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Forward Guidance under Disagreement

Evidence from the Fed's dot projections

March 1, 2016

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. I find that the Fed's forward guidance reduces the sensitivity of interest rates to macroeconomic news. The sensitivity shrinkage is stronger in the case of date-based forward guidance due to its unconditional nature. Yet, high levels of disagreement 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.

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

JEL classification: E52, E58

1 Introduction

Forward guidance has become a key instrument in monetary policy over the past years. Different measures of forward guidance have been provided, yet, their effectiveness is still under debate. Especially since the outbreak of the financial crisis in 2008, there has been increased need for further tools that manage expectations about the future path of monetary policy. Several central banks decided that in times of low inflation expectations together with an interest rate at the zero lower bound, accommodative financial conditions would be appropriate to reach the central bank's objectives. According to e.g. Blinder et al. (2008), in particular forward guidance is essential for 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 it 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 explicit period of time or until a certain condition is met.¹ Yet, forward guidance was already used before the crisis in conjunction with other macroeconomic projections as a measure of expectations management and central bank transparency.

Since its introduction, forward guidance at the Fed has experienced different designs. 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, in 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 adopted state-based forward guidance by linking a future rise in the federal funds rate to developments in unemployment and inflation. This step attenuated forward guidance but also made it more flexible. In January 2012, the participants of the Federal Open Market Committee (FOMC)² began to provide their individual assessments of the future policy rate path appropriate to support accommodative monetary policy. These dot projections should influence market expectations about future monetary policy. However, it is still unclear how and to what extent markets react to these forward interest rate publications.

This paper is the first to comprehensively compare the effectiveness of date- and state-based forward guidance as well as to consider the impact of disagreement within the FOMC on the effectiveness of forward guidance. Specifically, this paper builds on Swanson and Williams (2014) and Raskin (2013) and investigates the effectiveness

¹For 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 Filardo and Hofmann (2014).

²In fact, also the nonvoting Reserve Bank presidents provide their assessments. Hereinafter, if not explicitly stated, the term "participants" comprises all those who participate in the assessment that is published by the FOMC, i.e. it also implies the nonvoting presidents. For further details, see Section 3.

of forward guidance through the lens of interest rates' sensitivity to macroeconomic news. While macroeconomic models suggest that interest rates should not be persistently affected by macroeconomic news, the empirical literature finds that interest rates along the yield curve move upon a macroeconomic surprise, compare Gürkaynak et al. (2005). This reaction pattern can be used in order to analyse the effect of central bank's expectations management on the yield curve. If for instance the public central bank signal constitutes a focal point in the financial market, interest rates would be less affected by macroeconomic news. The sample covers a base period from December 2008 until August 2011 and I allow for a differential sensitivity change due to date- and state-based forward guidance respectively. For conditional and unbinding forward guidance, one would wish sensitivity to either stay constant or even rise (compare Moessner and Nelson (2008)) as the central bank projection just increases the information set of market participants and should not crowd out other signals. Unconditional forward guidance, by contrast, would result in a lower responsiveness of interest rates of respective maturities if the promise is perceived as credible. 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. Therefore this analysis contributes to the literature on monetary policy committees as e.g. Ehrmann and Fratzscher (2013) who are in favor of communicating only the consensus view of committee members.

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. By contrast, under state-based forward guidance, the sensitivity shrinkage is less pronounced. As credibility is crucial for the effectiveness of forward guidance, this implies that financial markets believe in the promise by the central bank to keep interest rates low, despite a potential time-inconsistency problem. If the central bank provides information on disagreement, this could be detrimental to the strength of forward guidance. In line with this intuition I find that high levels of disagreement among policymakers 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.

The rest of the paper is organized as follows. In the next section, I summarize the evolution of the Fed's forward guidance since 2008 and link it to the literature. In Section 2.3 the empirical model is introduced and the empirical results on date- and state-based forward guidance are presented. Section 3 discusses the FOMC's dot projections as well as several measures of disagreement. The section further presents the findings of the empirical model that is augmented by disagreement as well as a robust-

ness check where I control for policy uncertainty. Finally, section 4 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. 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, policymakers have moved to making concrete statements and now even provide forward guidance in their monetary policy statements (see Wynne (2013)).³ 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” (Federal Reserve System (2003)). 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 Blinder et al. (2008)).

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.⁴ This expectations management was further intended to lower interest rate uncertainty and thus volatility, and represented a significant increase in central bank transparency. However, monetary policymakers 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. 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.⁵ Campbell et al. (2012) define this assurance to stick to accommodative monetary policy as “Odyssean forward guidance”. In contrast, the projection of a presumable path conditional on the future economy represents a less 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.

³For a historical review of the Fed's forward guidance, see also Contessi and Li (2013a).

⁴The Reserve Bank of New Zealand was the first central bank to publish quantitative interest rate projections in 1997 (see Detmers and Nautz (2012)). Other central banks followed in providing forward guidance, as for example the Bank of Norway in 2005 and Sveriges Riksbank in 2007.

⁵The Bank of Japan introduced this kind of forward guidance already in 1999, when the policy rate was 0.15% (see Contessi and Li (2013b)).

Table 1 Forward Guidance at the Federal Reserve since December 2008

Dec 16, 2008	The Fed starts to provide forward guidance and projects low levels of the federal funds rate “for some time”.
March 18, 2009	The Fed prolongs the horizon to “an extended period of time”.
Aug 9, 2011	Date-based 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 dot projections revealing the disagreement among FOMC participants
Dec 12, 2012	State-based forward guidance (= conditional forward guidance linked to the actual unemployment rate and inflation projections)
March 19, 2014	Extension of time horizon of forward guidance; low interest rate levels even after 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 between December 2008 and March 2015. Source: FOMC.

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 reserve rate for some time”. This warranty got strengthened in the March 2009 statement by spanning “an extended period of time”.

In August 2011, the FOMC surprisingly⁶ introduced an even more explicit horizon which was renewed and prolonged in January and September 2012 (see Table 1). The horizon always covered the next 2 to 3 years over which the FOMC expected to hardly increase the target for the federal funds rate. This *date-based forward guidance* comes close to an unconditional commitment to keep interest rates at the actual 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 Federal Reserve System (2012)).

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 par-

⁶See Raskin (2013).

ticipants (compare Woodford (2012)).⁷ On the other hand, by committing to low future policy rates, the central bank loses flexibility and might run into a time-inconsistency problem (see also Woodford (2012)): 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. Nakata (2014) shows that despite this overshooting the decline in output and inflation is less extreme during crisis periods due to a reanchoring 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 effect of forward guidance on the economy. Thus, effective forward guidance is mostly a matter of central bank credibility and public understanding (see Filardo and Hofmann (2014)).⁸

Soon, FOMC statements additionally became more explicit about the economic conditions 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 policymakers 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 Federal Reserve System (2012), page 14). Instead of being explicit about the horizon, the FOMC started to link a rise in the federal funds rate to numerical economic conditions, i.e. thresholds in unemployment and projected inflation.⁹ 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 replaced by a rather conditional state-based forward guidance.¹⁰

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

⁷While the Fed's policy could be viewed as an extended commitment following Woodford (2012), Contessi and Li (2013a) suggest that date-based forward guidance may have also signalled either a weaker economic outlook or a change in the policy rule of the Federal Reserve.

⁸Filardo and Hofmann (2014) further suggest that forward guidance is potentially useful if there is a commitment that is clearly communicated and interpreted in the intended way.

⁹Specifically, 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.

¹⁰For comparison, the European Central Bank (2014) distinguishes four categories of forward guidance, namely pure qualitative forward guidance, qualitative forward guidance conditional on narrative, calendar-based and outcome-based forward guidance.

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 Woodford (2012)).

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 Morris and Shin (2002). This might be detrimental to social welfare, especially when the public signal is wrong. However, Svensson (2006) 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 especially applies to 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 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 level and volatility effects on interest rates and 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. Moessner and Nelson (2008)). Yet, the effect diminished after the outbreak of the financial crisis in 2008 (Detmers and Nautz (2012)). Filardo and Hofmann (2014) 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. At 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.

Moreover, the effect of interest rate projections should be persistent. An immediate effect at the policy day with a retraction in the following days is viewed as volatility-increasing (see Ferrero and Secchi (2009) and Detmers and Nautz (2012)). At the same time, fresh central bank announcements on the projected future path can lower interest rate uncertainty. Stale projections, by contrast, may lead to increased volatility (see

Detmers and Nautz (2014)). Furthermore, in the case of the Fed's binding forward guidance, Filardo and Hofmann (2014) 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 two and five year horizon, while volatility at the one year 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

Gürkaynak et al. (2005) 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.¹¹

Moessner and Nelson (2008) 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.¹² 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.

Swanson and Williams (2014) show that interest rates along the yield curve should be

¹¹Moessner et al. (2014) find that the forward guidance of the Sveriges Riksbank did not significantly impact the sensitivity of interest rates as market participants understood its conditionality.

¹²By contrast, Swanson and Williams (2014) show that sensitivity of treasury yields of three and six months significantly shrinks during the same period.

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.¹³ The authors argue that only large positive shocks would be able to generate a rise in the short-term rate. This would mean that if the central bank publicly commits to keep policy rates at the zero lower bound for a certain period, also expected short-term rates within this period 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. Swanson and Williams (2014) 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

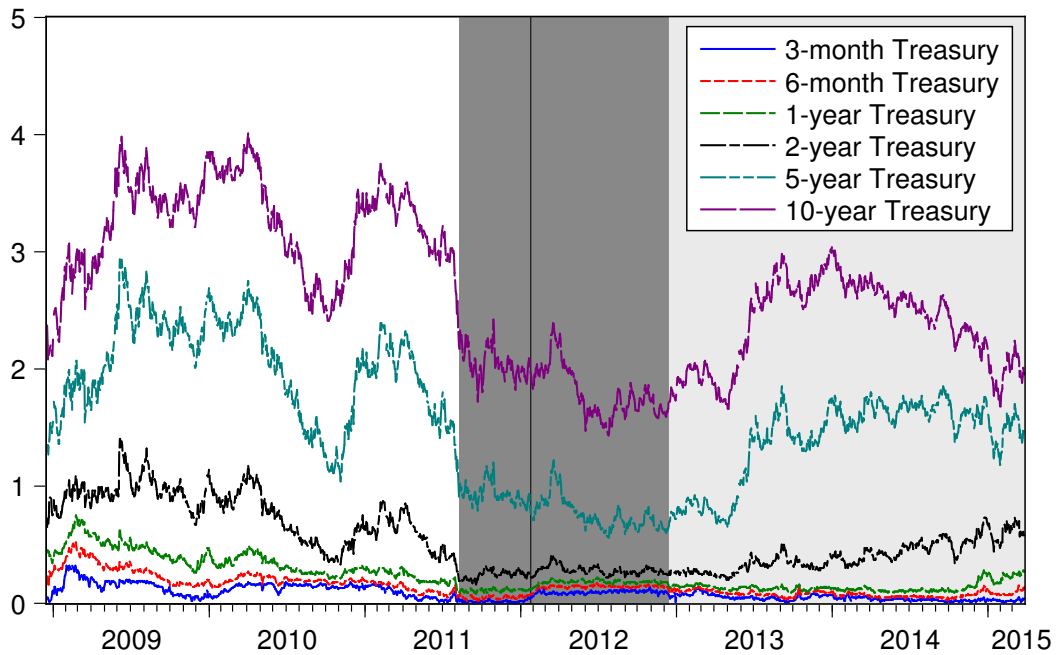
According to both theoretical and empirical literature, macroeconomic surprises should lead at least to a short-lasting move in short-term interest rates. By contrast, long-term interest rates should not move significantly upon macroeconomic news if expectations are well anchored. Yet, at the zero lower bound, the reaction of short-term rates should be reduced or not occur at all, see Swanson and Williams (2014).

In the empirical analysis, I use U.S. government treasury yields available at the Federal Reserve Board at multiple horizons from 1 month to 30 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 thereafter is shaded in light grey. Short-term interest rates are rather low due 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 seem to rise in mid-2013, suggesting that economic data indicates an upcoming lift-off.

For analyzing the sensitivity of treasury yields to macroeconomic news, I use actual releases together with the median forecast of the RTR poll from Datastream. I com-

¹³Moessner et al. (2014) support this finding for Sweden.

Figure 1 Treasury yields



Notes: Treasury yields at maturities 3m, 6m, 1y, 2y, 5y, 10y. 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.

pute surprises as the difference between forecast and actual releases and normalize them by their historical standard deviations. Following the literature (e.g. Gürkaynak et al. (2005), Swanson and Williams (2014), Raskin (2013)), the regressions include economic surprises on output, labor and prices, 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 7 in the Appendix summarizes some statistics of 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 announcements are made 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 is not credible to market participants. Second, this could imply a bad transparency scheme of the central bank. Markets then would be unable to correctly process the provided infor-

mation (see Filardo and Hofmann (2014)). Third, markets could 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. The first hypothesis to be tested in the model therefore reads:

Hypothesis 1: Credible 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 Swanson and Williams (2014) and Raskin (2013). 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 in the case of the Fed linked to unemployment and inflation projections. If a commitment is conditional on macroeconomic developments, market participants should still be attentive to macroeconomic surprises for the formation of expectations and interest rates. Consequently, the sensitivity shrinkage should be higher under date-based than under state-based forward guidance due to a different level of conditionality.

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

2.3.1 Empirical Model and Results

Advancing on Swanson and Williams (2014) and Raskin (2013), I analyze the sensitivity of treasury yields to macroeconomic news by making the sensitivity dependent on the prevailing forward guidance design. For treasury yields of maturities $j = 1, 3, 6$ months as well as $j = 1, 2, 3, 5, 7, 10, 20, 30$ years, I estimate the empirical model on all macroeconomic release dates from December 16, 2008 until March 30, 2015:¹⁴

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

¹⁴The estimation results are robust to whether only announcement days or all business days are covered in the sample.

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. γ then determines 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 $|\gamma^{d,j}| > |\gamma^{s,j}|$.

Table 2 summarizes the results from estimating Equation 1. In line with Raskin (2013), 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 January 2012 is already a period in which short-term interest rates are no longer sensitive to the whole set of macroeconomic news (compare Swanson and Williams (2014)). 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. Although for consumer confidence and core CPI, β^k is wrongly signed for the 1-month and 3-months horizons, all other significant responses are consistent with predictions from standard monetary policy reaction functions. Yet, as the period from December 2008 onwards is a period with rather low sensitivity to macroeconomic news, some results have to be interpreted with caution. The test on joint significance of all β s cannot be rejected for horizons of 6 months, 1, 10 and 30 years; still, the R^2 is reasonably high.

The shaded area in Table 2 shows 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 forward guidance throughout the yield curve. The reaction of treasury yields to macroeconomic surprises is lower under date-based forward guidance. This effect is significant even longer than the date-based indicated horizon, i.e. statistically significant for horizons up to 7 years. This points to a rather expansive influence of date-based forward guidance as its horizon always 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 (Woodford (2012)) or a strong correlation between treasury yields of different maturities. In other words, the Fed's forward guidance seems to be rather credible as the public does not expect the Fed to deviate from

Table 2 The sensitivity lowering effect of date- and state-based forward guidance on the sensitivity of treasury yields to macroeconomic news

	1month	3months	6months	1year	2years	3years	5years	7years	10years	20years	30years
Capacity utilization	-0.33 (0.23)	0.03 (0.21)	0.17 (0.2)	-0.20 (0.2)	0.33 (0.39)	0.43 (0.43)	0.02 (0.53)	-0.12 (0.47)	-0.53 (0.49)	-0.63 (0.45)	-0.52 (0.41)
Consumer confidence	-0.92*** (0.33)	-0.09 (0.22)	0.01 (0.14)	-0.04 (0.33)	0.38 (0.59)	0.54 (0.56)	0.72 (0.65)	0.87 (0.6)	0.85 (0.54)	1.12** (0.57)	1.12** (0.57)
Core CPI	-0.21 (0.25)	-0.52** (0.22)	-0.29 (0.28)	-0.19 (0.4)	-0.70 (0.78)	-0.71 (0.78)	-0.89 (0.9)	-0.99 (0.85)	-0.96 (0.83)	-0.86 (0.67)	-0.63 (0.58)
GDP advance	0.05 (0.2)	0.11 (0.18)	0.38** (0.18)	0.09 (0.15)	1.13* (0.66)	1.73* (1.03)	2.16* (1.12)	2.57* (1.38)	2.42** (1.19)	2.43** (1.14)	2.02* (1.04)
ISM index	0.96*** (0.34)	0.61*** (0.21)	0.36* (0.18)	0.00 (0.24)	0.28 (0.65)	0.69 (0.61)	1.25* (0.73)	1.42* (0.77)	1.57* (0.81)	1.57** (0.74)	1.61** (0.69)
Leading indicators	0.12 (0.48)	0.02 (0.16)	-0.11 (0.22)	0.01 (0.15)	0.50 (0.48)	0.59 (0.69)	0.40 (1)	0.10 (0.95)	0.21 (1.09)	-0.21 (0.95)	-0.08 (0.98)
New homes	-0.28 (0.31)	-0.04 (0.19)	0.19 (0.22)	-0.02 (0.21)	0.02 (0.41)	-0.05 (0.48)	-0.15 (0.52)	-0.25 (0.48)	-0.15 (0.4)	-0.09 (0.38)	-0.03 (0.37)
Nonfarm payrolls	0.09 (0.15)	0.76** (0.36)	0.83* (0.45)	2.57*** (0.86)	6.03*** (2.02)	5.64*** (1.92)	5.76*** (1.69)	4.74*** (1.37)	3.63*** (1.13)	3.1*** (0.98)	2.9*** (0.94)
Core PPI	-0.04 (0.14)	-0.08 (0.24)	0.18 (0.15)	0.48 (0.4)	1.7** (0.71)	2.17** (0.86)	2.25** (0.98)	1.72* (1)	1.31 (1)	1.39 (1.08)	1.63 (1.19)
Retail sales ex. autos	0.25 (0.28)	0.13 (0.09)	0.21 (0.14)	0.36* (0.2)	0.54 (0.43)	1.25** (0.57)	1.88** (0.84)	2.26*** (0.85)	2.13*** (0.79)	2.15*** (0.8)	1.79** (0.75)
Unemployment	0.08 (0.14)	0.06 (0.22)	0.19 (0.24)	0.16 (0.47)	0.31 (1.03)	0.61 (0.95)	0.79 (1.02)	0.94 (0.88)	0.77 (0.79)	0.77 (0.72)	0.93 (0.69)
Date-based FG: γ^d	-1.57*** (0.3)	-1.06*** (0.12)	-0.75*** (0.14)	-0.86*** (0.05)	-0.94*** (0.03)	-0.83*** (0.07)	-0.67*** (0.14)	-0.42* (0.25)	-0.17 (0.38)	-0.05 (0.46)	-0.14 (0.44)
State-based FG: γ^s	-0.97*** (0.2)	-1.59*** (0.26)	-1.26*** (0.22)	-0.65*** (0.19)	-0.33 (0.28)	0.08 (0.4)	0.32 (0.42)	0.57 (0.48)	0.55 (0.49)	0.55 (0.46)	0.61 (0.48)
$H_0 : \beta = 0$	0.03	0.05	0.11	0.13	0.02	0.04	0.05	0.08	0.13	0.09	0.13
R^2	0.04	0.07	0.05	0.14	0.16	0.13	0.11	0.09	0.08	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. $\Delta r_t^i = \alpha^i + \beta^{k,j} \sum_k s_k^i (1 + \gamma^{d,j} D_t^{date} + \gamma^{s,j} D_t^{state}) + \varepsilon_t^i$; Newey-West standard errors in parentheses; *** (**) [*] denotes significance at the 1% (5%) [10%] level. $H_0 : \beta = 0$ tests for all β s being jointly zero and states the respective p -value.

its promise despite the time-inconsistency problem. The discrepancy in the strength of reactions to date- and state-based forward guidance confirms their different conditionality. In fact, Berriel et al. (2015) 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.

3 Forward Guidance under 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. 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 market's perception of the Fed's forward guidance and impair its effectiveness. Specifically, the reaction of interest rates to macroeconomic surprises may be stronger in the presence of disagreement.

This section 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. After a short review of literature on disagreement and monetary committees, I provide some details on the institutional background of the dot projections. Next, I introduce different measures of disagreement and discuss their evolution over the sample. Finally, I augment the empirical model of Section 2 with a measure of disagreement and analyse the consequences of disagreement for the Fed's forward guidance.

3.1 Literature on Disagreement and Decision Making by Monetary Policy Committees

Monetary policy committees can 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 Gerlach-Kristen (2004) for the Bank of England and Riboni and Ruge-Murcia (2014) for the Sveriges Riksbank and the Federal Reserve). By contrast, in a committee with consensus-rule, the role of dissenting votes differs as it involves more discussion, convincing and a debate about the different opinions.

Disagreement about the likely future course of the economy has often been analysed in matters of private expectations and professional forecasters. However, although central banks tend to increase their transparency, there is little information about the disagreement among monetary policymakers. Neuenkirch and Siklos (2014) classify the Bank of Canada's procedure to not disclose its members' views about the future path as insufficient transparency. In contrast to Riboni and Ruge-Murcia (2014), Ehrmann and Fratzscher (2013) 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.

Reasons for disagreement on future interest rates lie either in the different economic outlooks or in the different policy reaction function. Dovern (2015) therefore 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. Yet, due to the anonymity of dot projections, this is not possible in the case of the FOMC at least until publication with a lag of several years. FOMC forecasts for GDP, CPI and unemployment have already been published before 2012, though in a restricted way with only range and a trimmed range¹⁵ rather than individual forecasts. For the whole dataset, there is again a publication lag. Banerghansa and McCracken (2009) test the FOMC projections on GDP, CPI and unemployment from 1992 to 1998 for different behaviour depending on the voting status. Furthermore, Berriel et al. (2015) use FOMC's dot projections to extract the degree of commitment and find a decrease in commitment after December 2012 when state-based forward guidance was issued.

Neuenkirch and Siklos (2014) state different risks for monetary policy decision making by committees that might partially apply to the assessments. On the one hand, 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. On the other hand, polarised committee members might tend to excessive 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.

¹⁵Trimmed range is the central tendency excluding the extreme values, i.e.the three highest and lowest projections respectively.

3.2 The FOMC

Blinder (2004) classifies the FOMC structure as collegial; however, their communication tends to be individualistic with differing views across members (see Blinder et al. (2008)). While the collegial character is apparent in the actual monetary policy decision, the individualistic communication essentially matters for expectations management through speeches and is also reflected in the individual assessments.

The FOMC consists of the Board of Governors, 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 Federal Open Market Committee 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.¹⁶

As Banternghansa and McCracken (2009) line out, participants' assessments may differ depending on their voting status. If a Reserve Bank president is a voting member, he might change his assessment of appropriate monetary policy with a bias to the situation in the region of the respective Reserve Bank. Unfortunately, I cannot distinguish between projections made by voting and non-voting members. 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.¹⁷ 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.

¹⁶This 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.

¹⁷The composition of the assessment's participants in the sample period is as follows: 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.¹⁸ 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.¹⁹ 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).

participants regard low levels of 1% and below as adequate to the projected economic situation within this horizon. This is in line with the date-based forward guidance issued on the same day which projects exceptionally low interest rates through late 2014. It is striking that none of the FOMC participants expects a return to normal conditions in the 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 all participants.

While dots are quite close together for the shortest horizon, they spread out over time. Reasons for a rather low disagreement about the appropriate level at the end of this year could 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.²² While the bulk of dots is located between 0.25% and 1% for the next three years, some participants expect that a substantial rise in future interest rates is already reasonable within this horizon. However, disagreement on the longer-run path of interest rates seems to be less pronounced. Thus, participants have a rather similar view on the steady state level of the policy rate.

There may be different reasons for 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. Second, regional Reserve Bank presidents may especially be biased in decision-making towards the economic situation in their own region (see Banerghansa and McCracken (2009)). Third, their individual policy reaction functions may differ. This is apparent in the longer run projections where there is little disagreement on how to achieve policy goals, while there is also some disagreement among FOMC participants on the optimal longer run values of output and unemployment (see FOMC Summary of Projections). However, as individual dots are anonymous, 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.

I now examine the *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) with a prolonged horizon of up to 4 years (see Figure 5 in Appendix). The typical (dis)agreement pattern over this period is characterized by lower disagreement in the short-term (end of this year) as well as in the longer run while disagreement at intermediate horizons is larger.

In the respective December projections (Panels e, i, m in Figure 5), there is no dis-

²²Jeffrey 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 Federal Reserve System (2012).

agreement on the rate at the end of the year. This reflects 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 made. Yet, participants could still see a higher interest rate as appropriate implying that they disagree with the decision on the current policy rate.²³ 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 and thus already agreed on the next monetary policy step.²⁴

The longer run projections refer to normal economic conditions and therefore to the steady state FOMC participants have in mind. In the first half of 2012, the longer run seems to refer to an uncertain point in time for all the 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 view late-2015 as constituting a return to longer-run conditions.²⁵ Henceforward, apart from the June 2013 projection, there is overlap of dots at explicit and longer run horizons implying that the steady state is expected to be achieved within that explicit time frame.

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.²⁶ This participant seems to favor the policy suggested by Woodford (2012). 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. Figure 5 further indicates that the perceived appropriate longer run / steady state level of the target federal funds rate changes over time. This could be due to participants modifying their policy reaction function or adjusting their long-term goals for output and unemployment.

²³One could attempt to draw conclusions from the votings 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.

²⁴Another reason could be that the participant that in the previous projection assessed a rate of 0.5% as appropriate for the end of the year, dropped out. In fact, Board of Governors members Elisabeth Duke and Sarah Bloom Raskin dropped out.

²⁵In 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.

²⁶This 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.

I now examine the *evolution of the median projected path over time*.²⁷ 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 / 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 this 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. 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 characterised by some seasonality with projected rates declining in the assessments at the end of the year. The median participant seems to revise her projection downwards, possibly because the current economic outlook in her view has worsened. Furthermore, as Figure 5 already indicated, there is a change in the median appropriate interest rate level in the steady state. Between mid-2012 and mid-2014, the median for lr declines from 4.25% to 3.75% .

3.4 Measuring Disagreement

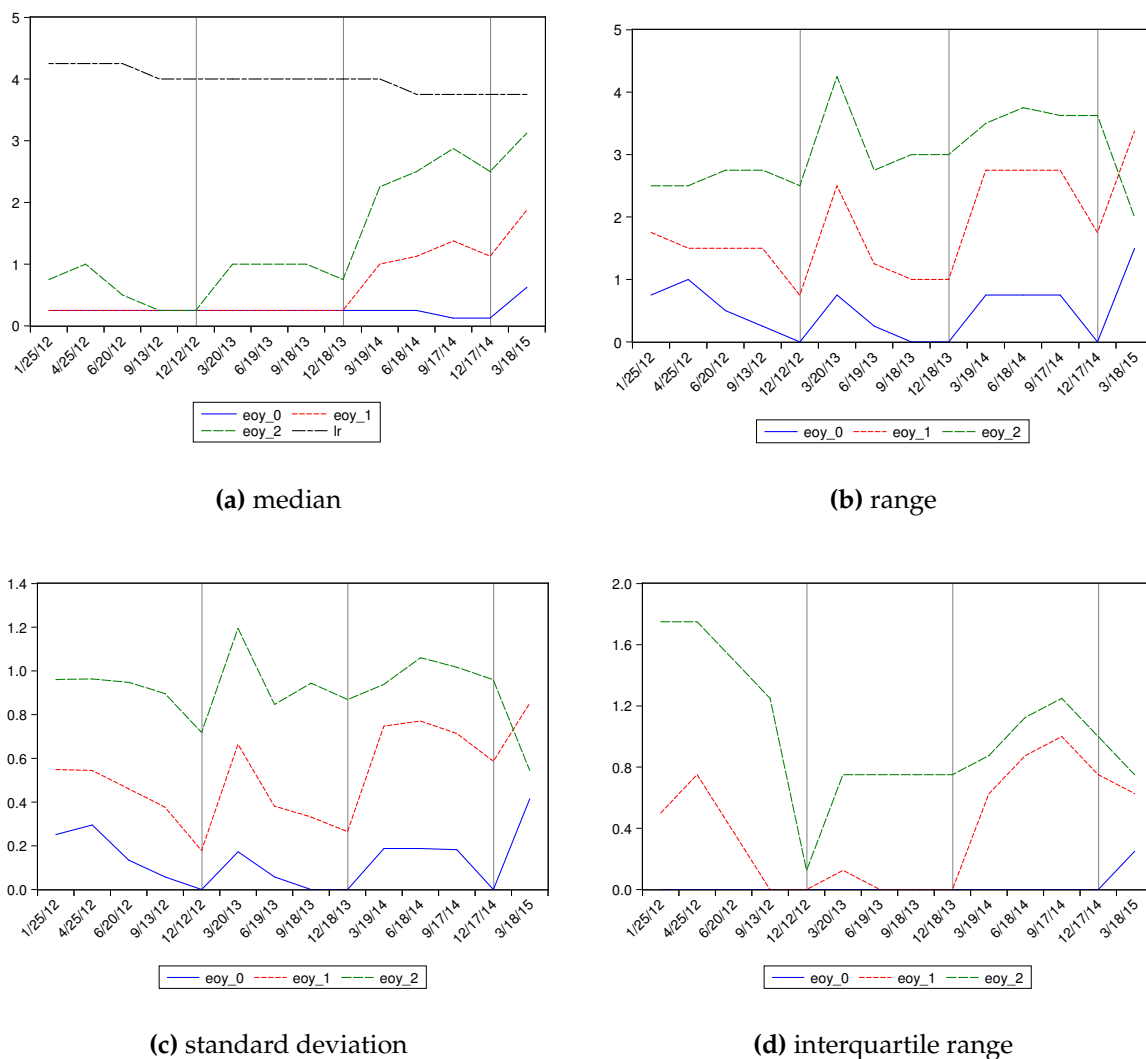
The heterogeneity in dot projections can be interpreted as the aggregate disagreement among FOMC participants and can be measured in different ways. Disagreement is typically measured within each cross-section at each point in time due to the anonymity of dots.²⁸ This gives one level of disagreement for each horizon after every second meeting. Although some FOMC participants might reveal changes in opinion through speeches in the meantime, I cannot infer a change in disagreement among them. Thus, I assume disagreement to be constant between two disclosures 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 Riboni and Ruge-Murcia (2014)), yet they do not prevent decisions to be taken if adopted by majority approval as in the case of the FOMC. Second moments

²⁷As the decision-making process in the committee is rather collegial (see Blinder (2004)) and due to the typical interest rate cuts and rises by 25 basis points, votes for the current policy rate target would always end up in a choice for the median rather than the mean, which is not robust to outliers.

²⁸By contrast, Banerghansa and McCracken (2009) 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.

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: FOMC Summary of Projections and author's calculations.

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 mean while monetary policymakers would rather base their decision on the median. Therefore, quantile-based measures such as the *interquartile range* as for instance used in Mankiw et al. (2004) and Andrade et al. (2015) seem to be more adequate. The interquartile range is defined as the difference between the 75th and the 25th 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 shows some summary statistics about the dot projections for the different horizons. Aside from eoy_3 , all horizons are disclosed in the 14 regular projections that

Table 3 Disagreement pattern along the horizon

	$eo y_0$	$eo y_1$	$eo y_2$	$eo y_3$	<i>longer run</i>
Obs.	14	14	14	6	14
Horizon in months (<i>min - 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.

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 dot projections are 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. Table 3 further lists the average disagreement based on the three measures along the horizons for the publications between January 2012 and March 2015. Disagreement is small in the short run ($eo y_0$)²⁹ 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).

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 policymakers agree on the future policy path in the short-run while standard deviation and range reveal the presence of some outliers. Those participants favor

²⁹This is in line with Banternghansa and McCracken (2009) who investigate FOMC projections on GDP, CPI and unemployment for the period from 1992 until 1998.

Table 4 Correlation of disagreement measures

	<i>eo</i> y_0			<i>eo</i> y_1			<i>eo</i> y_2		
	std. dev.	range	<i>IQR</i>	std. dev.	range	<i>IQR</i>	std. dev.	range	<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 at the three horizons, *eo* y_0 , *eo* y_1 and *eo* y_2 .

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, from September 2012 until December 2013, economic outlooks of participants must have been rather close together when the policy reaction function is assumed to not change substantially within that period and to be the similar across participants. A vast difference in measures becomes apparent in March 2013. While the range of the projected federal funds rate target almost 3 years (*eo* y_2) ahead is 4.25, the interquartile range is only 0.75. In fact, most of the participants agree on a projected target between 0.5% and 1.25% while some participants view an increase of the target to up to 5.5% as appropriate (see also Figure 5 Panel (e) in the Appendix).

As demonstrated in Section 2, when dot projections were first provided, date-based forward guidance foresaw low interest rates through late 2014. 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. In consideration of this time dimension, the empirical analysis concentrates on the *eo* y_1 and *eo* y_2 projections that mostly cover the date-based forward guidance horizon.³⁰ Yet, as *eo* y_2 is only covered by this horizon for the data until 2013, it seems best to measure disagreement based on participants' projections for the end of next year, *eo* y_1 . The next section therefore augments the empirical model of Section 2 by the interquartile range for *eo* y_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 issued forward guidance. Results for horizon *eo* y_2 as well as for range and standard deviation are provided in the appendix.

³⁰In September and December 2012, the date-based horizon is also covered by *eo* y_3 . Yet, this horizon is not available for the whole sample. Furthermore, in March 2015, the mid-2015 horizon is only covered by *eo* y_0 .

3.5 Empirical model and results

Filardo and Hofmann (2014) 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. 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.³¹ Market participants might perceive the commitment character of central bank's projections as less credible and therefore be more attentive to other information such as macroeconomic news. Therefore,

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

Again, one expects this effect to differ with the commitment character of forward guidance. Disagreement should especially matter when unconditional forward guidance is issued, i.e. in times of date-based forward guidance:

Hypothesis 4: The sensitivity shrinkage of treasury yields to macroeconomic news should be even more reduced 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 one of the disagreement measures introduced above. Specifically, I use the interquartile range from FOMC dot projections at the end of next year, eoY_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 Section 2.3.1 by this disagreement measure and I continue to allow for different effects for date- and state-based forward guidance:³²

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

where DA_t is the interquartile range of dot projections published at every second

³¹The 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.

³²Including the non-interacted variables following Ozer-Balli and Sørensen (2012) does not alter the main results of this analysis.

monetary policy meeting. DA_t equals zero before the introduction of dot projections and is assumed to be constant until the next publication. In line with Hypothesis 3, a high level of disagreement lowering the impact of forward guidance implies that the respective coefficients should be positive ($\delta > 0$). In other words, the sensitivity of treasury 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, $|\delta^{d,j}| > |\delta^{s,j}|$.

Accounting for disagreement in Equation 2 hardly alters the β coefficients for the sensitivity to macroeconomic news in a significant way, see Table 8 in the Appendix.³³ Table 6 shows the estimation results for the forward guidance and disagreement parameters of Equation 2. In the case of no disagreement³⁴ the impact of forward guidance is fully captured by the γ -coefficients. If there is disagreement, the effect of forward guidance on the sensitivity of interest rates is composed of γ plus δ multiplied by the actual level of disagreement, DA_t .

In the short to medium run, results for the γ -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.³⁵ The fact that coefficients do not decline for longer-term maturities point 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 impede the credibility of the short-run commitment to low interest rates. Markets seem to take the actual low policy rate as guaranteed up to one year and are hardly attentive to macroeconomic news. Disagreement in 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 the state-based period, forward guidance under full agreement still matters for short to medium run horizons (up to 2 years). Disagreement increases the

³³Merely news in core producer prices do now significantly impact treasury yields of also longer horizons.

³⁴As 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.

³⁵This 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

	1month	3months	6months	1year	2years	3years	5years	7years	10years	20years	30years
Date-based FG: γ^d	-0.93*** (0.32)	-1.22*** (0.25)	-0.82*** (0.13)	-0.86*** (0.05)	-0.97*** (0.02)	-0.89*** (0.04)	-0.82*** (0.08)	-0.75*** (0.13)	-0.72*** (0.18)	-0.76*** (0.16)	-0.8*** (0.14)
State-based FG: γ^s	-2.03*** (0.69)	-2.34*** (0.47)	-1.63*** (0.37)	-0.79*** (0.12)	-0.64*** (0.21)	-0.24 (0.34)	0.19 (0.43)	0.52 (0.49)	0.53 (0.47)	0.56 (0.44)	0.60 (0.47)
Date-FG*DA: δ^d	-1.16 (0.99)	1.23 (1)	1.21 (0.83)	0.06 (0.2)	0.4** (0.18)	0.92** (0.42)	2.14*** (0.8)	3.54*** (1.13)	4.12*** (1.33)	4.61*** (1.38)	4.98*** (1.51)
State-FG*DA: δ^s	1.93** (0.88)	1.92*** (0.7)	0.99 (0.6)	0.51 (0.49)	1.02** (0.48)	1.21* (0.63)	0.64 (0.56)	0.36 (0.58)	0.17 (0.56)	-0.07 (0.56)	0.02 (0.6)
$H_0 : \beta = 0$	0.08	0.16	0.14	0.18	0.03	0.06	0.05	0.04	0.04	0.02	0.04
R^2	0.05	0.08	0.06	0.14	0.17	0.14	0.11	0.11	0.10	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. $\Delta r_t^j = \alpha^j + \sum_k \beta_k^{k,j} s_t^k (1 + \gamma^{d,j} D_f^{date} + \delta^{d,j} D A_t \cdot D_f^{date} + \gamma^{s,j} D_f^{state} + \delta^{s,j} D A_t \cdot D_f^{state}) + \varepsilon_t^j$; Newey-West standard errors in parentheses; *** (**) [*] denotes significance at the 1% (5%) [10%] level. $H_0 : \beta = 0$ tests for all β s being jointly zero and states the respective p -value. The whole set of results is reported in Table 8 in the Appendix.

sensitivity of treasury yields for the very short run as well as for the medium run (2 and 3 year maturity), yet for the 3 year maturity it also leads to increased sensitivity, as becomes clear from the lack of a significant effect of forward guidance.

My results are robust to the choice of the disagreement measure (see Section 3.4) as well as of the horizon ($eo y_1$ and $eo y_2$). For comparison, the whole set of results for range and standard deviation is reported in Tables 8 to 13 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 up to the 6 months maturity when using alternative measures of disagreement. However, due to its robustness against outliers, I prefer the results for disagreement measured by the interquartile range.

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 β coefficients throughout the yield curve and the γ s at least for the short run are robust to including disagreement, it can have detrimental effects for medium to longer-term rates. 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 its credibility.

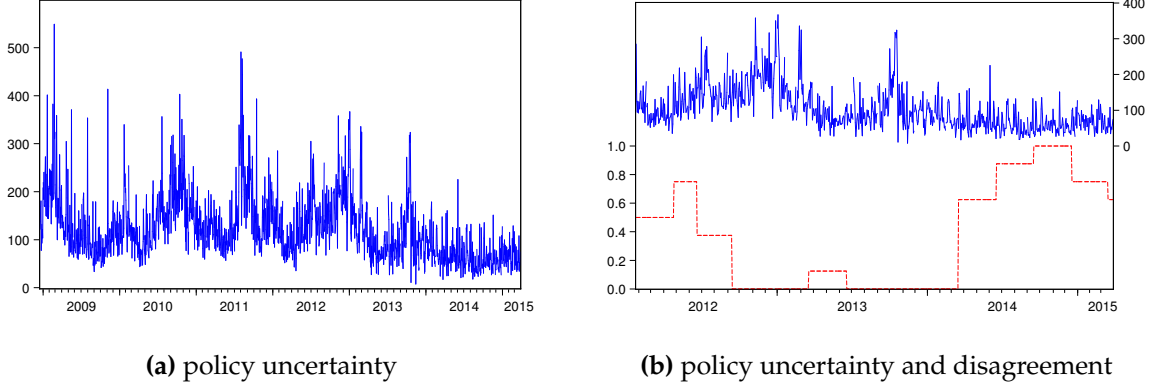
3.6 The Role of Policy Uncertainty

As argued in Swanson and Williams (2014) and Raskin (2013), monetary policy uncertainty could affect sensitivity of interest rates to macroeconomic news. One could raise concern that disagreement within the FOMC merely reflects general monetary 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 quantifies the number of articles on a given day that contain specific terms as for instance *economy*, *uncertainty* or *federal reserve*.³⁶ Panel (a) of Figure 4 depicts the evolution of the index over the whole sample. In line with the options-based uncertainty measure used in Swanson and Williams (2014), this series decreases over time. Aside from this trend, the index took large values in August 2011 when date-based forward guidance was introduced. While policy uncertainty decreases over time, disagreement as measured by the interquartile range of dot projections at the end of next year, $eo y_1$, is highest in the last year of the sample (see Panel (b) of Figure 4). For the dot projections sample,

³⁶The index is taken from http://www.policyuncertainty.com/us_daily.html

policy uncertainty is highest when state-based forward guidance was introduced in December 2012. By contrast, disagreement about the prevailing monetary policy over the next year was rather low at that time. Actually, policy uncertainty is negatively correlated with all disagreement measures. Disagreement should therefore not result from policy uncertainty according to this index.

Figure 4 Policy uncertainty



Notes: (a) Policy uncertainty index for the whole sample period. (b) Policy uncertainty index and disagreement measured by the interquartile range of dot projections for the end of next year (dotted line), $eoyn_1$, for the sample period from January 25, 2012 until March 30, 2015. Source: http://www.policyuncertainty.com/us_daily.html

I now augment the above model by policy uncertainty and let the sensitivity of interest rates jointly depend on this index p_t :

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

Table 6 shows the estimation results for the main coefficients of interest in Equation 3. For all horizons up to 5 years, explanatory power increases when including policy uncertainty. β coefficients (not shown for brevity) are merely the same for maturities up to seven years. Although the model explains about 10 % of the variation in rates for maturities of 10 to 30 years, there is no significance at all pointing to some multicollinearity. Aside from the longer run, γ coefficients are in line with the previous section. Similarly, the estimates of δ^d remain largely unchanged although they partially lose significance. Yet, there is some reversal in the coefficients' estimates for the date-based period for the one month horizon. However, since forward guidance and dot projections are not meant to influence the very short run expectations, I do not want to overinterpret this finding. Disagreement no longer seems to matter during the state-based forward guidance period aside from the 3 months horizon.

Table 6 The role of policy uncertainty

	1month	3months	6months	1year	2years	3years	5years	7years	10years	20years	30years
Date-based FG: γ^d	1.04* (0.55)	-0.6*** (0.15)	-0.24** (0.1)	-0.36*** (0.08)	-0.42*** (0.06)	-0.3*** (0.07)	-0.57*** (0.17)	-0.68*** (0.26)	-1.01* (0.53)	-3.00 (4.79)	-3.35 (5.92)
State-based FG: γ^s	-0.51*** (0.19)	-1.32*** (0.24)	-0.88*** (0.13)	-0.59*** (0.07)	-0.49*** (0.09)	-0.3** (0.12)	0.02 (0.32)	0.44 (0.59)	0.90 (1.12)	3.45 (7.33)	3.99 (9.18)
Date-FG*DA: δ^d	-2.05* (1.24)	0.48 (0.47)	0.40 (0.4)	-0.03 (0.17)	0.11 (0.13)	0.24** (0.12)	1.38** (0.66)	3.19* (1.63)	5.99 (4.09)	20.40 (36.21)	23.54 (46.05)
State-FG*DA: δ^s	0.14 (0.25)	0.72** (0.32)	0.22 (0.21)	0.14 (0.26)	0.31 (0.23)	0.25 (0.23)	0.33 (0.4)	0.29 (0.54)	0.41 (0.87)	1.06 (3.39)	1.52 (4.42)
policy uncertainty: η	-0.008*** (0.001)	-0.003*** (0.001)	-0.005*** (0.001)	-0.004*** (0.001)	-0.004*** (0.00)	-0.004*** (0.00)	-0.002 (0.001)	-0.001 (0.002)	0.003 (0.005)	0.024 (0.053)	0.027 (0.064)
$H_0 : \beta = 0$	0.60	0.04	0.00	0.14	0.02	0.00	0.60	0.88	0.99	1.00	1.00
R^2	0.08	0.10	0.08	0.16	0.20	0.16	0.12	0.11	0.10	0.11	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, $eoyn$. $\Delta r_t^j = \alpha^j + \sum_k \beta^{k,j} s_t^k (1 + \gamma^{d,j} D_t^{date} + \gamma^{s,j} D_t^{state} + \delta^{d,j} DA_t \cdot D_t^{date} + \delta^{s,j} DA_t \cdot D_t^{state} + \eta^j p_t) + e_t^j$; Newey-West standard errors in parentheses; *** (**) [*] denotes significance at the 1% (5%) [10%] level. $H_0 : \beta = 0$ tests for all β s being jointly zero and states the respective p -value.

Although one would expect policy uncertainty to have a sensitivity increasing effect, I find decreased responsiveness of interest rates to macroeconomic news. The policy uncertainty index ranges from 7.7 to 549 points. Most values, however, concentrate on the range between 25 and 200. If policy uncertainty increases from 25 to 200 index points, sensitivity of e.g. one year rates decreases by 0.7. Policy uncertainty, thus, strengthens the sensitivity shrinkage in the date-based period. This result seems counter-intuitive as one would expect sensitivity to rise in an uncertain situation (compare Swanson and Williams (2014) and Raskin (2013)). Yet, high economic uncertainty in this special period, which should also be captured by the index, could have led markets to believe that the period of low interest rates would last even longer. Overall, the core findings on the impact of disagreement on the effectiveness of forward guidance are robust to controlling for policy uncertainty.

4 Conclusion

Forward guidance is an essential tool for the effectiveness of monetary policy. Especially since the crisis, there has been increased importance of managing financial markets expectations 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 projects³⁷, that markets do not believe in those projections or that the guidance lacks 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 policymakers 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

³⁷See also the "follow the markets" principle discussed in Blinder (2004).

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 was able to weaken any such interpretation. While the Fed was able to reduce interest rates also at the longer end of the yield curve providing an unconditional policy rate path through date-based forward guidance, it regained flexibility by issuing other forward guidance measures such as state-based forward guidance and dot projections.

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Appendix

Table 7 Summary statistics of U.S. macroeconomic surprises

Figure 5 Dot projections

(a)-(d):	2012
(e)-(h):	2013
(i)-(l):	2014
(m):	2015

Table 8 Forward Guidance under Disagreement: *IQR* for $eo y_1$

Table 9 Forward Guidance under Disagreement: *IQR* for $eo y_2$

Table 10 Forward Guidance under Disagreement: *std. dev.* for $eo y_1$

Table 11 Forward Guidance under Disagreement: *std. dev.* for $eo y_2$

Table 12 Forward Guidance under Disagreement: *range* for $eo y_1$

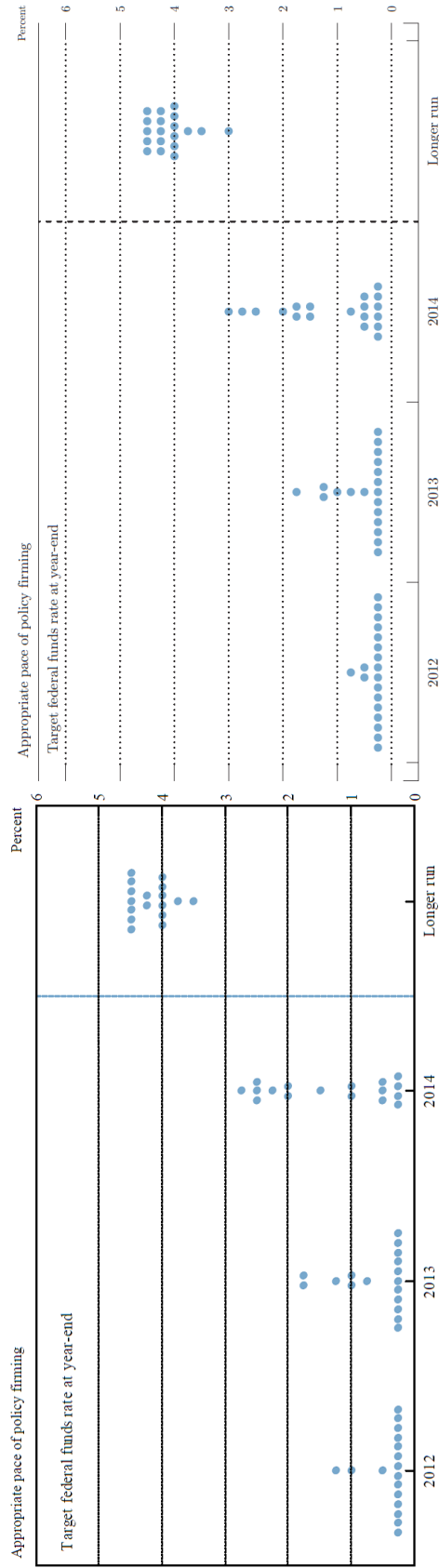
Table 13 Forward Guidance under Disagreement: *range* for $eo y_2$

Table 7 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	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					

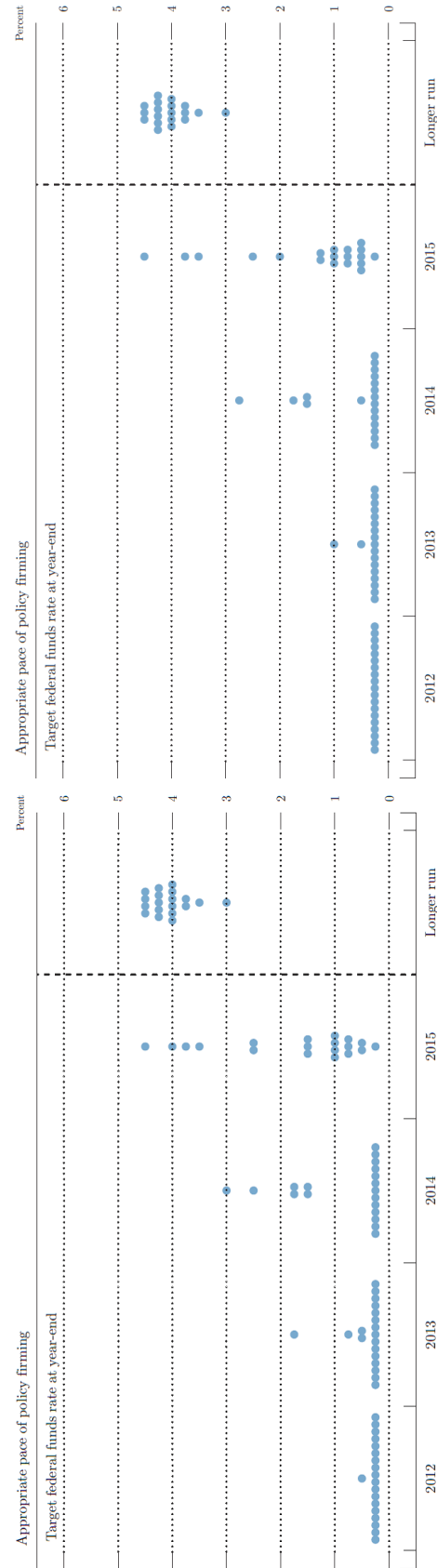
Notes: Macroeconomic surprises are computed as actual release minus the median forecast of the RTR poll from Datastream. Panel A separates the sample in the base period and the two different forward guidance periods. Panel B shows surprises for the period before and since the publication of dot projections.

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

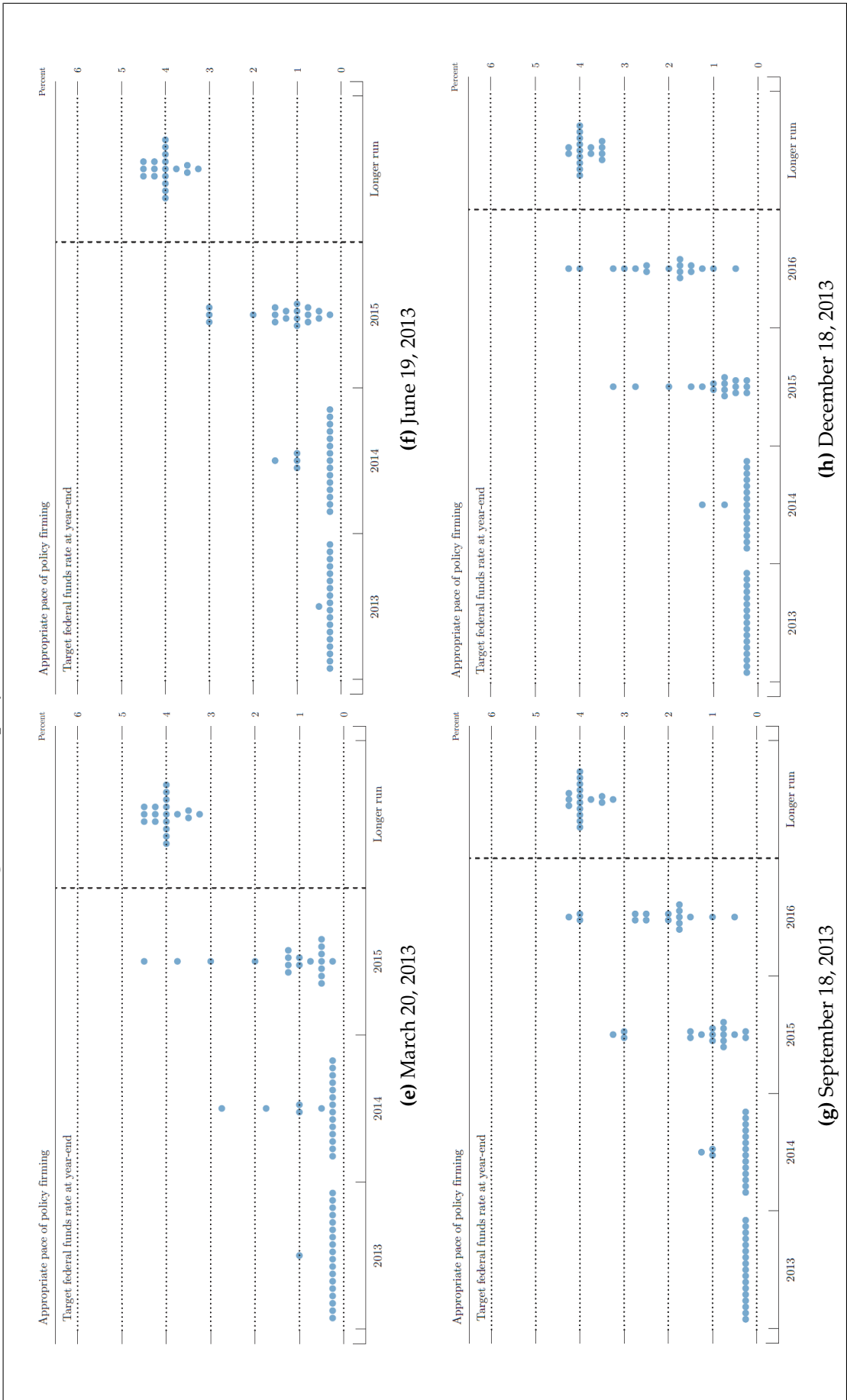


Figure 5 Dot projections continued

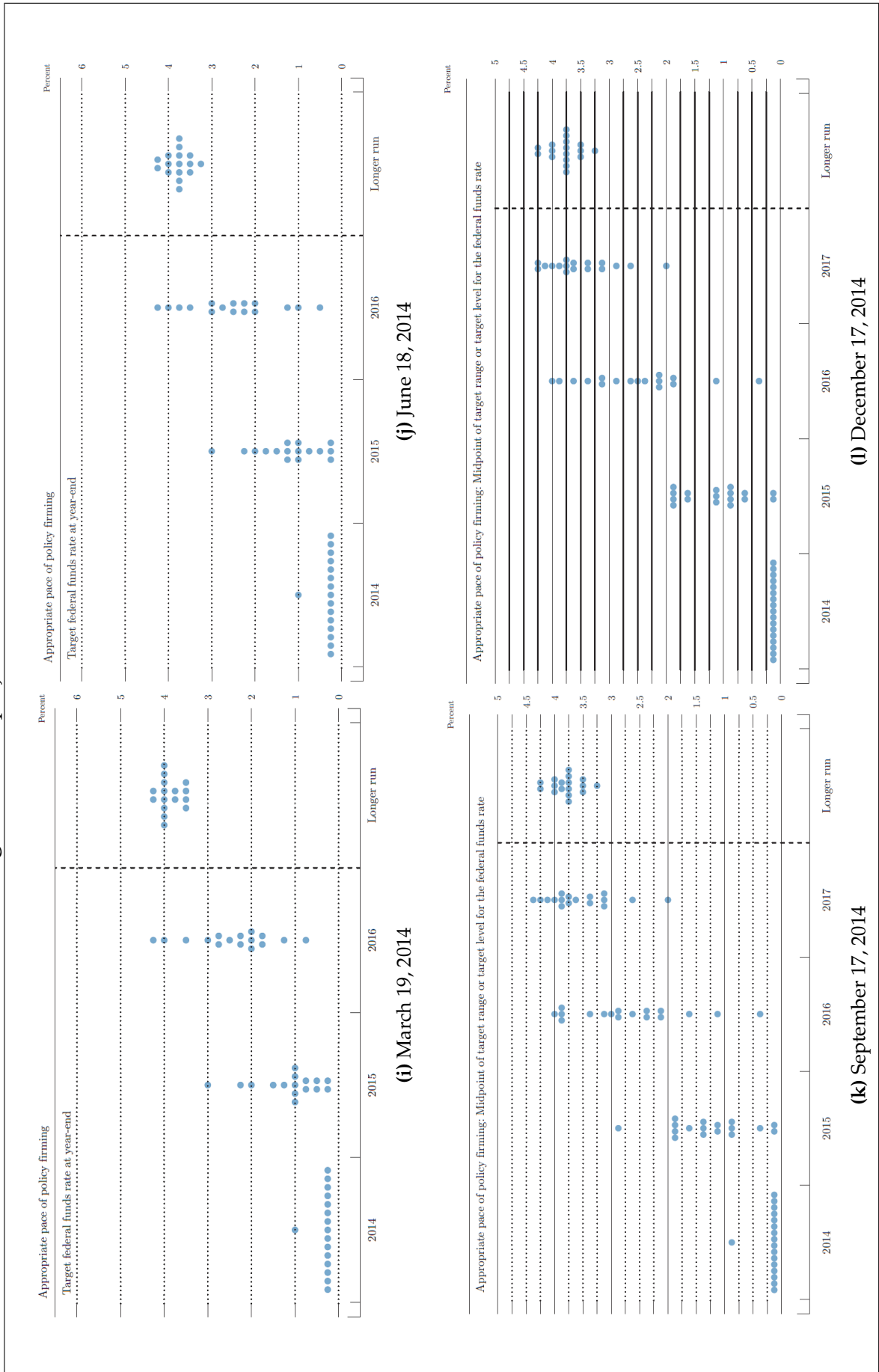
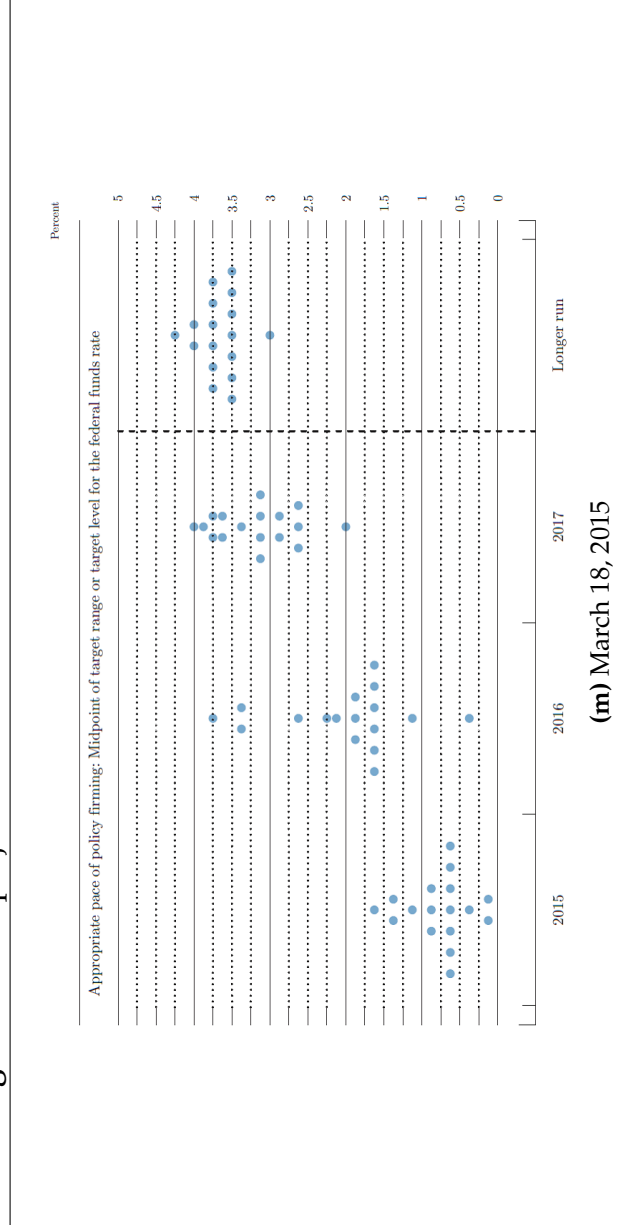


Figure 5 Dot projections continued



(m) March 18, 2015

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 $\frac{1}{4}$ %. Source: FOMC Summary of Projections.

Table 8 The effect of forward guidance under disagreement (IQR for the end of next year eoY_1) on treasury yields

	1month	3months	6months	1year	2years	3years	5years	7years	10years	20years	30years
Capacity utilization	0.35 (0.26)	0.14 (0.19)	0.21 (0.18)	-0.09 (0.23)	0.51 (0.36)	0.58 (0.37)	0.22 (0.47)	0.06 (0.41)	-0.30 (0.42)	-0.42 (0.35)	-0.27 (0.3)
Consumer confidence	-0.75** (0.31)	-0.25 (0.18)	0.01 (0.12)	-0.08 (0.32)	0.38 (0.5)	0.40 (0.45)	0.57 (0.52)	0.66 (0.46)	0.65 (0.41)	0.84* (0.43)	0.81** (0.41)
core CPI	-0.67* (0.37)	-0.5*** (0.19)	-0.36 (0.27)	-0.19 (0.37)	-0.72 (0.63)	-0.61 (0.6)	-0.78 (0.76)	-0.87 (0.75)	-0.78 (0.75)	-0.61 (0.62)	-0.39 (0.52)
GDP advance	0.14 (0.18)	0.11 (0.14)	0.32* (0.17)	0.10 (0.15)	1.1* (0.61)	1.69* (0.94)	0.16** (1.06)	2.6** (1.32)	2.47** (1.14)	2.46** (1.13)	2.05** (1.02)
ISM index	0.8** (0.32)	0.59*** (0.18)	0.39** (0.17)	0.06 (0.25)	0.29 (0.63)	0.67 (0.58)	1.13* (0.67)	1.19* (0.68)	1.3* (0.7)	1.28* (0.67)	1.27** (0.62)
Leading indicators	0.03 (0.45)	0.00 (0.14)	-0.13 (0.2)	0.00 (0.15)	0.37 (0.44)	0.50 (0.61)	.40 (0.87)	0.25 (0.8)	0.42 (0.91)	0.18 (0.85)	0.30 (0.84)
New homes	-0.10 (0.2)	0.10 (0.15)	0.21 (0.19)	0.01 (0.2)	0.05 (0.36)	-0.05 (0.41)	-0.18 (0.47)	-0.29 (0.45)	-0.21 (0.39)	-0.16 (0.38)	-0.11 (0.37)
Nonfarm payrolls	0.08 (0.19)	0.57* (0.31)	0.77* (0.43)	2.53*** (0.86)	0.89*** (2.02)	5.36*** (1.91)	5.47*** (1.67)	4.6*** (1.31)	3.77*** (1.07)	3.47*** (0.92)	3.15*** (0.86)
Core PPI	-0.34 (0.26)	-0.04 (0.2)	0.16 (0.16)	0.49 (0.41)	1.78** (0.79)	2.48** (1.03)	3.02** (1.18)	3.13*** (1.1)	3.35*** (1.13)	4.04*** (1.31)	4.35*** (1.43)
Retail sales ex. autos	0.19 (0.29)	0.08 (0.09)	0.19 (0.13)	0.36* (0.2)	0.63 (0.46)	1.33** (0.57)	1.89** (0.8)	2.2*** (0.79)	2.05*** (0.73)	2.04*** (0.73)	1.66** (0.67)
Unemployment	0.08 (0.13)	0.12 (0.19)	0.16 (0.22)	0.24 (0.48)	0.54 (1.05)	0.89 (0.96)	1.02 (0.99)	1.06 (0.8)	0.80 (0.7)	0.73 (0.62)	0.81 (0.57)
Date-based FG: γ^d	-0.93*** (0.32)	-1.22*** (0.25)	-0.82*** (0.13)	-0.86*** (0.05)	-0.97*** (0.02)	-0.89*** (0.04)	-0.82*** (0.08)	-0.75*** (0.13)	-0.72*** (0.18)	-0.76*** (0.16)	-0.8*** (0.14)
State-based FG: γ^s	-2.03*** (0.69)	-2.34*** (0.47)	-1.63*** (0.37)	-0.79*** (0.12)	-0.64*** (0.21)	-0.24 (0.34)	0.19 (0.43)	0.52 (0.49)	0.53 (0.47)	0.56 (0.44)	0.60 (0.47)
Date-FG*DA: δ^d	-1.16 (0.99)	1.23 (1)	1.21 (0.83)	0.06 (0.2)	0.4** (0.18)	0.92** (0.42)	2.14*** (0.8)	3.54*** (1.13)	4.12*** (1.33)	4.61*** (1.38)	4.98*** (1.51)
State-FG*DA: δ^s	1.93** (0.88)	1.92*** (0.7)	0.99 (0.6)	0.51 (0.49)	1.02** (0.48)	1.21* (0.63)	0.64 (0.56)	0.36 (0.58)	0.17 (0.56)	-0.07 (0.56)	0.02 (0.6)
$H_0 : \beta = 0$	0.08	0.16	0.14	0.18	0.03	0.06	0.05	0.04	0.04	0.02	0.04
R^2	0.05	0.08	0.06	0.14	0.17	0.14	0.11	0.11	0.10	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. $\Delta r_t^i = \alpha^i + \sum_k \beta_k^k s_t^k (1 + \gamma^{d,j} D_f^{state} + \delta^{d,j} DA_t + \gamma^{s,j} D_f^{state} + \delta^{s,j} DA_t + \epsilon_t^i) + \epsilon_t^i$; Newey-West standard errors in parentheses; *** (***) [*] denotes significance at the 1% (5%) [10%] level. $H_0 : \beta = 0$ tests for all β s being jointly zero and states the respective p -value.

Table 9 The effect of forward guidance under disagreement (IQR for the end of the year after next year $eq_{1/2}$) on treasury yields

	1month	3months	6months	1year	2years	3years	5years	7years	10years	20years	30years
Capacity utilization	0.04 (0.21)	0.13 (0.16)	0.24 (0.17)	-0.08 (0.23)	0.52 (0.36)	0.56 (0.39)	0.09 (0.49)	-0.11 (0.45)	-0.54 (0.46)	-0.74* (0.44)	-0.61 (0.42)
Consumer confidence	-0.95*** (0.31)	-0.22 (0.16)	0.02 (0.11)	-0.12 (0.32)	0.41 (0.52)	0.40 (0.48)	0.57 (0.56)	0.64 (0.5)	0.60 (0.44)	0.74* (0.45)	0.77* (0.44)
Core CPI	-0.39* (0.23)	-0.45** (0.18)	-0.33 (0.24)	-0.19 (0.37)	-0.80 (0.68)	-0.72 (0.66)	-0.95 (0.83)	-1.11 (0.81)	-1.00 (0.78)	-0.86 (0.63)	-0.66 (0.55)
GDP advance	0.14 (0.19)	0.10 (0.12)	0.3* (0.16)	0.10 (0.15)	0.99 (0.66)	1.68* (1)	2.17* (1.13)	2.67* (1.39)	2.54** (1.19)	2.48** (1.16)	2.09** (1.05)
ISM index	0.97*** (0.32)	0.58*** (0.19)	0.39** (0.17)	0.06 (0.25)	0.35 (0.63)	0.76 (0.58)	1.17* (0.67)	1.23* (0.7)	1.29* (0.7)	1.24* (0.67)	1.27** (0.62)
Leading indicators	0.08 (0.46)	0.00 (0.15)	-0.11 (0.21)	0.00 (0.15)	0.44 (0.45)	0.54 (0.63)	0.42 (0.9)	0.25 (0.84)	0.40 (0.95)	0.13 (0.86)	0.26 (0.86)
New homes	-0.23 (0.24)	0.16 (0.19)	0.20 (0.19)	0.01 (0.21)	0.02 (0.39)	-0.02 (0.44)	-0.14 (0.51)	-0.28 (0.48)	-0.18 (0.42)	-0.11 (0.4)	-0.06 (0.39)
Nonfarm payrolls	0.13 (0.18)	0.63* (0.33)	0.78* (0.43)	2.54*** (0.86)	5.93*** (2.01)	5.45*** (1.91)	5.69*** (1.67)	4.93*** (1.34)	4.07*** (1.11)	3.76*** (0.96)	3.46*** (0.92)
Core PPI	-0.09 (0.32)	-0.06 (0.22)	0.19 (0.16)	0.49 (0.4)	1.83** (0.78)	2.43** (0.97)	2.89*** (1.09)	2.78*** (0.99)	2.94*** (1.02)	3.36*** (1.18)	3.59*** (1.29)
Retail sales ex. autos	0.20 (0.29)	0.11 (0.09)	0.18 (0.13)	0.36* (0.2)	0.61 (0.46)	1.31** (0.58)	1.9** (0.82)	2.23*** (0.81)	2.08*** (0.74)	2.07*** (0.74)	1.74** (0.7)
Unemployment	0.04 (0.12)	0.10 (0.19)	0.20 (0.22)	0.21 (0.48)	0.42 (1.04)	0.75 (0.95)	0.76 (0.94)	0.73 (0.77)	0.46 (0.67)	0.31 (0.62)	0.41 (0.59)
Date-based FG: γ^d	-0.99*** (0.16)	-1.09*** (0.11)	-0.8*** (0.12)	-0.86*** (0.05)	-0.96*** (0.02)	-0.89*** (0.04)	-0.84*** (0.08)	-0.75*** (0.12)	-0.71*** (0.16)	-0.73*** (0.16)	-0.77*** (0.15)
State-based FG: γ^s	-2.75*** (0.63)	-3.86*** (0.99)	-2.68*** (0.74)	-1.37*** (0.44)	-1.51*** (0.51)	-1.31*** (0.48)	-0.45 (0.5)	-0.00 (0.56)	0.13 (0.57)	0.47 (0.66)	0.46 (0.68)
Date-FG*DA: δ^d	-0.45* (0.24)	0.08 (0.28)	0.18 (0.22)	0.01 (0.07)	0.11* (0.06)	0.28** (0.11)	0.65*** (0.21)	0.99*** (0.3)	1.16*** (0.36)	1.31*** (0.38)	1.35*** (0.42)
State-FG*DA: δ^s	2.04*** (0.66)	2.64*** (0.96)	1.71** (0.81)	0.88 (0.67)	1.43** (0.69)	1.71** (0.76)	0.93 (0.58)	0.63 (0.6)	0.40 (0.61)	-0.07 (0.67)	0.02 (0.68)
$H_0 : \beta = 0$	0.06	0.14	0.14	0.17	0.03	0.05	0.04	0.03	0.03	0.02	0.04
R^2	0.05	0.08	0.06	0.14	0.17	0.14	0.12	0.11	0.10	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. $\Delta r_t^j = \alpha^j + \sum_k \beta_k^k s_t^k (1 + \gamma^{d,j} D_t^{date} + \gamma^{s,j} D_t^{state} + \delta^{d,j} DA_t + \delta^{s,j} DA_t + \epsilon_t^j) + \epsilon_t^j$; Newey-West standard errors in parentheses; *** (***) [*] denotes significance at the 1% (5%) [10%] level. $H_0 : \beta = 0$ tests for all β s being jointly zero and states the respective p -value.

Table 10 The effect of forward guidance under disagreement (*range* for the end of next year eo_{y1}) on treasury yields

	1month	3months	6months	1year	2years	3years	5years	7years	10years	20years	30years
Capacity utilization	0.26 (0.24)	0.17 (0.18)	0.26 (0.18)	-0.22 (0.19)	0.33 (0.38)	0.44 (0.42)	-0.13 (0.5)	-0.31 (0.45)	-0.67 (0.45)	-0.76* (0.42)	-0.62 (0.4)
Consumer confidence	-0.78** (0.31)	-0.18 (0.19)	0.06 (0.12)	-0.04 (0.33)	0.39 (0.58)	0.51 (0.53)	0.59 (0.59)	0.64 (0.53)	0.60 (0.46)	0.74 (0.47)	0.77* (0.45)
Core CPI	-0.75* (0.4)	-0.58*** (0.2)	-0.38 (0.26)	-0.19 (0.41)	-0.71 (0.76)	-0.71 (0.74)	-1.05 (0.92)	-1.27 (0.9)	-1.09 (0.83)	-0.90 (0.64)	-0.67 (0.54)
GDP advance	0.17 (0.17)	0.10 (0.13)	0.28* (0.17)	0.09 (0.15)	1.13* (0.66)	1.74* (1.02)	2.12* (1.15)	2.53* (1.45)	2.41* (1.24)	2.44** (1.18)	2.08** (1.05)
ISM index	0.67** (0.31)	0.54*** (0.18)	0.36** (0.16)	-0.01 (0.24)	0.29 (0.65)	0.68 (0.6)	1.14* (0.68)	1.23* (0.7)	1.28* (0.71)	1.24* (0.66)	1.27** (0.62)
Leading indicators	0.03 (0.45)	0.03 (0.15)	-0.12 (0.21)	0.01 (0.15)	0.48 (0.47)	0.58 (0.67)	0.45 (0.95)	0.23 (0.89)	0.38 (0.99)	0.08 (0.86)	0.23 (0.86)
New homes	-0.01 (0.16)	0.12 (0.15)	0.23 (0.18)	-0.02 (0.21)	0.02 (0.41)	-0.05 (0.47)	-0.14 (0.54)	-0.25 (0.52)	-0.16 (0.44)	-0.09 (0.41)	-0.06 (0.39)
Nonfarm payrolls	0.17 (0.18)	0.6* (0.31)	0.75* (0.43)	2.57*** (0.86)	6.03*** (2.02)	5.57*** (1.92)	5.91*** (1.68)	5.19*** (1.36)	4.25*** (1.13)	3.85*** (0.98)	3.51*** (0.93)
Core PPI	-0.29 (0.26)	-0.06 (0.23)	0.13 (0.15)	0.48 (0.4)	1.74** (0.73)	2.33** (0.93)	2.64*** (0.99)	2.48*** (0.91)	2.61*** (0.96)	3.04*** (1.14)	3.37*** (1.28)
Retail sales ex. autos	0.21 (0.28)	0.12 (0.09)	0.20 (0.13)	0.36* (0.2)	0.55 (0.44)	1.29** (0.58)	1.87** (0.82)	2.19*** (0.8)	2.06*** (0.74)	2.06*** (0.73)	1.74** (0.7)
Unemployment	0.09 (0.11)	0.07 (0.18)	0.14 (0.21)	0.16 (0.47)	0.31 (1.05)	0.63 (0.95)	0.61 (0.93)	0.57 (0.75)	0.34 (0.66)	0.22 (0.62)	0.38 (0.6)
Date-based FG: γ^d	-0.97*** (0.1)	-1.07*** (0.09)	-0.77*** (0.14)	-0.86*** (0.05)	-0.96*** (0.02)	-0.89*** (0.04)	-0.83*** (0.07)	-0.73*** (0.1)	-0.68*** (0.15)	-0.69*** (0.16)	-0.74*** (0.16)
State-based FG: γ^s	-3.68** (1.44)	-3.42*** (0.85)	-2.35*** (0.73)	-0.57* (0.31)	-0.45 (0.33)	-0.12 (0.47)	0.53 (0.58)	0.88 (0.63)	0.73 (0.6)	0.62 (0.57)	0.39 (0.56)
Date-FG*DA: δ^d	-0.21 (0.36)	0.01 (0.33)	0.18 (0.22)	0.00 (0.07)	0.10 (0.07)	0.28** (0.11)	0.63*** (0.2)	0.93*** (0.28)	1.1*** (0.34)	1.24*** (0.38)	1.28*** (0.42)
State-FG*DA: δ^s	1.2** (0.55)	0.92*** (0.33)	0.58* (0.31)	-0.05 (0.19)	0.07 (0.2)	0.11 (0.25)	-0.15 (0.23)	-0.25 (0.23)	-0.19 (0.23)	-0.12 (0.25)	0.05 (0.28)
$H_0 : \beta = 0$	0.07	0.10	0.15	0.12	0.02	0.04	0.03	0.03	0.04	0.03	0.05
R^2	0.05	0.08	0.06	0.14	0.17	0.13	0.11	0.11	0.10	0.10	0.09

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

Table 11 The effect of forward guidance under disagreement (*range* for the end of the year after next year ϵ_{0Y_2}) on treasury yields

	1month	3months	6months	1year	2years	3years	5years	7years	10years	20years	30years
Capacity utilization	0.06 (0.28)	0.12 (0.19)	0.20 (0.18)	-0.21 (0.19)	0.24 (0.38)	0.37 (0.41)	-0.21 (0.47)	-0.35 (0.43)	-0.67 (0.43)	-0.73* (0.4)	-0.59 (0.39)
Consumer confidence	-0.96*** (0.3)	-0.13 (0.2)	0.05 (0.13)	-0.03 (0.33)	0.36 (0.59)	0.52 (0.54)	0.53 (0.58)	0.57 (0.53)	0.55 (0.46)	0.72 (0.48)	0.75 (0.46)
Core CPI	-0.55** (0.28)	-0.47** (0.19)	-0.31 (0.27)	-0.19 (0.4)	-0.72 (0.77)	-0.77 (0.77)	-1.13 (0.88)	-1.32 (0.84)	-1.13 (0.8)	-0.91 (0.61)	-0.62 (0.54)
GDP advance	0.15 (0.41)	0.11 (0.14)	0.33* (0.17)	0.09 (0.15)	1.12* (0.66)	1.7* (1.03)	1.99* (1.13)	2.36 (1.44)	2.32* (1.24)	2.46** (1.17)	2.19** (1.04)
ISM index	0.83*** (0.27)	0.57*** (0.19)	0.36** (0.18)	-0.00 (0.24)	0.31 (0.64)	0.68 (0.6)	1.17* (0.68)	1.29* (0.71)	1.33* (0.71)	1.28* (0.65)	1.27** (0.59)
Leading indicators	0.11 (0.23)	0.06 (0.16)	-0.11 (0.21)	0.01 (0.15)	0.48 (0.47)	0.59 (0.68)	0.39 (0.94)	0.15 (0.87)	0.33 (0.98)	0.08 (0.86)	0.27 (0.87)
New homes	-0.12 (0.23)	0.17 (0.15)	0.22 (0.2)	-0.02 (0.21)	0.01 (0.39)	-0.06 (0.47)	-0.09 (0.47)	-0.15 (0.45)	-0.13 (0.41)	-0.10 (0.4)	-0.07 (0.41)
Nonfarm payrolls	0.25 (0.33)	0.68** (0.34)	0.82* (0.45)	2.57*** (0.86)	6.06*** (2.02)	5.64*** (1.92)	6.01*** (1.69)	5.27*** (1.38)	4.28*** (1.14)	3.84*** (0.98)	3.5*** (0.94)
Core PPI	-0.12 (0.48)	-0.10 (0.23)	0.16 (0.15)	0.48 (0.4)	1.68** (0.7)	2.24** (0.88)	2.45*** (0.92)	2.31*** (0.87)	2.47*** (0.94)	2.91** (1.14)	3.29** (1.29)
Retail sales ex. autos	0.24 (0.23)	0.12 (0.09)	0.21 (0.14)	0.36* (0.2)	0.54 (0.43)	1.27** (0.57)	1.87** (0.82)	2.19*** (0.8)	2.06*** (0.74)	2.06*** (0.73)	1.74** (0.69)
Unemployment	0.05 (0.25)	0.06 (0.19)	0.16 (0.22)	0.16 (0.47)	0.27 (1.02)	0.58 (0.92)	0.56 (0.88)	0.54 (0.73)	0.32 (0.64)	0.19 (0.61)	0.33 (0.6)
Date-based FG: γ^d	-0.95** (0.48)	-1*** (0.04)	-0.79*** (0.12)	-0.86*** (0.05)	-0.96*** (0.02)	-0.89*** (0.04)	-0.82*** (0.06)	-0.72*** (0.1)	-0.66*** (0.15)	-0.68*** (0.17)	-0.73*** (0.16)
State-based FG: γ^s	-5.31*** (1.8)	-4.99*** (1.67)	-2.72** (1.31)	-0.31 (0.72)	0.28 (1.31)	0.39 (1.6)	2.01 (1.55)	2.40 (1.59)	1.59 (1.45)	0.59 (1.47)	-0.66 (1.48)
Date-FG*DA: δ^d	-0.27 (0.26)	-0.07 (0.19)	0.10 (0.13)	0.00 (0.04)	0.06 (0.04)	0.16** (0.07)	0.37*** (0.12)	0.55*** (0.17)	0.65*** (0.2)	0.75*** (0.23)	0.77*** (0.25)
State-FG*DA: δ^s	1.22** (0.52)	0.97** (0.44)	0.43 (0.36)	-0.10 (0.22)	-0.18 (0.4)	-0.09 (0.49)	-0.52 (0.42)	-0.59 (0.42)	-0.36 (0.39)	-0.06 (0.43)	0.34 (0.46)
$H_0 : \beta = 0$	0.03	0.08	0.13	0.13	0.02	0.04	0.04	0.03	0.04	0.03	0.05
R^2	0.05	0.07	0.05	0.14	0.17	0.13	0.11	0.11	0.10	0.10	0.09

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

Table 12 The effect of forward guidance under disagreement (sd for the end of next year eoy_{1t}) on treasury yields

	1month	3months	6months	1year	2years	3years	5years	7years	10years	20years	30years
Capacity utilization	0.23 (0.23)	0.12 (0.17)	0.22 (0.17)	-0.20 (0.2)	0.36 (0.39)	0.47 (0.42)	-0.07 (0.5)	-0.26 (0.46)	-0.63 (0.47)	-0.74* (0.44)	-0.58 (0.41)
Consumer confidence	-0.85*** (0.31)	-0.21 (0.18)	0.04 (0.12)	-0.04 (0.33)	0.39 (0.58)	0.50 (0.53)	0.59 (0.58)	0.65 (0.51)	0.60 (0.44)	0.75* (0.45)	0.76* (0.43)
Core CPI	-0.69* (0.38)	-0.57*** (0.2)	-0.36 (0.27)	-0.19 (0.4)	-0.71 (0.75)	-0.68 (0.73)	-1.00 (0.9)	-1.21 (0.88)	-1.04 (0.82)	-0.86 (0.64)	-0.61 (0.53)
GDP advance	0.16 (0.17)	0.11 (0.13)	0.31* (0.17)	0.09 (0.15)	1.13* (0.66)	1.75* (1.01)	2.15* (1.13)	2.57* (1.43)	2.46** (1.21)	2.49** (1.16)	2.11** (1.02)
ISM index	0.75** (0.31)	0.56*** (0.18)	0.37** (0.17)	-0.00 (0.25)	0.29 (0.65)	0.68 (0.6)	1.14* (0.68)	1.22* (0.7)	1.28* (0.71)	1.24* (0.67)	1.26** (0.62)
Leading indicators	0.04 (0.46)	0.02 (0.15)	-0.12 (0.21)	0.01 (0.15)	0.47 (0.47)	0.57 (0.66)	0.45 (0.93)	0.25 (0.87)	0.40 (0.97)	0.13 (0.85)	0.26 (0.84)
New homes	-0.06 (0.18)	0.12 (0.16)	0.23 (0.19)	-0.02 (0.21)	0.02 (0.41)	-0.05 (0.46)	-0.15 (0.53)	-0.25 (0.51)	-0.17 (0.43)	-0.11 (0.4)	-0.08 (0.38)
Nonfarm payrolls	0.19 (0.18)	0.58* (0.31)	0.77* (0.43)	2.57*** (0.86)	6.02*** (2.02)	5.54*** (1.92)	5.82*** (1.68)	5.07*** (1.35)	4.14*** (1.11)	3.75*** (0.96)	3.41*** (0.91)
Core PPI	-0.28 (0.27)	-0.06 (0.22)	0.15 (0.16)	0.48 (0.4)	1.74** (0.74)	2.36** (0.95)	2.76*** (1.04)	2.68*** (0.95)	2.88*** (1)	3.39*** (1.19)	3.75*** (1.33)
Retail sales ex. autos	0.21 (0.28)	0.11 (0.09)	0.20 (0.13)	0.36* (0.2)	0.56 (0.44)	1.29** (0.58)	1.89** (0.83)	2.21*** (0.81)	2.07*** (0.75)	2.07*** (0.74)	1.73** (0.69)
Unemployment	0.08 (0.11)	0.08 (0.18)	0.14 (0.22)	0.16 (0.48)	0.34 (1.05)	0.67 (0.96)	0.68 (0.95)	0.66 (0.77)	0.42 (0.67)	0.31 (0.62)	0.48 (0.6)
Date-based FG: γ^d	-0.96*** (0.12)	-1.11*** (0.13)	-0.79*** (0.13)	-0.86*** (0.05)	-0.96*** (0.02)	-0.89*** (0.04)	-0.84*** (0.07)	-0.75*** (0.11)	-0.71*** (0.16)	-0.73*** (0.16)	-0.78*** (0.15)
State-based FG: γ^s	-3.44*** (1.19)	-3.58*** (0.86)	-2.26*** (0.68)	-0.65*** (0.27)	-0.53* (0.29)	-0.23 (0.43)	0.40 (0.54)	0.74 (0.6)	0.57 (0.57)	0.45 (0.55)	0.20 (0.53)
Date-FG*DA: δ^d	-0.95 (0.89)	0.29 (0.97)	0.71 (0.75)	0.03 (0.21)	0.35* (0.2)	0.9** (0.36)	2.08*** (0.66)	3.14*** (0.92)	3.73*** (1.13)	4.24*** (1.24)	4.37*** (1.36)
State-FG*DA: δ^s	4.11** (1.68)	3.66*** (1.25)	1.93* (1.06)	-0.01 (0.64)	0.42 (0.7)	0.67 (0.93)	-0.22 (0.86)	-0.55 (0.86)	-0.30 (0.87)	-0.06 (0.94)	0.63 (1.06)
$H_0 : \beta = 0$	0.05	0.11	0.14	0.13	0.02	0.04	0.04	0.03	0.03	0.02	0.04
R^2	0.05	0.08	0.06	0.14	0.17	0.13	0.11	0.11	0.10	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. $\Delta r_t^i = \alpha^j + \sum_k \beta_k^k s_t^k (1 + \gamma^{d,j} D_t^{date} + \gamma^{s,j} D_t^{state} + \delta^{d,j} DA_t \cdot D_t^{date} + \delta^{s,j} DA_t \cdot D_t^{state}) + \epsilon_t^i$; Newey-West standard errors in parentheses; *** (***) [*] denotes significance at the 1% (5%) [10%] level. $H_0 : \beta = 0$ tests for all β s being jointly zero and states the respective p -value.

Table 13 The effect of forward guidance under disagreement (*sd* for the end of the year after next year $ey_{1/2}$) on treasury yields

	1month	3months	6months	1year	2years	3years	5years	7years	10years	20years	30years
Capacity utilization	-0.17 (0.3)	0.09 (0.19)	0.20 (0.19)	-0.21 (0.19)	0.23 (0.38)	0.34 (0.4)	-0.18 (0.47)	-0.31 (0.44)	-0.64 (0.44)	-0.73* (0.42)	-0.59 (0.4)
Consumer confidence	-1.02*** (0.3)	-0.12 (0.2)	0.04 (0.13)	-0.02 (0.33)	0.34 (0.58)	0.51 (0.54)	0.52 (0.57)	0.57 (0.51)	0.57 (0.45)	0.73 (0.47)	0.75* (0.45)
Core CPI	-0.34 (0.28)	-0.46** (0.19)	-0.29 (0.26)	-0.18 (0.4)	-0.71 (0.76)	-0.77 (0.76)	-1.09 (0.86)	-1.27 (0.83)	-1.09 (0.79)	-0.87 (0.62)	-0.56 (0.55)
GDP advance	0.12 (0.42)	0.12 (0.15)	0.35** (0.17)	0.08 (0.15)	1.13* (0.65)	1.66 (1.02)	2* (1.12)	2.39* (1.43)	2.38* (1.23)	2.51** (1.16)	2.22** (1.02)
ISM index	0.88*** (0.27)	0.57*** (0.19)	0.35** (0.18)	-0.01 (0.24)	0.31 (0.64)	0.67 (0.59)	1.14* (0.67)	1.25* (0.71)	1.3* (0.71)	1.25* (0.65)	1.25** (0.6)
Leading indicators	0.13 (0.23)	0.05 (0.16)	-0.12 (0.21)	0.00 (0.15)	0.46 (0.47)	0.57 (0.68)	0.38 (0.93)	0.16 (0.87)	0.36 (0.98)	0.12 (0.86)	0.30 (0.86)
New homes	-0.23 (0.26)	0.14 (0.16)	0.21 (0.2)	-0.02 (0.2)	0.01 (0.38)	-0.06 (0.44)	-0.10 (0.46)	-0.16 (0.44)	-0.15 (0.41)	-0.11 (0.41)	-0.06 (0.41)
Nonfarm payrolls	0.23 (0.33)	0.72** (0.34)	0.83* (0.45)	2.57*** (0.86)	6.06*** (2.02)	5.67*** (1.92)	5.98*** (1.69)	5.23*** (1.37)	4.23*** (1.14)	3.8*** (0.97)	3.45*** (0.92)
Core PPI	-0.04 (0.49)	-0.11 (0.23)	0.17 (0.16)	0.47 (0.39)	1.66** (0.69)	2.19** (0.85)	2.5*** (0.94)	2.43*** (0.89)	2.64*** (0.97)	3.12*** (1.17)	3.49*** (1.31)
Retail sales ex. autos	0.23 (0.23)	0.13 (0.09)	0.22 (0.14)	0.36* (0.2)	0.55 (0.43)	1.27** (0.57)	1.87** (0.81)	2.19*** (0.79)	2.07*** (0.74)	2.07*** (0.73)	1.76** (0.71)
Unemployment	0.06 (0.25)	0.05 (0.2)	0.16 (0.23)	0.16 (0.47)	0.30 (1)	0.59 (0.9)	0.62 (0.88)	0.61 (0.73)	0.37 (0.65)	0.24 (0.61)	0.37 (0.6)
Date-based FG: γ^d	-0.96** (0.49)	-1.02*** (0.05)	-0.8*** (0.12)	-0.86*** (0.05)	-0.96*** (0.02)	-0.89*** (0.04)	-0.83*** (0.06)	-0.73*** (0.1)	-0.68*** (0.15)	-0.71*** (0.16)	-0.76*** (0.16)
State-based FG: γ^s	-4.59** (1.83)	-4.69*** (1.66)	-2.64** (1.29)	0.12 (0.81)	0.81 (1.44)	1.18 (1.7)	2.48 (1.67)	2.57 (1.67)	1.38 (1.5)	0.20 (1.56)	-1.37 (1.57)
Date-FG*DA: δ^d	-0.96 (0.75)	-0.09 (0.47)	0.32 (0.37)	0.01 (0.12)	0.18 (0.11)	0.46** (0.18)	1.05*** (0.34)	1.57*** (0.47)	1.86*** (0.58)	2.13*** (0.64)	2.2*** (0.71)
State-FG*DA: δ^s	3.7** (1.88)	3.1** (1.55)	1.43 (1.26)	-0.79 (0.8)	-1.17 (1.47)	-1.15 (1.72)	-2.30 (1.57)	-2.23 (1.56)	-1.02 (1.44)	0.22 (1.62)	1.95 (1.72)
$H_0 : \beta = 0$	0.02	0.07	0.12	0.13	0.02	0.04	0.04	0.03	0.04	0.02	0.04
R^2	0.05	0.07	0.05	0.14	0.17	0.13	0.12	0.11	0.10	0.10	0.09

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