Estimating the Monetary Policy Rule Perceived by Forecasters

By Brent Bundick

Communicating the expected future path of monetary policy to the public is inherently difficult. Policymakers often set a single policy instrument as a function of many different, and likely conflicting, macroeconomic indicators. In communicating their actions, central banks often explain how economic conditions affect the stance of monetary policy. By outlining how policy responds to economic conditions, the central bank implicitly communicates a policy rule that guides their decisionmaking process.

Professional forecasters, in turn, attempt to identify this implicit monetary policy rule. Many economists and financial market participants regularly produce forecasts for inflation, unemployment, output growth, and interest rates. The relationship between these variables shows how forecasters perceive the Federal Open Market Committee (FOMC) will set future policy as a function of future economic conditions. Ensuring the public correctly understands this reaction function is crucial for policymakers to implement sound monetary policy (Woodford).

In this article, I examine whether the policy rule perceived by forecasters has changed since the end of 2008, when the FOMC lowered its conventional policy tool, the federal funds rate, to its effective lower bound. Since December 2008, policymakers have used less conventional tools such as large-scale asset purchases and forward guidance

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about future policy actions to achieve their dual mandate of stable prices and maximum employment. Providing statements about likely future policy actions allows the FOMC to influence expectations about future interest rates even when they are constrained by the zero lower bound (Eggertsson and Woodford; Smith and Becker).

Has forward guidance changed perceptions of the FOMC's implicit policy rule? Statistical evidence suggests the forecaster-perceived policy rule remains relatively unchanged at the zero lower bound. Forecasters believe the FOMC responds significantly but gradually to changes in unemployment and inflation.

These findings suggest the FOMC's forward guidance is largely consistent with its behavior prior to hitting the zero lower bound. While unconventional policy may have changed some specifics of the FOMC's communication and conduct, the reaction function forecasters perceive is similar to the pre-zero lower bound period. These results suggest forecasters do not believe the FOMC's reaction function has changed simply because the economy hit the zero lower bound. More specifically, the statistical results suggest forecasters believe the FOMC's desired response to economic conditions remains intact even when current short-term rates are near zero.

I. Policy Rules as a Description of Monetary Policy

Policymakers consider a wide range of economic indicators when setting the appropriate path of monetary policy. For example, they may examine recent conditions in labor markets, household consumption, business investment, and changes in the overall prices of goods and services. However, determining the relevance of any single indicator in setting appropriate policy remains difficult.

To reduce the complexity of responding to "everything," policymakers often use simple rules to help guide their decisionmaking. Simple rules prescribe the stance of monetary policy as a function of a few key economic variables. Nevertheless, good policy sometimes requires flexibility and discretion, and central bankers cannot blindly follow an explicit rule (Yellen). Therefore, while the FOMC may use rules as a guide, it does not follow one explicit, publicly available policy rule.

Nevertheless, Taylor (1993, 1999), Kahn, and many others show that a simple policy rule can reasonably describe actual central bank

actions. While the exact rule varies across studies, a large body of statistical evidence suggests the FOMC has responded systematically to changes in real economic activity, labor market conditions, and the prices for goods and services. However, Clarida, Galí, and Gertler, among others, show that the simple rule that best describes monetary policy has not been constant over time.

The zero lower bound period, for example, may correspond with a change in the FOMC's implicit policy rule. The zero lower bound represents a significant constraint on policymakers, as their conventional policy tool for stabilizing the economy—the overnight federal funds rate—is no longer available as a tool for easing policy. As a result, the FOMC has had to rely on unconventional tools such as forward guidance and large-scale asset purchases. The Committee's relative inexperience with these new policy tools and the zero lower bound might suggest a change in how it responded to economic conditions.

To examine how professional forecasters interpreted unconventional actions during this period, I study their perceptions of the FOMC's implicit rule. Examining forecasters' perceived rule has two main benefits. First, professional forecasters have reputational incentives to use all available information to help predict future macroeconomic conditions and the stance of monetary policy. Thus, their forecasts about future interest rates reflect their best estimates of future FOMC behavior. Second, even when current nominal interest rates are stuck at zero, forecasts about the future stance of policy can reveal valuable information about the FOMC's implicit rule.

II. Modeling Monetary Policy

The conduct and communication of monetary policy after 2008 may have caused professional forecasters to change their perceptions about the FOMC's implicit policy rule. Evaluating whether the perceived rule changed first requires a model that can capture forecasters' beliefs about how the FOMC sets the stance of monetary policy. In the following empirical work, I assume forecasters believe the FOMC sets its short-term nominal rate using the rule:

$$r_t = \phi_r r_{t-1} + (1-\phi_r)[r + \phi_\pi(\pi_t - \pi) + \phi_u(u_t - u) + \phi_{\Delta y}(\Delta y_t - \Delta y)],$$

where r_t is the short-term policy rate set by the central bank (the federal funds rate), π_t denotes the percent change in the personal consumption expenditure (PCE) price index, u_t is the unemployment rate, and Δy_t is the growth in real gross domestic product. The central bank's inflation target is denoted by π, while u and Δy denote the long-run values for unemployment and output growth, respectively. Since forecasters don't announce their perceived rule, the assumed model includes many features that previous researchers have found helpful in describing actual FOMC behavior. The ϕ parameters denote the central bank's reaction to changes in inflation, unemployment, and output growth. The rule describes how forecasters expect policy rates to change if inflation, unemployment, and growth deviate from the FOMC's longer-run or target objectives. Current policy rates are also seen as a function of lagged policy rates, r_{t-1}, under forecasters' assumptions that policymakers smooth changes in interest rates over time. Smoothing changes in policy rates implies that the central bank responds gradually to changing economic conditions.

The interest rate rule assumes forecasters perceive policy is set as a function of past interest rates and current macroeconomic conditions. However, the rule can also be used to predict how future policy will be determined as a function of expected fundamentals. At a given point in time t, forecasts for the expected four-quarter-ahead policy rate, r^e_{t+4} can be determined using the following rule:

$$r^e_{t+4} = \phi_r r^e_{t+3} + (1-\phi_r)[r + \phi_\pi(\pi^e_{t+4} - \pi) + \phi_u(u^e_{t+4} - u) + \phi_{\Delta y}(\Delta y^e_{t+4} - \Delta y)].$$

After replacing the values of current inflation, unemployment, and output growth with their respective forecasts, the rule implies expected future short-term rates depend on expected future macroeconomic conditions. As with the earlier, contemporaneous policy rule, this simple forecast-based rule describes how policy rates are expected to change if inflation, unemployment, and growth are expected to deviate from their longer-run or target objectives.

The purpose of specifying these rules is to determine whether the coefficients in the forecaster-perceived policy rule changed after the economy hit the zero lower bound. A significant change in the ϕ coefficients of the perceived policy rule would imply that forecasters believe the FOMC's policy rule has indeed changed since the end of 2008.

In making this determination, I estimate the rule using monthly Blue Chip survey data from both the pre-zero lower bound period (January 1984–December 2008) and the zero lower bound period (January 2009–August 2015).[1]

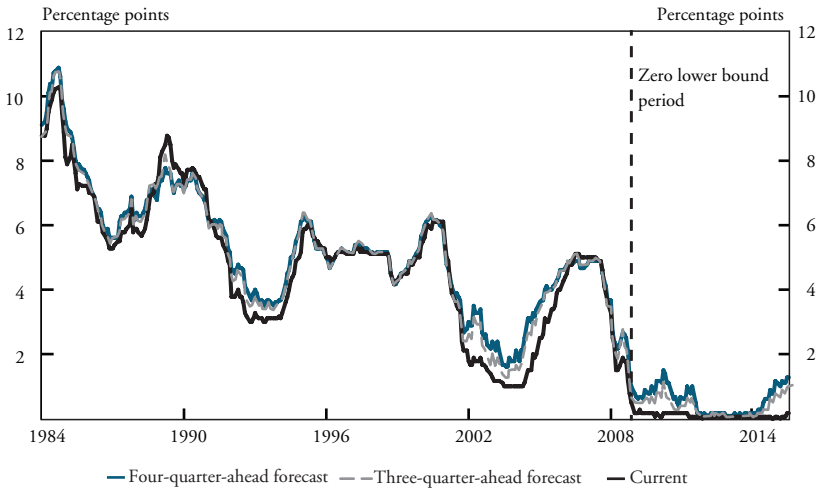
Blue Chip Economic Indicators conducts monthly surveys of various professional forecasters to measure expectations about future inflation, unemployment, output growth, and interest rates. To match the assumed model of monetary policy with the forecast variables available in the survey, I substitute forecasts of the federal funds rate with forecasts for the three-month Treasury bill rate. This assumption is common in previous research, as these two interest rates are highly correlated. In addition, I measure inflation using the consumer price index (CPI), rather than the PCE price index.

Forecast data provides a useful framework for examining the FOMC's implicit policy rule before and after the zero lower bound. Chart 1 plots the current and three-quarter and four-quarter-ahead forecasts of short-term nominal interest rates. Several key features of the data are noteworthy. First, short-term nominal rates fell to near zero in December 2008 and have remained there since. Without variation in the level of short-term interest rates since 2008, any estimation procedure will fail to uncover the parameters of the policy rule after 2008.[2] However, the four-quarter-ahead forecasts continue to vary over time, even when policy is constrained by the effective lower bound. Therefore, these forecasts can be used to estimate the perceived policy rule parameters at the zero lower bound.

One difficulty in estimating the perceived policy rule is that the long-run levels of unemployment and GDP growth are not observed. However, by taking the difference between the three-quarter and four-quarter-ahead forecasts, I can estimate the parameters without making assumptions or estimating the long-run or target objectives in the rule.[3] These parameters reveal the FOMC's reaction to changes in inflation, unemployment, or output growth. Chart 1 shows that the gap between the three-quarter and four-quarter-ahead forecasts fluctuates over time, including during the zero lower bound period. Further details on the statistical procedures are in the Appendix.

Chart 1

Forecasts of Short-Term Interest Rates



Note: Expectations about short-term interest rates are measured using the Blue Chip surveys for the three-month Treasury bill rate.
Sources: Blue Chip Economic Indicators and Board of Governors of the Federal Reserve System.

Before the Zero Lower Bound

Prior to 2008, forecasters appear to have believed that the FOMC responded significantly to changes in unemployment, inflation, and output growth. The second column of Table 1 shows estimated coefficients of the forecaster-perceived policy rule over the 1984–2008 sample period. The estimated parameters ϕ_π and ϕ_u indicate the central bank's reaction to deviations of inflation and unemployment, respectively, from their longer-run values. The large, negative coefficient on unemployment, -5.40, suggests forecasters believe the FOMC responded significantly to fluctuations in unemployment. The reaction coefficient on inflation (ϕ_π) is also large at 2.88 but is not estimated precisely. In addition, the perceived rule is characterized by a large estimated ϕ_r coefficient, which implies a high degree of interest rate smoothing. A high degree of smoothing suggests the central bank adjusts interest rates slowly over time in response to changing economic conditions.[4] Finally, the large coefficient on the $\phi_{\Delta y}$ parameter suggests forecasters also believed the FOMC responded significantly to fluctuations in output growth. The implied policy rule explains over 40 percent of the variation in the gap between the three-quarter and four-quarter interest rate forecasts.

Table 1
Parameter Estimates of the Policy Rule Perceived by Forecasters

Parameter	Pre-zero lower bound 1984–2008	Zero lower bound Post-2008
ϕ_r	0.93 (0.78, 1.07)	0.91 (0.83, 0.98)
ϕ_π	2.88 (-0.79, 6.56)	1.59 (0.64, 2.53)
ϕ_u	-5.40 (-9.43, -1.36)	-6.84 (-9.38, -4.30)
$\phi_{\Delta y}$	3.09 (1.65, 4.54)	0.31 (-0.59, 1.20)
Observations	292	80
R^2	0.44	0.69
P-value from overidentifying restrictions test	0.71	0.90

Note: Numbers in parentheses denote 95 percent confidence intervals.
Sources: Blue Chip Economic Indicators and author's calculations.

Over the 1984–2008 period, the estimated policy rule's predictions closely match forecasters' actual projections. Using the estimated policy rule, I compute the implied forecasts for the four-quarter-ahead interest rate.[5] Chart 2 plots these predicted values versus the actual four-quarter-ahead Blue Chip forecasts. The predicated rates from the estimated policy rule appear to closely track forecasters' actual projections.

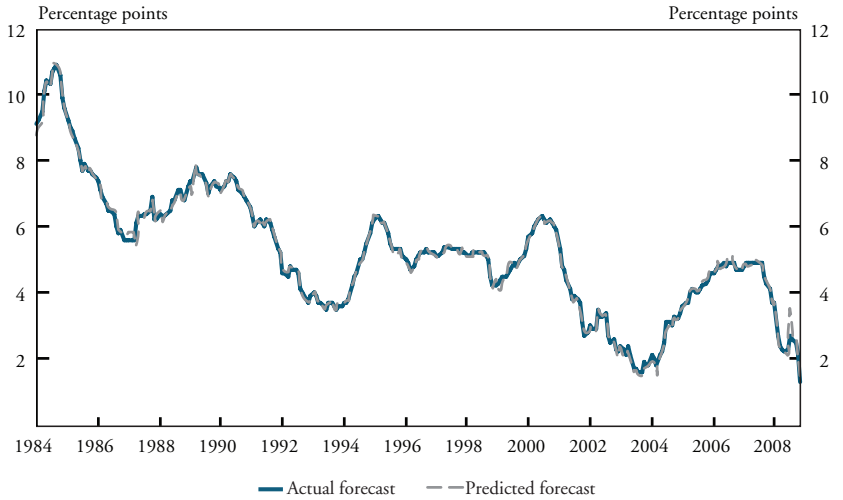
At the Zero Lower Bound

At the end of 2008, the FOMC lowered its nominal policy rate to its effective lower bound. Unable to lower rates further, the FOMC turned to unconventional policies such as forward guidance to help stabilize the economy. Smith and Becker discuss the FOMC's use of forward guidance over the last several years and find that unexpected changes in the FOMC's forward guidance have significant effects on economic activity and inflation. In this article, I instead examine how forecasters interpreted changes in the FOMC's guidance over this period. Did forecasters interpret the use of explicit forward guidance as a change in the central bank's implicit rule? Or did they interpret forward guidance as simply a communication device, with the bank's policy rule remaining unchanged?

To determine which of these views is supported by empirical evidence, I first examine how well the previously estimated rule from the

Chart 2

Actual and Predicted Four-Quarter-Ahead Interest Rates Prior to 2009

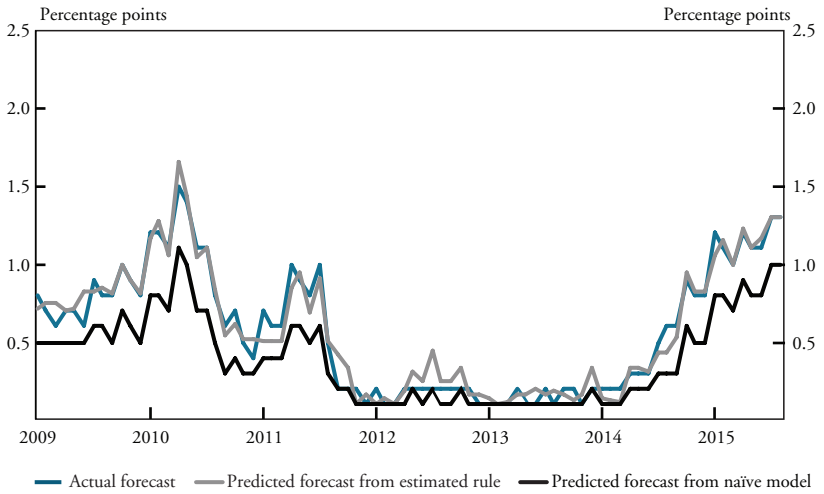


Sources: Blue Chip Economic Indicators and author's calculations.

pre-zero lower bound period predicts interest rate forecasts over the last few years. Using the policy rule estimated over the pre-2009 data, I generate the implied four-quarter-ahead interest rate forecasts for the zero lower bound period. Chart 3 plots these out-of-sample predictions against the actual four-quarter-ahead forecasts since 2009. The out-of-sample predictions of the pre-zero lower bound rule (gray line) are surprisingly consistent with forecasters' actual projections in the zero lower bound period (blue line). Like the actual forecasts, the estimated rule predicts a large decline in expected rates in the middle of 2010 and a gradual rising of interest rate expectations beginning in 2014. The close fit of these out-of-sample predictions to their actual forecasts suggests the forecaster-perceived rule has not changed dramatically since the end of 2008.

In addition, the predictions from the estimated policy rule fit the actual forecast data significantly better than a simple time series model. Chart 3 also plots the forecasts from a naïve random-walk model, where the forecast for the four-quarter-ahead interest rate simply equals the three-quarter-ahead forecast. The predictions from this simple model (black line) do not appear to closely track the actual forecasts well. The persistent differences between the random-walk model and the actual

Chart 3
Actual and Predicted Four-Quarter-Ahead Interest Rates



Sources: Blue Chip Economic Indicators and author's calculations.

forecasts suggest that forecasters' perceptions about future policy are not well captured by this naïve forecasting model.

To further test for a change in the forecaster-perceived rule, I re-estimate the rule over the January 2009–August 2015 sample period. Comparing the estimated coefficients across sample periods allows me to determine whether the perceived rule changed over time. The third column of Table 1 shows the parameter estimates over the zero lower bound period. The coefficients are similar to those in the pre-zero lower bound period, suggesting the policy rule perceived by forecasters is relatively unchanged since hitting the zero lower bound. For example, the coefficients on unemployment(ϕ_u) across both subsamples are about –6. The response coefficients on inflation(ϕ_π) are also similar across both subsamples, but the coefficient is more precisely estimated in the post-2008 period.[6] Forecasters continued to believe the FOMC responded significantly to fluctuations in unemployment with a large degree of interest rate smoothing. The coefficient on output growth is somewhat smaller in the zero lower pound period, suggesting forecasters believed the FOMC put less weight on output growth deviations in the last few years.[7] Even in the era of explicit forward guidance, the simple policy rule continues to explain much of the variation in the gap between the four-quarter and three-quarter-ahead forecasts. These subsample

estimation results suggest forecasters' perceived policy rule did not change dramatically over the zero lower bound period. [8]

III. Interpreting the August 2011 Period

The statistical results suggest forecasters believed the FOMC would respond to economic conditions in the zero lower bound period in the same way they did before the lower bound became a policy constraint. However, one notable change in forward guidance during this period challenges this interpretation. Before August 2011, the FOMC's forward guidance indicated "economic conditions … are likely to warrant exceptionally low levels of the federal funds rate for an extended period" (FOMC). One meeting later, however, the FOMC released a statement that indicating significant changes to its forward guidance regarding future rates. In its August 9, 2011 statement, the Committee replaced the "extended period" language with "at least through 2013." After this statement, forecasters significantly revised down their expectations of future short-term rates (Chart 3).

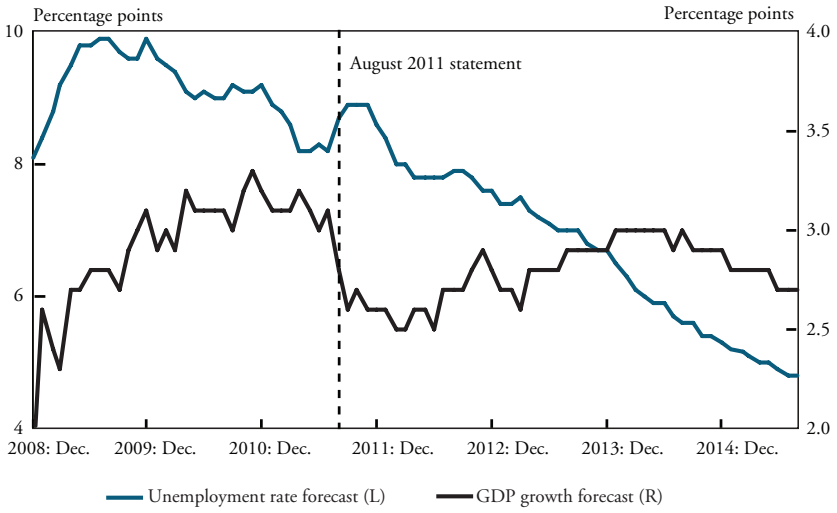
On the surface, this large change in guidance in the span of one meeting might have suggested a change in the FOMC's policy rule. However, private-sector forecasts show the economic outlook deteriorated rapidly in the middle of 2011. Chart 4 plots the four-quarter-ahead unemployment and real GDP growth forecasts during the zero lower bound period. In the summer of 2011, forecasters significantly revised down their projections for growth and unemployment. Growth expectations fell by 0.5 percentage point, and the unemployment rate was expected to reverse its downward trend. Many of these revisions occurred after releases of labor market data that painted a more pessimistic picture of the labor market than expected.[9]

Despite the large change in the FOMC's guidance, the pre-zero lower bound policy rule appears to accurately predict the change in interest rate forecasts.[10] Chart 3 shows that the predicted four-quarter-ahead interest rate forecasts also fell sharply around August 2011. These results suggest that the decline in interest rate forecasts was consistent with deterioration in the economic outlook rather than a change in the FOMC's underlying policy rule.[11]

The August 2011 statement and the FOMC participants' own forecasts around that time also suggest a deteriorating macroeconomic

Chart 4

Four-Quarter-Ahead Unemployment and Real GDP Growth Forecasts



Source: Blue Chip Economic Indicators.

Table 2

Central Tendencies from the Survey of Economic Projections

Variable	Forecast date	2011	2012	2013
Real GDP growth	June 2011	2.7–2.9	3.3–3.7	3.5–4.2
	November 2011	1.6–1.7	2.5–2.9	3.0–3.5
Unemployment rate	June 2011	8.6–8.9	7.8–8.2	7.0–7.5
	November 2011	9.0–9.1	8.5–8.7	7.8–8.2

Source: Board of Governors of the Federal Reserve System.

outlook in the middle of 2011. Table 2 shows central tendencies from the Survey of Economic Projections (SEP) for FOMC participants in June and November 2011.[12] The central tendencies of real GDP growth and employment fell significantly throughout the forecast period. Expectations for 2012 unemployment rose by over 0.5 percentage point from June to November 2011. The rapid change in the FOMC participants' forecasts suggests that the change in forward guidance was consistent with a rapid change in economic conditions.

IV. Conclusion

Despite the FOMC's unprecedented use of unconventional policy tools over the last few years, its implicit policy rule, as perceived by forecasters, appears to have remained relatively unchanged since hitting the zero lower bound. This suggests the Committee's communication strategies and forward guidance over the last few years were consistent with its previous behavior. Even when current short-term policy rates were constrained by the zero lower bound, forecasters believed the FOMC would respond similarly to developments in the economy as they did before the zero lower bound constrained policy.

However, a few significant caveats apply to the results and interpretation. The estimated policy rule does not account for the effects of large-scale asset purchases by the Federal Reserve. If these actions provided additional monetary accommodation, they are not captured by my analysis. However, Woodford and others argue that these large-scale asset purchases simply reflected a signaling channel of monetary policy. Under this view, the central bank supports its forward guidance by purchasing longer-term securities.

Despite this caveat, my estimation strategy helps identify the implicit policy rule forecasters believe the FOMC will follow *after* the economy lifts off from the zero lower bound. Forecasters could believe the FOMC has temporarily deviated from its established rule at the zero lower bound but will return to its previous rule when it begins raising interest rates. While my results cannot definitively address some of the more nuanced aspects of the FOMC's implicit policy rule at the zero lower bound, the statistical evidence suggests that the forecaster-perceived rule remains relatively constant.

Appendix
Data and Estimation Procedure

This Appendix provides additional details about the data and estimation procedure. Monthly Blue Chip Consensus surveys provide forecasts for quarterly variables. For example, the January, February, and March forecasts for the one-year-ahead inflation rate all pertain to the first quarter of the following year. Due to this overlapping forecast structure, I compute heteroskedastic and autocorrelated-corrected standard errors with two lags. I use the three-month Treasury bill interest rate forecasts, which are highly correlated with the federal funds rate, as the dependent variable.

I derive the primary equation used in the statistical analysis assuming forecasters believe the FOMC sets its short-term nominal rate using the following rule:

$$[r_t = \phi_r r_{t-1} + (1-\phi_r)r + \phi_\pi(\pi_t - \pi) + \phi_u(u_t - u) + \phi_{\Delta y}(\Delta y_t - \Delta y)]$$

where r_t is the short-term policy rate set by the central bank, π_t denotes the rate of inflation, u_t is the unemployment rate, and Δy_t is the growth in real gross domestic product. The central bank's inflation target is denoted by π, while u and Δy denote the long-run values for unemployment and output growth, respectively. Iterating this equation forward and taking expectations at time t, the three-quarter and four-quarter-ahead forecasts can be written as follows:

$$r^e_{t+3} = \phi_r r^e_{t+2} + (1-\phi_r)[r + \phi_\pi(\pi^e_{t+3} - \pi) + \phi_u(u^e_{t+3} - u) + \phi_{\Delta y}(\Delta y^e_{t+3} - \Delta y)]$$

$$r^e_{t+4} = \phi_r r^e_{t+3} + (1-\phi_r)[r + \phi_\pi(\pi^e_{t+4} - \pi) + \phi_u(u^e_{t+4} - u) + \phi_{\Delta y}(\Delta y^e_{t+4} - \Delta y)]$$

Since both equations hold for each forecast date , taking the difference of the two equations results in the following relationship between forecasts:

$$r^e_{t+4} - r^e_{t+3} = \phi_r(r^e_{t+3} - r^e_{t+2}) + (1-\phi_r)[\phi_\pi(\pi^e_{t+4} - \pi^e_{t+3}) + \phi_u(u^e_{t+4} - u^e_{t+3}) + \phi_{\Delta y}(\Delta y^e_{t+4} - \Delta y^e_{t+3})]$$

At a given date, the differences between the three-quarter and four-quarter-ahead forecasts can help identify the implicit policy rule perceived by forecasters. I estimate the policy rule parameters ϕ_r, ϕ_u,

Table A-1
Ordinary Least Squares Policy Rule Estimates

Parameter	Pre-zero lower bound 1984–2008	Zero lower bound Post-2008
ϕ_r	0.58 (0.38, 0.78)	0.85 (0.74, 0.95)
ϕ_π	0.31 (-0.06, 0.69)	0.74 (-0.08, 1.56)
ϕ_u	-1.31 (-1.92, -0.70)	-2.22 (-4.37, -0.07)
$\phi_{\Delta y}$	0.06 (-0.09, 0.22)	-0.03 (-0.62, 0.56)
Observations	300	80
R^2	0.58	0.71
P-value from exogeneity test	0.00	0.39

Note: Numbers in parentheses denote 95 percent confidence intervals.
Sources: Blue Chip Economic Indicators and author's calculations.

ϕ_π, and $\phi_{\Delta y}$. Note that this difference specification allows me to estimate the key policy parameters without making assumptions about the inflation target, π, or longer-run values for unemployment, u, or output growth, Δy . To compute the four-quarter-ahead policy rate implied by the estimated rule, I use the fitted values from the statistical model and add the value of the three-quarter-ahead policy rate to both sides of the estimating equation.

The estimation procedure uses generalized method of moments. The analogous ordinary least squares results appear in Table A-1. Statistical tests reject the exogeneity of the regressors at the 1 percent level for the pre-zero lower bound period. Thus, I use generalized method of moments for the baseline estimation, which is common in previous literature on estimating monetary policy rules. I estimate the model using the third through eighth lags of the right-hand-side variables. Due to the overlapping forecast structure, I find the first and second lags fail to satisfy weak instrument tests. The Hansen J-test fails to reject the overidentifying restrictions, which suggests the use of valid instruments. I implement the generalized method of moment estimation using the *ivreg2* package developed by Baum, Schaffer, and Stillman.

Constants are included in the statistical models but are not statistically significant from zero for the difference specification. I allow for estimation error in the statistical procedure by appending an uncorrelated shock to the estimating equation.

Endnotes

[1]I begin the analysis in 1984 to avoid any structural changes in the policy rule associated with the Volcker disinflation in the late 1970s and early 1980s. The December 2008 Blue Chip survey was conducted before the FOMC lowered the federal funds rate to its effective lower bound. Therefore, I include the December 2008 survey with the pre-zero lower bound sample.

[2]Kim and Pruitt show that at the zero lower bound, estimating policy rules with the level of the current short-term rates suffers from a censoring problem, which biases their coefficients toward zero. Hakkio and Kahn, instead, estimate policy rules using the Wu and Xia shadow rate. This shadow rate is not constrained by the zero lower bound and can be interpreted as the central bank's desired nominal policy rate.

[3]Estimating the model in first differences also allows the long-run or target objectives to differ across the two subsamples without affecting my estimation results. This feature is particularly important for inflation, because the FOMC explicitly sets a target for the PCE price index, rather than the CPI that is used in the statistical analysis.

[4]In a related work, Coibion and Gorodnichenko find significant evidence of interest rate smoothing in the FOMC's actual reaction function. In their baseline specification, they also find a reaction coefficient on inflation larger than 2. However, my article focuses on forecasters' perceptions of the FOMC's implicit policy rule.

[5]To determine the implied four-quarter-ahead policy rate, r^{e}_{t+4} , I use the fitted values from the statistical model and add the value of the three-quarter- ahead policy rate, r^{e}_{t+3} , to both sides of the estimating equation.

[6]While the estimated coefficients on inflation in Table 1 differ slightly across subsamples, the 95 percent confidence intervals show that the coefficient is imprecisely estimated in the pre-zero lower bound period. The estimated coefficient for the zero lower bound sample lies within the confidence interval for the 1984–2008 sample period.

[7]In related work, Hamilton, Pruitt, and Borger estimate the monetary policy rule perceived by financial market participants using high-frequency data on interest rate expectations. Their estimated rule suggests the FOMC's response to output fell after 2000.

[8]This work is similar to a recent paper by Kim and Pruitt. They also use forecast data to examine the FOMC's implicit policy rule before and after the onset of the zero lower bound. However, they find a decrease in the forecasters' perceived response to inflation in the zero lower bound period. In contrast, I find that the perceived inflation response was relatively unchanged across sample periods. These different conclusions occur for two reasons. First, my zero lower bound sample period extends through 2015, while Kim and Pruitt's analysis ends

in 2011. Second, I use a slightly different estimation procedure that uses generalized method of moments and an alternative empirical specification.

[9]Employment growth and unemployment rate releases were significantly worse than expected during the middle of 2011. In addition, past months' data were revised downward.

[10]Ideally, I would re-estimate the policy rule before and after the August 2011 FOMC statement. However, there are too few observations in the zero lower bound period to conduct meaningful statistical inference.

[11]A third explanation is also possible: forecasters may have believed that the FOMC chose to temporarily deviate from its established rule, but would follow its previous rule in the near future. In standard macroeconomic models, this interpretation could be modeled as an unexpected shock to the monetary policy rule that is uncorrelated with current economic conditions. However, Smith and Becker's empirical evidence suggests that such a shock would have to have been extremely large and highly unlikely by historical standards.

[12]SEP projections are only released every other FOMC meeting. Thus, the June and November projections are the closest available to the August meeting.

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