefore less attentive to other macroeconomic news. However, the decrease in sensitivity of interest rates to macroeconomic news was less pronounced when guidance was linked to explicit conditions.

In 2012 when FOMC participants started to disclose dot projections, financial markets learned about the disagreement among policy makers on the future path of interest rates. The publication of a disagreement signal can have detrimental effects on how forward guidance is perceived by markets. In line with this intuition, I find that the effectiveness of forward guidance was lowered by disagreement implying that market participants were again more attentive to macroeconomic news. Yet, this can be interpreted in two ways. On the one hand, forward guidance is less effective as financial markets do not see the low rate as guaranteed. On the other hand, before introducing dot projections, the FOMC was concerned that markets interpret forward guidance as a full commitment. Therefore, by the publication of disagreement, the FOMC managed to weaken any such interpretation. While the Fed was able to reduce interest rates also at the longer end of the yield curve by providing an unconditional policy rate path through date-based forward guidance, it regained flexibility by implementing other forward guidance measures such as state-based forward guidance and dot projections.



# Appendices

## Appendix A: The Participants in the Individual Assessments

The FOMC consists of the Board of Governors (5 members in general), the president of the Federal Reserve Bank of New York as well as four Reserve Bank Presidents on a rotating basis with one-year terms. Nonvoting presidents participate in the meeting, but they are not allowed to vote on actual policy decisions, although they can influence the decision-making process. Yet, individual assessments about the appropriate future policy rate are given by the members of the FOMC as well as by alternate members and attendant non-voting regional Reserve Bank presidents. Overall, there are generally 17 participants in the regular assessment of the economy and policy options. This number is subject to changes in the Board of Governors. In the assessments covered by this paper's sample, there are 16 to 19 participants in each assessment. Specifically, the Board of Governors consisted of 7 members instead of 5 between May 2012 and June 2013. Furthermore, after Janet L. Yellen took office as Chair of the Board of Governors in February 2014, there were only four members in the BoG.

While there is at least an annual change in the composition of the FOMC due to the rotating voting status of regional Reserve Bank presidents, there is more continuity in the composition of the participants in the economic projections. There are three members that did not even change their function throughout the whole sample, two of which have voting status. FOMC Vice Chair William C. Dudley (President of New York Fed) and the respective alternate member Catherine M. Cumming (1st Vice President of New York Fed) as well as Daniel K. Tarullo, member of the Board of Governors. Janet L. Yellen was a member of the FOMC throughout the sample although her status changed from regular Board member to the Chair position in February 2014 when she succeeded Ben Bernanke. While there were some changes in the composition of the Board of Governors, there was only one change in the group of regional Reserve Bank presidents. President Sandra Pianalto of the Federal Reserve of Cleveland was succeeded by Loretta J. Mester in May 2014. Furthermore, three regional Reserve Bank Presidents designated the respective vice presidents as their representatives, yet, only when they held non-voting status. All other presidents of the regional Reserve Banks held their position as president throughout the sample, but changed their status within the FOMC meeting (voting, alternate, non-voting). Yet, also a non-voting member can

try to steer the decision-making process of the FOMC and relate his or her own assessment to the region's requirements.

## References

- [1] Andrade, P., Crump, R., Eusepi, S., and Moench, E. (2014). Fundamental disagreement. *Banque de France Working Papers*, 524.
- [2] Andrade, P., Gaballo, G., Mengus, E., and Mojon, B. (2015). Forward guidance and heterogeneous beliefs. *Banque de France Working Papers*, 573.
- [3] Baker, S. R., Bloom, N., and Davis, S. J. (2016). Measuring Economic Policy Uncertainty. *The Quarterly Journal of Economics*, forthcoming.
- [4] Banterngansa, C. and McCracken, M. W. (2009). Forecast Disagreement Among FOMC Members. *Federal Reserve Bank of St. Louis Working Paper Series*, 59:1–41.
- [5] Berriel, T., Carvalho, C., and Machado, O. P. (2015). Lift-off uncertainty: What can we infer from the fomc’s summary of economic projections? *Meeting Papers from Society for Economic Dynamics*, 903.
- [6] Blinder, A. S. (2004). *The Quiet Revolution: Central Banking Goes Modern*. Yale University Press.
- [7] Blinder, A. S., Ehrmann, M., Fratzscher, M., De Haan, J., and Jansen, D.-J. (2008). Central Bank Communication and Monetary Policy: A Survey of Theory and Evidence. *Journal of Economic Literature*, 46(4):910–945.
- [8] Campbell, J. R., Evans, C. L., Fisher, J. D., and Justiniano, A. (2012). Macroeconomic Effects of Federal Reserve Forward Guidance. *Brookings Papers on Economic Activity*, pages 1–54.
- [9] Contessi, S. and Li, L. (2013a). Forward Guidance 101A: A Roadmap of the U.S. Experience. *Federal Reserve Bank of St. Louis Economic Synopses*, 25:1–3.
- [10] Contessi, S. and Li, L. (2013b). Forward Guidance 101B: A Roadmap of the International Experience. *Federal Reserve Bank of St. Louis Economic Synopses*, 28:1–4.
- [11] Detmers, G.-A. and Nautz, D. (2012). The Information Content of Central Bank Interest Rate Projections: Evidence from New Zealand. *Economic Record*, 88(282):323–329.
- [12] Detmers, G.-A. and Nautz, D. (2014). Stale Forward Guidance. *Economics Letters*, 124:358–361.
- [13] Dovern, J. (2015). A Multivariate Analysis of Forecast Disagreement: Confronting Models of Disagreement with Survey Data. *European Economic Review*, 80:16 – 35.
- [14] Eggertsson, G. B. and Woodford, M. (2003). The Zero Lower Bound on Interest Rates and Optimal Monetary Policy. *Brookings Papers on Economic Activity*, 1.

**Table 8** Summary Statistics of U.S. Macroeconomic Surprises

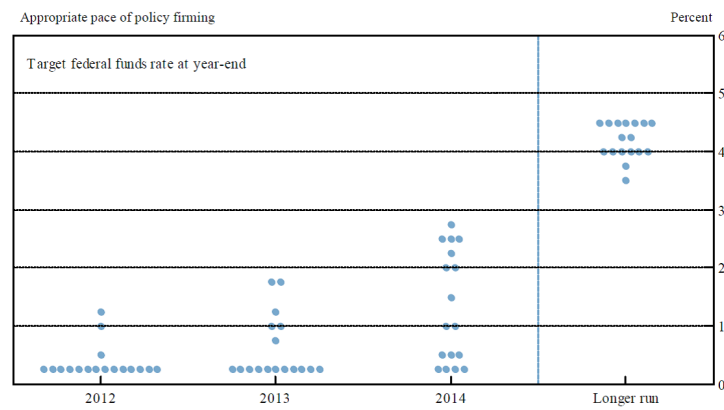
	Panel A														
	base period (Dec 16, 2008 - Aug 8, 2011)					date-based (Aug 9, 2011 - Dec 11, 2012)					state-based (Dec 12, 2012 - Mar 30, 2015)				
	Mean	Std. dev.	Min	Max	Obs	Mean	Std. dev.	Min	Max	Obs	Mean	Std. dev.	Min	Max	Obs
Capacity utilization	-0.02	0.35	-1.00	0.80	31	-0.10	0.34	-1.00	0.60	16	-0.03	0.41	-0.80	0.80	28
Consumer confidence	-0.05	5.44	-10.50	12.80	31	0.27	5.86	-7.50	12.00	16	0.66	4.91	-8.30	8.60	27
Core CPI	0.01	0.10	-0.20	0.20	31	-0.01	0.09	-0.10	0.20	16	-0.02	0.09	-0.20	0.10	28
GDP advance	-0.25	1.29	-3.40	1.60	11	-0.08	0.16	-0.30	0.10	5	-0.02	0.82	-1.20	1.00	9
ISM index	0.67	2.13	-4.20	3.50	32	0.01	1.36	-2.30	2.10	16	0.30	1.85	-4.70	3.40	27
Leading indicators	0.08	0.38	-1.30	1.00	32	0.09	0.20	-0.30	0.40	16	0.05	0.18	-0.30	0.40	28
New homes	-0.01	0.04	-0.11	0.08	32	-0.00	0.01	-0.02	0.02	16	0.00	0.04	-0.10	0.08	28
Nonfarm payrolls	-10.38	74.15	-109.00	175.00	32	26.69	127.40	-83.00	459.00	16	4.63	55.81	-122.00	91.00	27
Core PPI	0.00	0.23	-0.70	0.40	31	0.19	0.69	-0.30	2.70	16	0.00	0.11	-0.20	0.40	25
Retail sales ex. auto.	-0.21	1.05	-4.80	1.40	31	0.05	0.33	-0.50	0.50	16	-0.10	0.34	-1.00	0.50	28
Unemployment	-0.02	0.20	-0.50	0.30	32	-0.11	0.15	-0.40	0.10	16	-0.06	0.13	-0.30	0.10	27

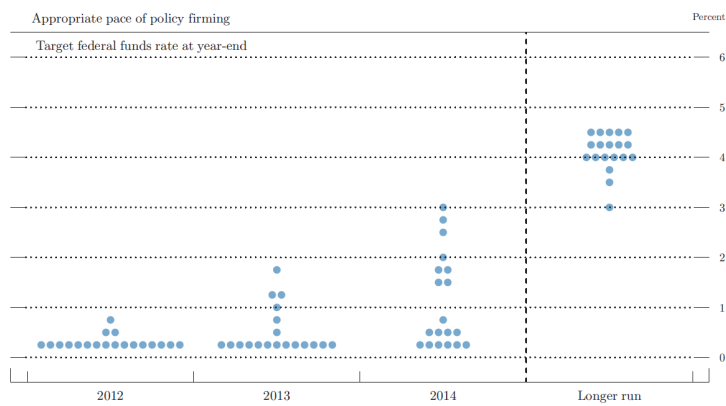
	Panel B														
	before dots (Dec 16, 2008 - Jan 24, 2012)					since dots (Jan 25, 2012 - Mar 30, 2015)									
	Mean	Std. dev.	Min	Max	Obs	Mean	Std. dev.	Min	Max	Obs					
Capacity utilization	-0.01	0.34	-1.00	0.80	37	-0.08	0.40	-1.00	0.80	38					
Consumer confidence	0.07	5.77	-10.50	12.80	36	0.48	4.85	-8.30	8.60	38					
Core CPI	0.01	0.10	-0.20	0.20	37	-0.02	0.09	-0.20	0.10	38					
GDP advance	-0.23	1.23	-3.40	1.60	12	-0.05	0.68	-1.20	1.00	13					
ISM index	0.68	2.01	-4.20	3.50	37	0.12	1.73	-4.70	3.40	38					
Leading indicators	0.09	0.36	-1.30	1.00	37	0.05	0.19	-0.30	0.40	39					
New homes	-0.01	0.04	-0.11	0.08	7	0.00	0.04	-0.10	0.08	39					
Nonfarm payrolls	2.30	104.45	-109.00	459.00	37	3.55	56.21	-122.00	93.00	38					
Core PPI	0.08	0.49	-0.70	2.70	37	0.00	0.12	-0.30	0.40	35					
Retail sales ex. auto.	-0.17	0.97	-4.80	1.40	37	-0.06	0.34	-1.00	0.50	38					
Unemployment	-0.04	0.20	-0.50	0.30	37	-0.07	0.13	-0.40	0.10	38					

*Notes:* Macroeconomic surprises are computed as actual release minus the median forecast of the RTR poll from Datastream. Panel A separates the sample in the base period and the two different forward guidance periods. Panel B shows surprises for the period before and since the publication of dot projections.

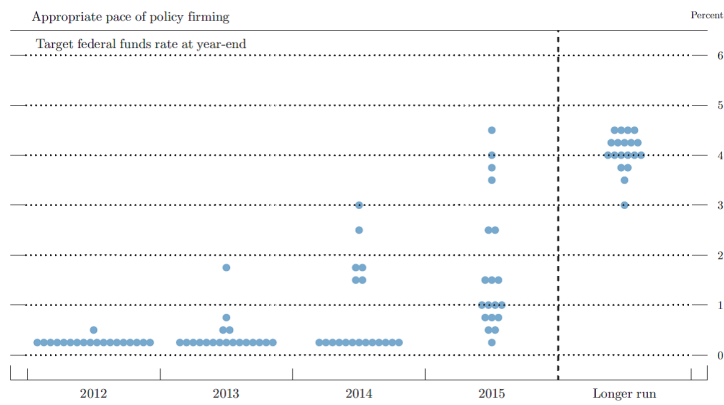
**Figure 5** Dot Projections



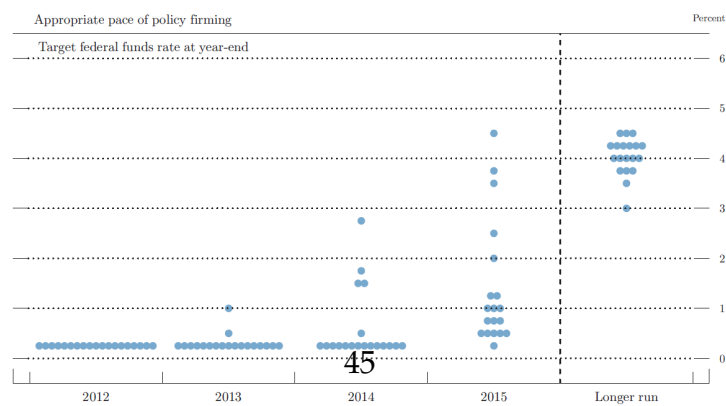
**(a)** April 25, 2012



**(b)** June 20, 2012

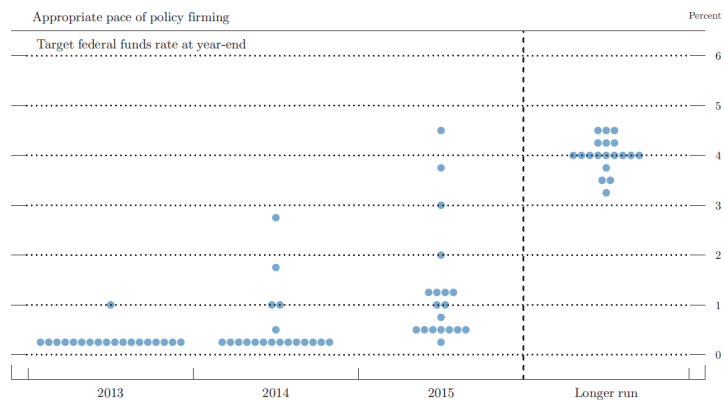


**(c)** September 13, 2012

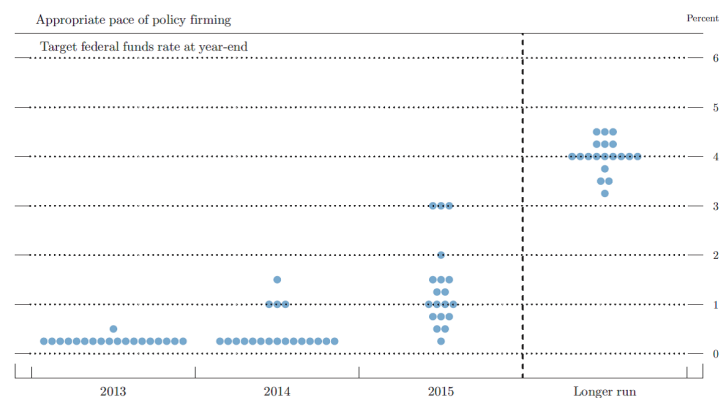


**(d)** December 12, 2012

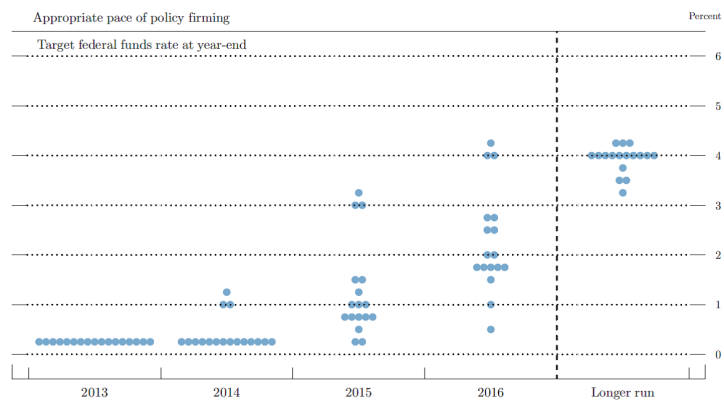
Figure 5: Dot Projections continued



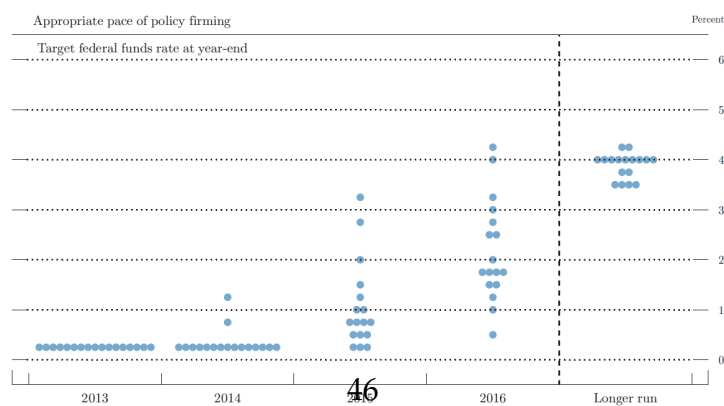
(e) March 20, 2013



(f) June 19, 2013

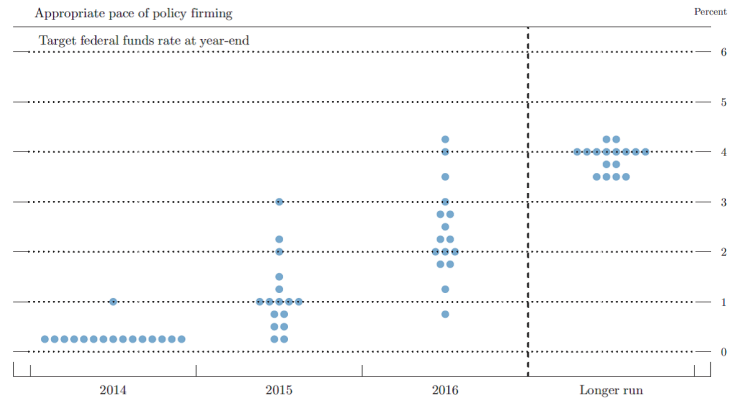


(g) September 18, 2013

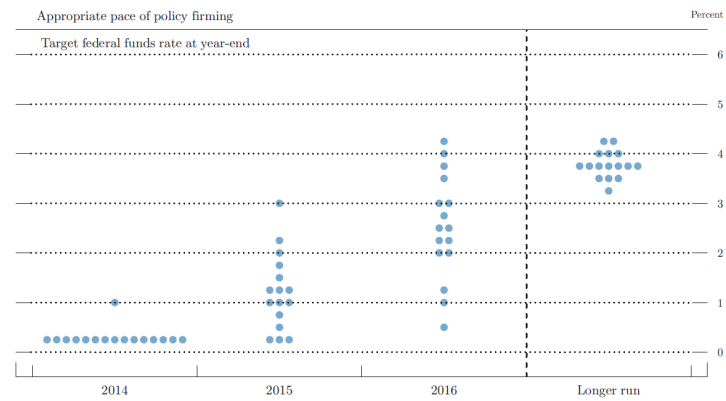


(h) December 18, 2013

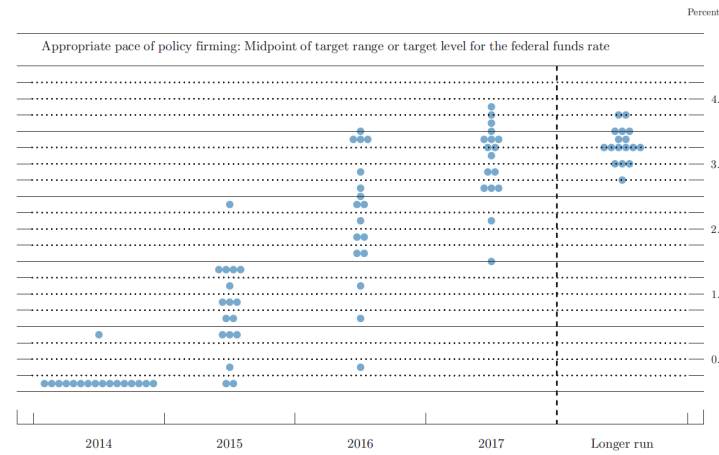
Figure 5: Dot Projections continued



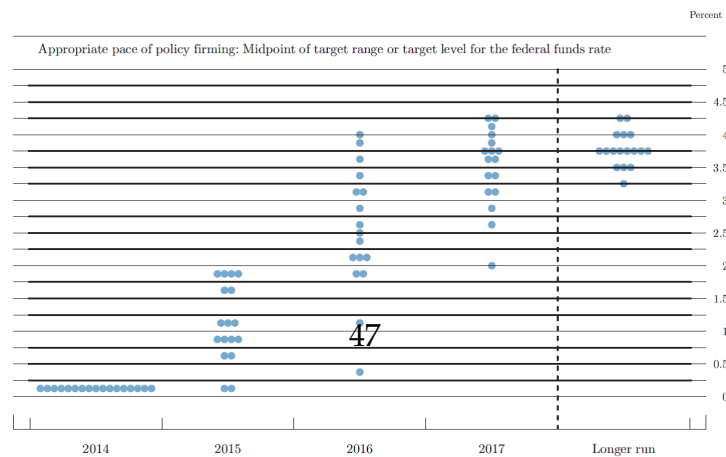
(i) March 19, 2014



(j) June 18, 2014

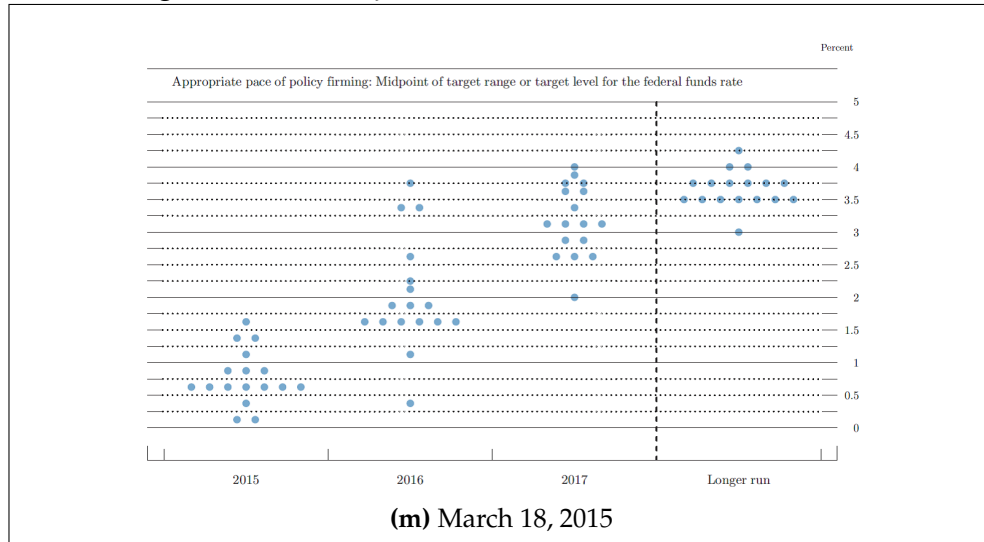


(k) September 17, 2014



(l) December 17, 2014

Figure 5: Dot Projections continued



*Notes:* Dot projections from the Summaries of Projections in (a)-(d) 2012, (e)-(h) 2013, (i)-(l) 2014 as well as of (m) March 2015. Each dot indicates the appropriate level in the view of an individual participant at the end of the specified calendar year or for the longer-run respectively. Data is rounded to the nearest 0.25% or 0.125% since September 2014 respectively. Source: Federal Reserve System - FOMC Summary of Economic Projections.



**Table 9** The Effect of Forward Guidance under Disagreement (*iqr* for *ey<sub>1</sub>*) on Treasury Yields

	6months	1year	2years	3years	5years	10years	20years
Capacity utilization	0.21 (0.18)	-0.09 (0.23)	0.51 (0.36)	0.58 (0.37)	0.22 (0.47)	-0.30 (0.42)	-0.42 (0.35)
Consumer confidence	0.01 (0.12)	-0.08 (0.32)	0.38 (0.50)	0.40 (0.45)	0.57 (0.52)	0.65 (0.41)	0.84* (0.43)
core CPI	-0.36 (0.27)	-0.19 (0.37)	-0.72 (0.63)	-0.61 (0.60)	-0.78 (0.76)	-0.78 (0.75)	-0.61 (0.62)
GDP advance	0.32* (0.17)	0.10 (0.15)	1.10* (0.61)	1.69* (0.94)	2.16** (1.06)	2.47** (1.14)	2.46** (1.13)
ISM index	0.39** (0.17)	0.06 (0.25)	0.29 (0.63)	0.67 (0.58)	1.13* (0.67)	1.3* (0.70)	1.28* (0.67)
Leading indicators	-0.13 (0.20)	0.00 (0.15)	0.37 (0.44)	0.50 (0.61)	0.40 (0.87)	0.42 (0.91)	0.18 (0.85)
New homes	0.21 (0.19)	0.01 (0.20)	0.05 (0.36)	-0.05 (0.41)	-0.18 (0.47)	-0.21 (0.39)	-0.16 (0.38)
Nonfarm payrolls	0.77* (0.43)	2.53*** (0.86)	5.89*** (2.02)	5.36*** (1.91)	5.47*** (1.67)	3.77*** (1.07)	3.47*** (0.92)
Core PPI	0.16 (0.16)	0.49 (0.41)	1.78** (0.79)	2.48** (1.03)	3.02** (1.18)	3.35*** (1.13)	4.04*** (1.31)
Retail sales ex. autos	0.19 (0.13)	0.36* (0.20)	0.63 (0.46)	1.33** (0.57)	1.89** (0.80)	2.05*** (0.73)	2.04*** (0.73)
Unemployment	0.16 (0.22)	0.24 (0.48)	0.54 (1.05)	0.89 (0.96)	1.02 (0.99)	0.80 (0.70)	0.73 (0.62)
$\gamma^d$ : Date	-0.82*** (0.13)	-0.86*** (0.05)	-0.97*** (0.02)	-0.89*** (0.04)	-0.82*** (0.08)	-0.72*** (0.18)	-0.76*** (0.16)
$\gamma^s$ : State	-1.63*** (0.37)	-0.79*** (0.12)	-0.64*** (0.21)	-0.24 (0.34)	0.19 (0.43)	0.53 (0.47)	0.56 (0.44)
$\delta^d$ : DA (Date)	1.21 (0.83)	0.06 (0.20)	0.40** (0.18)	0.92** (0.42)	2.14*** (0.80)	4.12*** (1.33)	4.61*** (1.38)
$\delta^s$ : DA (State)	0.99 (0.60)	0.51 (0.49)	1.02** (0.48)	1.21* (0.63)	0.64 (0.56)	0.17 (0.56)	-0.07 (0.56)
$H_0 : \beta = 0$	0.14	0.18	0.03	0.06	0.05	0.04	0.02
$R^2$	0.06	0.14	0.17	0.14	0.11	0.10	0.10

Notes: Estimations for Equation 2 for all announcement days between December 16, 2008 and March 30, 2015. i.e. 603 observations for each horizon.  $\Delta r_t^j = \alpha^j + \sum_k \beta^{k,j} s_t^k (1 + \gamma^{d,j} D_t^{date} + \gamma^{s,j} D_t^{state} + \delta^{d,j} DA_t \cdot D_t^{date} + \delta^{s,j} DA_t \cdot D_t^{state}) + \varepsilon_t^j$ . Newey-West standard errors in parentheses; \*\*\* (\*\*) [\*] denotes significance at the 1% (5%) [10%] level.  $H_0 : \beta = 0$  tests for all  $\beta$ s being jointly zero and states the respective  $p$ -value.

**Table 10** The Effect of Forward Guidance under Disagreement (*iqr* for *eo*<sub>2</sub>) on Treasury Yields

	6months	1year	2years	3years	5years	10years	20years
Capacity utilization	0.24 (0.17)	-0.08 (0.23)	0.52 (0.36)	0.56 (0.39)	0.09 (0.49)	-0.54 (0.46)	-0.74* (0.44)
Consumer confidence	0.02 (0.11)	-0.12 (0.32)	0.41 (0.52)	0.40 (0.48)	0.57 (0.56)	0.60 (0.44)	0.74* (0.45)
Core CPI	-0.33 (0.24)	-0.19 (0.37)	-0.80 (0.68)	-0.72 (0.66)	-0.95 (0.83)	-1.00 (0.78)	-0.86 (0.63)
GDP advance	0.30* (0.16)	0.10 (0.15)	0.99 (0.66)	1.68* (1.00)	2.17* (1.13)	2.54** (1.19)	2.48** (1.16)
ISM index	0.39** (0.17)	0.06 (0.25)	0.35 (0.63)	0.76 (0.58)	1.17* (0.67)	1.29* (0.7)	1.24* (0.67)
Leading indicators	-0.11 (0.21)	0.00 (0.15)	0.44 (0.45)	0.54 (0.63)	0.42 (0.90)	0.40 (0.95)	0.13 (0.86)
New homes	0.20 (0.19)	0.01 (0.21)	0.02 (0.39)	-0.02 (0.44)	-0.14 (0.51)	-0.18 (0.42)	-0.11 (0.40)
Nonfarm payrolls	0.78* (0.43)	2.54*** (0.86)	5.93*** (2.01)	5.45*** (1.91)	5.69*** (1.67)	4.07*** (1.11)	3.76*** (0.96)
Core PPI	0.19 (0.16)	0.49 (0.40)	1.83** (0.78)	2.43** (0.97)	2.89*** (1.09)	2.94*** (1.02)	3.36*** (1.18)
Retail sales ex. autos	0.18 (0.13)	0.36* (0.20)	0.61 (0.46)	1.31** (0.58)	1.90** (0.82)	2.08*** (0.74)	2.07*** (0.74)
Unemployment	0.20 (0.22)	0.21 (0.48)	0.42 (1.04)	0.75 (0.95)	0.76 (0.94)	0.46 (0.67)	0.31 (0.62)
$\gamma^d$ : Date	-0.80*** (0.12)	-0.86*** (0.05)	-0.96*** (0.02)	-0.89*** (0.04)	-0.84*** (0.08)	-0.71*** (0.16)	-0.73*** (0.16)
$\gamma^s$ : State	-2.68*** (0.74)	-1.37*** (0.44)	-1.51*** (0.51)	-1.31*** (0.48)	-0.45 (0.50)	0.13 (0.57)	0.47 (0.66)
$\delta^d$ : DA (Date)	0.18 (0.22)	0.01 (0.07)	0.11* (0.06)	0.28** (0.11)	0.65*** (0.21)	1.16*** (0.36)	1.31*** (0.38)
$\delta^s$ : DA (State)	1.71** (0.81)	0.88 (0.67)	1.43** (0.69)	1.71** (0.76)	0.93 (0.58)	0.40 (0.61)	-0.07 (0.67)
$H_0 : \beta = 0$	0.14	0.17	0.03	0.05	0.04	0.03	0.02
$R^2$	0.06	0.14	0.17	0.14	0.12	0.10	0.10

Notes: Estimations for Equation 2 for all announcement days between December 16, 2008 and March 30, 2015. i.e. 603 observations for each horizon.  $\Delta r_t^j = \alpha^j + \sum_k \beta^{k,j} s_t^k (1 + \gamma^{d,j} D_t^{date} + \gamma^{s,j} D_t^{state} + \delta^{d,j} DA_t \cdot D_t^{date} + \delta^{s,j} DA_t \cdot D_t^{state}) + \varepsilon_t^j$ . Newey-West standard errors in parentheses; \*\*\* (\*\*) [\*] denotes significance at the 1% (5%) [10%] level.  $H_0 : \beta = 0$  tests for all  $\beta$ s being jointly zero and states the respective  $p$ -value.

**Table 11** The Effect of Forward Guidance under Disagreement (*range* for  $ey_1$ ) on Treasury Yields

	6months	1year	2years	3years	5years	10years	20years
Capacity utilization	0.26 (0.18)	-0.22 (0.19)	0.33 (0.38)	0.44 (0.42)	-0.13 (0.5)	-0.67 (0.45)	-0.76* (0.42)
Consumer confidence	0.06 (0.12)	-0.04 (0.33)	0.39 (0.58)	0.51 (0.53)	0.59 (0.59)	0.60 (0.46)	0.74 (0.47)
Core CPI	-0.38 (0.26)	-0.19 (0.41)	-0.71 (0.76)	-0.71 (0.74)	-1.05 (0.92)	-1.09 (0.83)	-0.90 (0.64)
GDP advance	0.28* (0.17)	0.09 (0.15)	1.13* (0.66)	1.74* (1.02)	2.12* (1.15)	2.41* (1.24)	2.44** (1.18)
ISM index	0.36** (0.16)	-0.01 (0.24)	0.29 (0.65)	0.68 (0.60)	1.14* (0.68)	1.28* (0.71)	1.24* (0.66)
Leading indicators	-0.12 (0.21)	0.01 (0.15)	0.48 (0.47)	0.58 (0.67)	0.45 (0.95)	0.38 (0.99)	0.08 (0.86)
New homes	0.23 (0.18)	-0.02 (0.21)	0.02 (0.41)	-0.05 (0.47)	-0.14 (0.54)	-0.16 (0.44)	-0.09 (0.41)
Nonfarm payrolls	0.75* (0.43)	2.57*** (0.86)	6.03*** (2.02)	5.57*** (1.92)	5.91*** (1.68)	4.25*** (1.13)	3.85*** (0.98)
Core PPI	0.13 (0.15)	0.48 (0.40)	1.74** (0.73)	2.33** (0.93)	2.64*** (0.99)	2.61*** (0.96)	3.04*** (1.14)
Retail sales ex. autos	0.20 (0.13)	0.36* (0.20)	0.55 (0.44)	1.29** (0.58)	1.87** (0.82)	2.06*** (0.74)	2.06*** (0.73)
Unemployment	0.14 (0.21)	0.16 (0.47)	0.31 (1.05)	0.63 (0.95)	0.61 (0.93)	0.34 (0.66)	0.22 (0.62)
$\gamma^d$ : Date	-0.77*** (0.14)	-0.86*** (0.05)	-0.96*** (0.02)	-0.89*** (0.04)	-0.83*** (0.07)	-0.68*** (0.15)	-0.69*** (0.16)
$\gamma^s$ : State	-2.35*** (0.73)	-0.57* (0.31)	-0.45 (0.33)	-0.12 (0.47)	0.53 (0.58)	0.73 (0.60)	0.62 (0.57)
$\delta^d$ : DA (Date)	0.18 (0.22)	0.00 (0.07)	0.10 (0.07)	0.28** (0.11)	0.63*** (0.2)	1.10*** (0.34)	1.24*** (0.38)
$\delta^s$ : DA (State)	0.58* (0.31)	-0.05 (0.19)	0.07 (0.20)	0.11 (0.25)	-0.15 (0.23)	-0.19 (0.23)	-0.12 (0.25)
$H_0 : \beta = 0$	0.15	0.12	0.02	0.04	0.03	0.04	0.03
$R^2$	0.06	0.14	0.17	0.13	0.11	0.10	0.10

Notes: Estimations for Equation 2 for all announcement days between December 16, 2008 and March 30, 2015. i.e. 603 observations for each horizon.  $\Delta r_t^j = \alpha^j + \sum_k \beta^{k,j} s_t^k (1 + \gamma^{d,j} D_t^{date} + \gamma^{s,j} D_t^{state} + \delta^{d,j} DA_t \cdot D_t^{date} + \delta^{s,j} DA_t \cdot D_t^{state}) + \varepsilon_t^j$ . Newey-West standard errors in parentheses; \*\*\* (\*\*) [\*] denotes significance at the 1% (5%) [10%] level.  $H_0 : \beta = 0$  tests for all  $\beta$ s being jointly zero and states the respective  $p$ -value.

**Table 12** The Effect of Forward Guidance under Disagreement (*range* for *coy*<sub>2</sub>) on Treasury Yields

	6months	1year	2years	3years	5years	10years	20years
Capacity utilization	0.20 (0.18)	-0.21 (0.19)	0.24 (0.38)	0.37 (0.41)	-0.21 (0.47)	-0.67 (0.43)	-0.73* (0.40)
Consumer confidence	0.05 (0.13)	-0.03 (0.33)	0.36 (0.59)	0.52 (0.54)	0.53 (0.58)	0.55 (0.46)	0.72 (0.48)
Core CPI	-0.31 (0.27)	-0.19 (0.40)	-0.72 (0.77)	-0.77 (0.77)	-1.13 (0.88)	-1.13 (0.8)	-0.91 (0.61)
GDP advance	0.33* (0.17)	0.09 (0.15)	1.12* (0.66)	1.70* (1.03)	1.99* (1.13)	2.32* (1.24)	2.46** (1.17)
ISM index	0.36** (0.18)	0.00 (0.24)	0.31 (0.64)	0.68 (0.60)	1.17* (0.68)	1.33* (0.71)	1.28* (0.65)
Leading indicators	-0.11 (0.21)	0.01 (0.15)	0.48 (0.47)	0.59 (0.68)	0.39 (0.94)	0.33 (0.98)	0.08 (0.86)
New homes	0.22 (0.20)	-0.02 (0.21)	0.01 (0.39)	-0.06 (0.47)	-0.09 (0.47)	-0.13 (0.41)	-0.10 (0.40)
Nonfarm payrolls	0.82* (0.45)	2.57*** (0.86)	6.06*** (2.02)	5.64*** (1.92)	6.01*** (1.69)	4.28*** (1.14)	3.84*** (0.98)
Core PPI	0.16 (0.15)	0.48 (0.40)	1.68** (0.70)	2.24** (0.88)	2.45*** (0.92)	2.47*** (0.94)	2.91** (1.14)
Retail sales ex. autos	0.21 (0.14)	0.36* (0.20)	0.54 (0.43)	1.27** (0.57)	1.87** (0.82)	2.06*** (0.74)	2.06*** (0.73)
Unemployment	0.16 (0.22)	0.16 (0.47)	0.27 (1.02)	0.58 (0.92)	0.56 (0.88)	0.32 (0.64)	0.19 (0.61)
$\gamma^d$ : Date	-0.79*** (0.12)	-0.86*** (0.05)	-0.96*** (0.02)	-0.89*** (0.04)	-0.82*** (0.06)	-0.66*** (0.15)	-0.68*** (0.17)
$\gamma^s$ : State	-2.72** (1.31)	-0.31 (0.72)	0.28 (1.31)	0.39 (1.60)	2.01 (1.55)	1.59 (1.45)	0.59 (1.47)
$\delta^d$ : DA (Date)	0.10 (0.13)	0.00 (0.04)	0.06 (0.04)	0.16** (0.07)	0.37*** (0.12)	0.65*** (0.20)	0.75*** (0.23)
$\delta^s$ : DA (State)	0.43 (0.36)	-0.10 (0.22)	-0.18 (0.4)	-0.09 (0.49)	-0.52 (0.42)	-0.36 (0.39)	-0.06 (0.43)
$H_0 : \beta = 0$	0.13	0.13	0.02	0.04	0.04	0.04	0.03
$R^2$	0.05	0.14	0.17	0.13	0.11	0.10	0.10

Notes: Estimations for Equation 2 for all announcement days between December 16, 2008 and March 30, 2015. i.e. 603 observations for each horizon.  $\Delta r_t^j = \alpha^j + \sum_k \beta^{k,j} s_t^k (1 + \gamma^{d,j} D_t^{date} + \gamma^{s,j} D_t^{state} + \delta^{d,j} DA_t \cdot D_t^{date} + \delta^{s,j} DA_t \cdot D_t^{state}) + \varepsilon_t^j$ . Newey-West standard errors in parentheses; \*\*\* (\*\*) [\*] denotes significance at the 1% (5%) [10%] level.  $H_0 : \beta = 0$  tests for all  $\beta$ s being jointly zero and states the respective  $p$ -value.

**Table 13** The Effect of Forward Guidance under Disagreement (*sd* for *ey*<sub>1</sub>) on Treasury Yields

	6months	1year	2years	3years	5years	10years	20years
Capacity utilization	0.22 (0.17)	-0.20 (0.20)	0.36 (0.39)	0.47 (0.42)	-0.07 (0.50)	-0.63 (0.47)	-0.74* (0.44)
Consumer confidence	0.04 (0.12)	-0.04 (0.33)	0.39 (0.58)	0.50 (0.53)	0.59 (0.58)	0.60 (0.44)	0.75* (0.45)
Core CPI	-0.36 (0.27)	-0.19 (0.4)	-0.71 (0.75)	-0.68 (0.73)	-1.00 (0.90)	-1.04 (0.82)	-0.86 (0.64)
GDP advance	0.31* (0.17)	0.09 (0.15)	1.13* (0.66)	1.75* (1.01)	2.15* (1.13)	2.46** (1.21)	2.49** (1.16)
ISM index	0.37** (0.17)	-0.00 (0.25)	0.29 (0.65)	0.68 (0.60)	1.14* (0.68)	1.28* (0.71)	1.24* (0.67)
Leading indicators	-0.12 (0.21)	0.01 (0.15)	0.47 (0.47)	0.57 (0.66)	0.45 (0.93)	0.40 (0.97)	0.13 (0.85)
New homes	0.23 (0.19)	-0.02 (0.21)	0.02 (0.41)	-0.05 (0.46)	-0.15 (0.53)	-0.17 (0.43)	-0.11 (0.40)
Nonfarm payrolls	0.77* (0.43)	2.57*** (0.86)	6.02*** (2.02)	5.54*** (1.92)	5.82*** (1.68)	4.14*** (1.11)	3.75*** (0.96)
Core PPI	0.15 (0.16)	0.48 (0.40)	1.74** (0.74)	2.36** (0.95)	2.76*** (1.04)	2.88*** (1.00)	3.39*** (1.19)
Retail sales ex. autos	0.20 (0.13)	0.36* (0.20)	0.56 (0.44)	1.29** (0.58)	1.89** (0.83)	2.07*** (0.75)	2.07*** (0.74)
Unemployment	0.14 (0.22)	0.16 (0.48)	0.34 (1.05)	0.67 (0.96)	0.68 (0.95)	0.42 (0.67)	0.31 (0.62)
$\gamma^d$ : Date	-0.79*** (0.13)	-0.86*** (0.05)	-0.96*** (0.02)	-0.89*** (0.04)	-0.84*** (0.07)	-0.71*** (0.16)	-0.73*** (0.16)
$\gamma^s$ : State	-2.26*** (0.68)	-0.65** (0.27)	-0.53* (0.29)	-0.23 (0.43)	0.40 (0.54)	0.57 (0.57)	0.45 (0.55)
$\delta^d$ : DA (Date)	0.71 (0.75)	0.03 (0.21)	0.35* (0.2)	0.90** (0.36)	2.08*** (0.66)	3.73*** (1.13)	4.24*** (1.24)
$\delta^s$ : DA (State)	1.93* (1.06)	-0.01 (0.64)	0.42 (0.70)	0.67 (0.93)	-0.22 (0.86)	-0.30 (0.87)	-0.06 (0.94)
$H_0 : \beta = 0$	0.14	0.13	0.02	0.04	0.04	0.03	0.02
$R^2$	0.06	0.14	0.17	0.13	0.11	0.10	0.10

Notes: Estimations for Equation 2 for all announcement days between December 16, 2008 and March 30, 2015. i.e. 603 observations for each horizon.  $\Delta r_t^j = \alpha^j + \sum_k \beta^{k,j} s_t^k (1 + \gamma^{d,j} D_t^{date} + \gamma^{s,j} D_t^{state} + \delta^{d,j} DA_t \cdot D_t^{date} + \delta^{s,j} DA_t \cdot D_t^{state}) + \varepsilon_t^j$ . Newey-West standard errors in parentheses; \*\*\* (\*\*) [\*] denotes significance at the 1% (5%) [10%] level.  $H_0 : \beta = 0$  tests for all  $\beta$ s being jointly zero and states the respective  $p$ -value.

**Table 14** The Effect of Forward Guidance under Disagreement (*sd* for *eo*<sub>2</sub>) on Treasury Yields

	6months	1year	2years	3years	5years	10years	20years
Capacity utilization	0.20 (0.19)	-0.21 (0.19)	0.23 (0.38)	0.34 (0.4)	-0.18 (0.47)	-0.64 (0.44)	-0.73* (0.42)
Consumer confidence	0.04 (0.13)	-0.02 (0.33)	0.34 (0.58)	0.51 (0.54)	0.52 (0.57)	0.57 (0.45)	0.73 (0.47)
Core CPI	-0.29 (0.26)	-0.18 (0.40)	-0.71 (0.76)	-0.77 (0.76)	-1.09 (0.86)	-1.09 (0.79)	-0.87 (0.62)
GDP advance	0.35** (0.17)	0.08 (0.15)	1.13* (0.65)	1.66 (1.02)	2.00* (1.12)	2.38* (1.23)	2.51** (1.16)
ISM index	0.35** (0.18)	-0.01 (0.24)	0.31 (0.64)	0.67 (0.59)	1.14* (0.67)	1.30* (0.71)	1.25* (0.65)
Leading indicators	-0.12 (0.21)	0.00 (0.15)	0.46 (0.47)	0.57 (0.68)	0.38 (0.93)	0.36 (0.98)	0.12 (0.86)
New homes	0.21 (0.20)	-0.02 (0.20)	0.01 (0.38)	-0.06 (0.44)	-0.10 (0.46)	-0.15 (0.41)	-0.11 (0.41)
Nonfarm payrolls	0.83* (0.45)	2.57*** (0.86)	6.06*** (2.02)	5.67*** (1.92)	5.98*** (1.69)	4.23*** (1.14)	3.80*** (0.97)
Core PPI	0.17 (0.16)	0.47 (0.39)	1.66** (0.69)	2.19** (0.85)	2.50*** (0.94)	2.64*** (0.97)	3.12*** (1.17)
Retail sales ex. autos	0.22 (0.14)	0.36* (0.20)	0.55 (0.43)	1.27** (0.57)	1.87** (0.81)	2.07*** (0.74)	2.07*** (0.73)
Unemployment	0.16 (0.23)	0.16 (0.47)	0.30 (1.00)	0.59 (0.90)	0.62 (0.88)	0.37 (0.65)	0.24 (0.61)
$\gamma^d$ : Date	-0.8*** (0.12)	-0.86*** (0.05)	-0.96*** (0.02)	-0.89*** (0.04)	-0.83*** (0.06)	-0.68*** (0.15)	-0.71*** (0.16)
$\gamma^s$ : State	-2.64** (1.29)	0.12 (0.81)	0.81 (1.44)	1.18 (1.70)	2.48 (1.67)	1.38 (1.50)	0.20 (1.56)
$\delta^d$ : DA (Date)	0.32 (0.37)	0.01 (0.12)	0.18 (0.11)	0.46** (0.18)	1.05*** (0.34)	1.86*** (0.58)	2.13*** (0.64)
$\delta^s$ : DA (State)	1.43 (1.26)	-0.79 (0.8)	-1.17 (1.47)	-1.15 (1.72)	-2.30 (1.57)	-1.02 (1.44)	0.22 (1.62)
$H_0 : \beta = 0$	0.12	0.13	0.02	0.04	0.04	0.04	0.02
$R^2$	0.05	0.14	0.17	0.13	0.12	0.10	0.10

Notes: Estimations for Equation 2 for all announcement days between December 16, 2008 and March 30, 2015. i.e. 603 observations for each horizon.  $\Delta r_t^j = \alpha^j + \sum_k \beta^{k,j} s_t^k (1 + \gamma^{d,j} D_t^{date} + \gamma^{s,j} D_t^{state} + \delta^{d,j} DA_t \cdot D_t^{date} + \delta^{s,j} DA_t \cdot D_t^{state}) + \varepsilon_t^j$ ; Newey-West standard errors in parentheses; \*\*\* (\*\*) [\*] denotes significance at the 1% (5%) [10%] level.  $H_0 : \beta = 0$  tests for all  $\beta$ s being jointly zero and states the respective  $p$ -value.

[15] Ehrmann, M. and Fratzscher, M. (2013). Dispersed Communication by Central Bank Committees and the Predictability of Monetary Decisions. *Public Choice*, 157(1-2):223–244.

[16] European Central Bank (2014). The ECB's Forward Guidance. *ECB Monthly Bulletin April*, pages 358–361.

**Table 15** The Role of Policy Uncertainty

	6months	1year	2years	3years	5years	10years	20years
Capacity utilization	0.28** (0.13)	-0.14 (0.22)	0.55 (0.36)	0.65* (0.39)	0.23 (0.47)	-0.54 (0.46)	-0.68 (0.42)
Consumer confidence	-0.03 (0.05)	-0.05 (0.31)	0.38 (0.50)	0.39 (0.47)	0.57 (0.53)	0.59 (0.38)	0.73* (0.39)
Core CPI	-0.47** (0.24)	-0.17 (0.37)	-0.74 (0.63)	-0.63 (0.60)	-0.78 (0.76)	-0.78 (0.77)	-0.60 (0.64)
GDP advance	0.20 (0.18)	0.11 (0.15)	1.09* (0.62)	1.75* (0.97)	2.16** (1.08)	2.31** (1.14)	2.24** (1.12)
ISM index	0.32** (0.14)	0.06 (0.25)	0.28 (0.63)	0.67 (0.59)	1.14* (0.67)	1.28* (0.69)	1.26* (0.65)
Leading indicators	-0.14 (0.19)	0.00 (0.15)	0.38 (0.44)	0.51 (0.61)	0.40 (0.87)	0.41 (0.94)	0.15 (0.87)
New homes	0.20 (0.15)	0.01 (0.20)	0.04 (0.37)	-0.04 (0.41)	-0.18 (0.47)	-0.17 (0.39)	-0.11 (0.37)
Nonfarm payrolls	0.65 (0.41)	2.54*** (0.86)	5.88*** (2.02)	5.35*** (1.91)	5.47*** (1.67)	3.91*** (1.10)	3.61*** (0.94)
Core PPI	0.22 (0.14)	0.49 (0.40)	1.78** (0.79)	2.47** (1.02)	3.02** (1.18)	3.23*** (1.09)	3.89*** (1.26)
Retail sales ex. Autos	0.19 (0.13)	0.36* (0.20)	0.63 (0.46)	1.32** (0.57)	1.89** (0.80)	2.10** (0.75)	2.10*** (0.75)
Unemployment	0.19 (0.18)	0.23 (0.47)	0.55 (1.05)	0.89 (0.97)	1.02 (0.99)	0.74 (0.68)	0.62 (0.60)
$\gamma^d$ : Date	-0.74*** (0.16)	-0.86*** (0.05)	-0.96*** (0.02)	-0.88*** (0.04)	-0.82*** (0.08)	-0.71*** (0.17)	-0.75*** (0.16)
$\gamma^s$ : State	-2.03*** (0.49)	-0.72*** (0.17)	-0.69*** (0.25)	-0.34 (0.37)	0.19 (0.51)	0.72 (0.58)	0.78 (0.54)
$\delta^d$ : DA (Date)	1.32 (1.18)	0.04 (0.19)	0.41** (0.18)	0.95** (0.40)	2.14*** (0.81)	3.91*** (1.26)	4.39*** (1.30)
$\delta^s$ : DA (State)	0.28 (0.52)	0.54 (0.48)	0.98** (0.45)	1.11* (0.58)	0.63 (0.52)	0.24 (0.52)	0.02 (0.52)
$\eta$ policy uncertainty	-1.01* (0.59)	0.11 (0.14)	-0.09 (0.16)	-0.19 (0.25)	-0.01 (0.33)	0.39 (0.40)	0.46 (0.39)
$H_0 : \beta = 0$	0.20	0.17	0.03	0.06	0.06	0.04	0.02
$R^2$	0.07	0.14	0.17	0.14	0.11	0.10	0.10

Notes: Estimations for Equation 3 for all announcement days between December 16, 2008 and March 30, 2015. i.e. 603 observations for each horizon. Disagreement is measured by the interquartile range of dot projections  $iqr$  for the end of next year  $eo y_1$ .  $\Delta r_t^j = \alpha^j + \sum_k \beta^{k,j} s_t^k (1 + \gamma^{d,j} D_t^{date} + \gamma^{s,j} D_t^{state} + \delta^{d,j} DA_t \cdot D_t^{date} + \delta^{s,j} DA_t \cdot D_t^{state} + \eta^j p_t \cdot D_t^{dots}) + \varepsilon_{t,j}^j$ ; Newey-West standard errors in parentheses; \*\*\* (\*\*) [\*] denotes significance at the 1% (5%) [10%] level.  $H_0 : \beta = 0$  tests for all  $\beta$ s being jointly zero and states the respective  $p$ -value.

[17] Federal Reserve System (2003). Statement / Press Release on August 12, 2003.

[18] Federal Reserve System (2011). Minutes of the Federal Open Market Committee, December 13, 2011.

- [19] Federal Reserve System (2012). Minutes of the Federal Open Market Committee, January 24-25, 2012.
- [20] Federal Reserve System (2013). Statement of the Federal Open Market Committee, June 19, 2013.
- [21] Femia, K., Friedman, S., and Sack, B. (2013). The Effects of Policy Guidance on Perceptions of the Fed's Reaction Function. *Federal Reserve Bank of New York Staff Reports*, 652.
- [22] Ferrero, G. and Secchi, A. (2009). The Announcement of Monetary Policy Intentions. *Bank of Italy Temi di Discussione (Working Paper)*, 720.
- [23] Filardo, A. and Hofmann, B. (2014). Forward Guidance at the Zero Lower Bound. *BIS Quarterly Review*, pages 37–53.
- [24] Gerlach-Kristen, P. (2004). Is the MPC's Voting Record Informative about Future UK Monetary Policy? *The Scandinavian Journal of Economics*, 106(2):299–313.
- [25] Gürkaynak, R. S., Sack, B., and Swanson, E. (2005). The Sensitivity of Long-Term Interest Rates to Economic News: Evidence and Implications for Macroeconomic Models. *American Economic Review*, 95(1):425–436.
- [26] Mankiw, N. G., Reis, R., and Wolfers, J. (2004). Disagreement about Inflation Expectations. In *NBER Macroeconomics Annual 2003*, volume 18, pages 209–270. The MIT Press.
- [27] Meade, E. E., Nozawa, Y., Petrasek, L., and Zickler, J. K. (2015). The Effects of FOMC Communications before Policy Tightening in 1994 and 2004. *Board of Governors of the Federal Reserve System, FEDS Notes*, 2015-09-24.
- [28] Moessner, R., De Haan, J., and Jansen, D.-J. (2014). The Effect of the Zero Lower Bound, Forward Guidance and Unconventional Monetary Policy on Interest Rate Sensitivity to Economic News in Sweden. *DNB Working Paper*, 413.
- [29] Moessner, R. and Nelson, W. R. (2008). Central Bank Policy Rate Guidance and Financial Market Functioning. *International Journal of Central Banking*.
- [30] Morris, S. and Shin, H. S. S. (2002). Social Value of Public Information. *American Economic Review*, 92(5):1521–1534.
- [Morris, Stephen D.] Morris, Stephen D. Future Monetary Policy Rules in Forward Guidance. *mimeo*.
- [32] Nakata, T. (2014). Reputation and Liquidity Traps. *Finance and Economics Discussion Series, Board of Governors of the Federal Reserve System*, 50.
- [33] Neuenkirch, M. and Siklos, P. L. (2014). When is Lift-Off? Evaluating Forward Guidance from the Shadow. *Open Economies Review*, 25:819–839.



- [34] Ozer-Balli, H. and Sørensen, B. E. (2012). Interaction Effects in Econometrics. *Empirical Economics*, 45(1):583–603.
- [35] Raskin, M. D. (2013). The Effects of the Federal Reserve’s Date-Based Forward Guidance. *Finance and Economics Discussion Series, Board of Governors of the Federal Reserve System*.
- [36] Riboni, A. and Ruge-Murcia, F. (2014). Dissent in Monetary Policy Decisions. *Journal of Monetary Economics*, 66:137–154.
- [37] Smales, L. A. and Apergis, N. (2016). The Influence of FOMC Member Characteristics on the Monetary Policy Decision-Making Process. *Journal of Banking and Finance*, 64:216 – 231.
- [38] Svensson, L. E. (2006). Social Value of Public Information: Morris and Shin (2002) is Actually Pro Transparency, Not Con. *American Economic Review*, 96(1).
- [39] Swanson, E. T. and Williams, J. C. (2014). Measuring the Effect of the Zero Lower Bound on Medium- and Longer-Term Interest Rates. *American Economic Review*, 104(10):3154–3185.
- [40] Woodford, M. (2005). Central Bank Communication and Policy Effectiveness. *National Bureau of Economic Research Working Paper Series*, 11898.
- [41] Woodford, M. (2012). Methods of Policy Accommodation at the Interest-Rate Lower Bound. In *The Changing Policy Landscape: 2012 Jackson Hole Symposium*. Federal Reserve Bank of Kansas City.
- [42] Wu and Xia (2016). Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound. *Journal of Money, Credit and Banking*, 48.
- [43] Wynne, M. A. (2013). A Short History of FOMC Communication. *Federal Reserve Bank of Dallas Economic Letter*, 8(8).