Rules versus Discretion: A Reconsideration

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1 Introduction

In this paper, I compare two kinds of monetary policy regimes. The first kind of regime is a rule in which the policymaker sets the central bank’s instruments (asset purchases or the short-term interest rate) according to a pre-determined function of publicly observable variables. The second kind of regime features complete discretion, so that the policymaker can make whatever instrument choice is seen as being appropriate at that point in time. Over the past forty years, a broad consensus has developed among academic macroeconomists that policymakers’ choices should closely adhere to pre-determined rules.1 It can be traced back to two key papers. From a theoretical perspective, Kydland and Prescott (1977) showed nominal rigidities created a challenging time consistency problem for monetary policymakers.

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1Taylor (1993, p. 197) writes, “If there is anything about which modern macroeconomics is clear however - and on which there is substantial consensus - it is that policy rules have major advantages over discretion in improving economic performance.” His words go back nearly a quarter century but are probably now even more widely viewed as being true. Thus, three Nobel Laureates joined Taylor in signing this letter in support of Congress’ requiring the Fed to explain any deviations from the Taylor Rule: http://financialservices.house.gov/uploadedfiles/020916_taylor_letter_with_signatories_.pdf. Rules enjoy considerably less support among those who actually have the responsibility of making policy, as evidenced in this open letter from Chair Janet Yellen to Representatives Pelosi and Ryan: http://www.federalreserve.gov/foia/files/ryan-pelosi-letter-20151116.pdf. But even she relies heavily on variants of the Taylor Rule when it comes to thinking about how to structure policy responses to shocks (Yellen (2016)).
Given this problem, it was welfare-improving to require monetary policymakers to follow a pre-determined rule. From a practical perspective, Taylor (1993) demonstrated that the Federal Reserve’s monetary policy choices could, in fact, be well-approximated by a simple feedback rule (from publicly observed economic conditions to interest rates) and that rule was associated with good macroeconomic outcomes. These two papers have had enormous influence in both academic and policy circles. Most academic papers in monetary economics treat policymakers as mere error terms on a pre-specified feedback rule. Most modern central bank staffs model their policymaker bosses in exactly the same way.

In this paper, I re-evaluate the relative merits of discretion versus rules from both an empirical and theoretical perspective. The empirical problem with rules is that monetary policymakers or their overseers are forced to choose rules based in large part on their prior performance. Unfortunately, the performance of the rule may deteriorate sharply if conditions change sufficiently. I argue that the FOMC’s 2009-10 decisions can be seen as an important illustration of this general problem with rules.

To make this argument, I use information in the transcripts\(^2\) from 2009-10 Federal Open Market Committee (FOMC) meetings (shortly after the end of the Great Recession in June 2009). I document that the FOMC pursued a relatively slow recovery, in which unemployment and inflation were anticipated to take at least six years to return to their long-run levels.\(^3\) I trace this lack of aggressiveness to the FOMC’s treating the staff forecast for the evolution of unemployment and inflation as an approximate target for appropriate monetary policy. The staff forecast was based on the presumption that the Committee would use the Taylor Rule\(^4\)

\(^2\)The Federal Open Market Committee publicly releases transcripts of its meetings, along with supporting staff materials, with a five to six year lag. The transcript from the December 2010 meeting is the latest one that has been released so far.

\(^3\)I served on the Federal Open Market Committee from October 2009 through October 2015. Throughout the November 2009-November 2010 time frame, I believed that, under appropriate monetary policy, inflation would return to 2% or even slightly above within two to three years. However, I thought that inflationary pressures were considerably stronger than most of my colleagues on the FOMC, and so favored less monetary accommodation than most of them.

\(^4\)The term “Taylor Rule” is used to refer to a wide class of monetary policy rules. Throughout the paper, I use the term to refer specifically to the interest rate rule originally described in Taylor (1993), or to the FOMC staff’s version of that rule (which uses Okun’s Law to substitute an unemployment gap for the Taylor Rule’s output gap), subject to a lower bound of a quarter percent.
seen as a good approximation to the FOMC’s pre-2007 reaction function - as its guide to the removal of accommodation. It follows that the FOMC’s desire for a slow recovery was based on this same presumption that its exit strategy would be shaped by the Taylor Rule.\(^5\)

The empirical analysis does leave open the possibility that there is some other rule out there, yet to be found, that would dominate discretion. In the second part of the paper, I explore this question theoretically using the delegation model of Holmstrom (1984). The main trade-off in the theoretical framework is that the central bank may desire a different level of inflation than does society, but the central bank also has information about the future evolution of inflation that is impossible to write into a rule. Here, I have in mind that the central bank sees a large number of possible factors, with time-varying factor loadings, that help it forecast inflation. For example, suppose a large European financial institution suddenly closes three investment funds.\(^6\) How will the central bank respond to that shock? The appropriate response will depend on a host of details that would be hard to write into any pre-determined rule.

I compare two possible institutional setups in the context of the model: discretion, under which the central bank can choose any level of monetary accommodation that it wishes, and a rule, under which the central bank’s decision is a fixed function of some publicly observable information.\(^7\) The benefit of the former institutional framework is that the central bank has the ability to offset shocks that can’t be encoded into a rule, but would otherwise generate highly variable inflation. The cost of the former framework is that inflationary outcomes will be systematically different from the socially optimal level, because of the central bank’s inflation bias. Correspondingly, I show that, in terms of ex-ante welfare, discretion generates better outcomes for society as long the central bank has a sufficiently small inflation bias relative to the magnitude of non-rulable inflationary shocks. (Here, I use two notions of

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\(^5\)I made a similar argument in Kocherlakota (2015b).

\(^6\)Readers will recognize this as a description of BNP Paribas’ decision on August 9, 2007.

\(^7\)My terminology mirrors that in Kydland and Prescott (1977). However, others prefer a broader notion of rules: what I call discretion in this paper, Bernanke has called a rule: [http://blogs.wsj.com/economics/2015/03/02/bernanke-says-fed-already-follows-policy-rule/](http://blogs.wsj.com/economics/2015/03/02/bernanke-says-fed-already-follows-policy-rule/).
ex-ante welfare: quadratic loss and a min-max robustness criterion as in Hansen-Sargent (2007).) I use evidence from the past two decades to argue that the Federal Reserve does not have a material pro-inflation bias (meaning, at most, a quarter percent).\textsuperscript{8}

The empirics and the theory both suggest that, contrary to conventional wisdom, monetary policy rules impede central bank performance. Central banks will achieve better outcomes if they are given discretion - that is, if on an ongoing basis, they make choices based on all available information to keep inflation or employment close to target. Importantly, this recommendation does hinge on the inflationary bias of the central bank being small. That seems to be an accurate description of the Federal Reserve in the past twenty years, but I provide no guidance about how to ensure that it continues to be true going forward.

My analysis is closely related to much prior work. In terms of the empirics, during the 2009-10 time period, many observers critiqued the FOMC for providing insufficient levels of accommodation.\textsuperscript{9} My contribution here is that my use of internal Committee documents (only released over the last couple years) sheds new light on how the FOMC’s pre-crisis framework contributed to this under-provision of accommodation. In terms of the theory, Canzoneri (1985) illustrates a similar tension between central bank bias and central bank private information. Svensson (2003) makes similar points to mine about how discretion allows central banks to use judgment so as to achieve better macroeconomic outcomes.\textsuperscript{10}

\section{The Not-So-Great Recovery and the Taylor Rule}

In this section, I discuss the actions of the Federal Open Market Committee (FOMC) during the beginning of the recovery from the 2007-09 Great Recession. The main argument unfolds

\textsuperscript{8}See Kocherlakota (2015a) for a related discussion.
\textsuperscript{9}For example, see Gagnon (2009).
\textsuperscript{10}Throughout the paper, I compare outcomes under rules to outcomes under complete discretion, so that the central bank can choose any amount of accommodation. In a dynamic version of the problem that I study, Athey, Atkeson, and P. Kehoe (2005) prove that the optimal delegation game is either a rule or has \textit{bounded} discretion (which is what I term constrained discretion). In their benchmark parametric example, they prove that, as the central bank’s private information becomes increasingly large, the optimal delegation game converges to one without any constraint on discretion.
in three steps. I first show that the FOMC was aiming for a slow recovery in both inflation and unemployment. I next show that the FOMC’s projected slow recovery was, in fact, close to the forecast of the FOMC staff for unemployment and inflation - in essence, the FOMC was treating the FOMC staff’s forecast as its target for monetary policy. The staff forecast assumed that that the Committee’s decisions about the timing of the initial fed funds rate increase, and subsequent increases, would be based on the Taylor Rule, because it was viewed as providing a good approximation to the Committee’s pre-2007 reaction function. I conclude that the FOMC’s desire for a slow recovery was grounded in its treating the staff’s model of its pre-2007 reaction function - that is, the Taylor Rule - as a guide to the appropriate normalization of monetary policy.

I then use the Brainard (1967) policy uncertainty framework to assess the possible influence of concerns about policy ineffectiveness on the Fed’s decisions. I argue that those concerns should have led to more aggressive policy choices than those made by the Committee. I discuss the parallels between the 2009-10 FOMC decisions and the 1929-30 policy errors discussed by Brunner and Meltzer (1968). I close the section by arguing that the FOMC’s continued reliance on variants of the Taylor Rule seems likely to lead to slow recoveries from future recessions.

2.1 The Summary of Economic Projections

My discussion relies heavily on the Summary of Economic Projections (SEP). Beginning in 2007, FOMC participants (all twelve Presidents of the regional Reserve Banks and the members of the Federal Reserve’s Board of Governors) have submitted their forecasts for key macroeconomic variables four times per year. These submissions make up the SEP. Importantly, as the description of the SEP clearly states, a given participant’s forecast is “based ... on each participant’s assumptions about factors likely to affect economic outcomes, including his or her assessment of appropriate monetary policy. ’Appropriate monetary policy’ is defined as the future path of policy that the participant deems most likely to
foster outcomes for economic activity and inflation that best satisfy his or her interpretation of the Federal Reserve’s dual objectives of maximum employment and stable prices.” A given participant’s assessment of the appropriate stance of monetary policy may well differ from their forecast of what the Committee would actually do. As a result, these so-called projections should not be seen as reflecting participants’ forecasts for the actual course of the economy. Rather, beyond the usual one to two year lag associated with monetary policy, a participant’s projection is best viewed as a description of his or her monetary policy goals for the evolution of the relevant macroeconomic variables.

After the relevant meeting, the FOMC releases summary statistics from the SEP to the public. However, when the FOMC releases the meeting transcript (five plus years later), it also releases the full set of SEP submissions. The full SEPs provide valuable information, as they link participants’ relatively detailed and standardized assessments of the economy and policy with their forecasts.11 I exploit all of this public information heavily. Hence, my discussion will focus on the SEP from the years 2009-10, since the full SEP from later years have not been released. As well, I restrict attention to the fourth quarter SEPs from those years because they have a longer forecast horizon than SEPs from earlier in the year.

2.2 The FOMC’s Limited Ambitions

According to the Federal Reserve Act, the FOMC is charged by Congress to make monetary policy so as to promote price stability and maximum employment. The Committee has translated the former objective into a goal of 2% for Personal Consumption Expenditure (PCE) inflation. In terms of the latter objective, it tracks progress using a number of metrics, but tends to put the most weight on the unemployment rate. In principle, the two mandated objectives could conflict with one another, and that conflict did shape the SEP submissions of some participants. However, most saw no conflict between the two goals during this time.

11Unfortunately, the submissions remain anonymous for another five years. As a result, it is impossible to link a participant’s submissions at one meeting to his/her submissions at another until a decade after both meetings.
frame between the two mandates: inflation was expected to be too low and unemployment was expected to be too high.

The first table documents the intentions of the median FOMC participant in the fourth quarter of 2009 and 2010 for the evolution of the unemployment rate over the medium term.

Table 1: Median Fourth Quarter SEP Projections for the Unemployment Rate

<table>
<thead>
<tr>
<th></th>
<th>Current</th>
<th>2 Years Ahead</th>
<th>3 Years Ahead</th>
<th>Long Run</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>9.8</td>
<td>8.3</td>
<td>7.0</td>
<td>5.0</td>
</tr>
<tr>
<td>2010</td>
<td>9.5</td>
<td>8.0</td>
<td>7.1</td>
<td>5.3</td>
</tr>
</tbody>
</table>

The median FOMC participant believed that, under appropriate monetary policy, the unemployment rate would fall to about 8% in 2 years and to about 7% in 3 years. Obviously, these figures were well below the unemployment rate that prevailed at the time that the forecasts were made. At the same time, though, the Committee was aiming for a relatively slow recovery in employment, in the sense that the unemployment rate in three years’ time remained well above its long run level.

As noted above, though, the FOMC has two objectives. It could be that the Committee was aiming for a measured recovery in the unemployment rate in order to guard against inflation. The second table documents the Committee’s intentions in the fourth quarters of 2009 and 2010 for the evolution of the PCE inflation rate over the medium term.\footnote{Tables 1 and 2 are based on page 5 of the November 2009 Summary of Economic Projections and page 5 of the November 2010 Summary of Economic Projections.}

Table 2: Median Fourth Quarter SEP Projections for Inflation

<table>
<thead>
<tr>
<th></th>
<th>Current</th>
<th>2 Years Ahead</th>
<th>3 Years Ahead</th>
<th>Long Run</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>-0.5</td>
<td>1.5</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>2010</td>
<td>1.3</td>
<td>1.4</td>
<td>1.5</td>
<td>2.0</td>
</tr>
</tbody>
</table>

The median FOMC participant believed that, under appropriate monetary policy, the inflation rate would rise to about 1.5% in both 2 years and 3 years, well short of the median
long-run target of 2%. In both years, and at both horizons, at most one FOMC participant saw above 2% inflation as being appropriate.\textsuperscript{13} In 2009 and 2010, the FOMC was aiming to use its monetary policy tools to foster a recovery that would return both inflation and unemployment to their long run levels relatively slowly.

The FOMC did not adopt an official long-run target until January 2012. Even so, in 2009 and 2010, no FOMC participant believed that inflation should be above 2% in the long run. However, in 2009, five participants said that it would be appropriate for inflation to converge to less than 2% in the long run. One year later, that number had grown to seven. Perhaps surprisingly, the various median projections are essentially unchanged if we only focus on those dovish participants who view a long-run inflation rate of 2% as being appropriate.

These forecasts only extend out three years. However, the SEPs also ask the FOMC participants whether the economy’s convergence to the Committee’s long-run goals would take more or less time than five or six years. In November 2009, only one participant saw this convergence taking place in less than five years. Over half believed that it would take longer than six years. In November 2010, only two participants saw this convergence taking place in less than five years. Several believed that it would take longer than six years.

2.3 Why Were the FOMC’s Aims so Modest?

The FOMC’s stated goals for monetary policy are to return inflation to its long-run target and to return unemployment to its long-run level. As Ben Bernanke put it in 2015, when he was no longer chair of the FOMC: “The Fed has a rule. The Fed’s rule is that we will go for a two percent inflation rate. We will go for the natural rate of unemployment. We will put equal weight on those two things. We will give you information about our projection, our interest rates. That is a rule.”\textsuperscript{14} This is presumably intended to be a description of forecast-

\textsuperscript{13}The FOMC did not adopt an official long-run target until January 2012. Even so, in 2009 and 2010, no FOMC participant believed that inflation should be above 2% in the long run. However, in 2009, five participants said that it would be appropriate for inflation to converge to less than 2% in the long run. Interestingly, one year later that number had grown to seven. Discarding these “sub-2%” participants moves the various medians by at most 0.1 percent.

\textsuperscript{14}Bernanke (2015).
targeting, along the lines discussed by Svensson (1997), among others. But, like all other Fed descriptions of its monetary policy objectives, Bernanke’s does not specify any target horizon. As a result, Bernanke’s description is equally consistent with a plan to return inflation to target over 1 year, 2 years, or twenty years. Put another way, it is equally consistent with the FOMC’s using the (1993) Taylor Rule or instead using a version of the Taylor Rule with coefficients of 10000 on the inflation gap and output gap (that would return unemployment and inflation to desired levels much more rapidly). The FOMC’s framework simply provides no judgment about the appropriate pace of the recovery of inflation and unemployment from an adverse shock.

In this subsection, I argue that in 2009 and 2010, the FOMC filled this vacuum by treating the staff forecast as its target for appropriate monetary policy. That staff forecast was based on the Taylor Rule (as a good stand-in for the FOMC’s pre-2007 reaction function). Hence, the FOMC was essentially using the Taylor Rule as its monetary policy rule, especially in its determination of the appropriate timing and pace of liftoff from the effective lower bound.

To make this case, I turn next to the staff forecasts for the economy. The staff based its forecasts on the assumption that the FOMC would begin to raise interest rates around the time implied by the Taylor Rule, and then follow the Taylor Rule thereafter. The staff made this assumption on empirical grounds: their analysis suggested that the Taylor Rule had served as a good approximation to the Committee’s pre-crisis behavior. It led them to the following outlooks in the fourth quarters of 2009 and 2010.

15 Many wonder about the influence of the Chair on the staff’s forecast. My own perspective is well-summarized by these words from then Governor Larry Meyer’s classic (1998) speech, “Come with Me to the FOMC”: “Whose forecast is this? Is it really the staff’s independent judgment, or is it the chairman’s forecast that the staff has dutifully adopted as their own? I wondered about this myself before joining the Board. I can only talk about my experience, though I have, as you might guess, taken some interest in the workings and history of the FOMC, and will over time develop a better understanding of past practice. But it is very clear today that the forecast is the staff’s independent judgment.”

16 See footnote 4, October 2009 Greenbook Part I and footnote 3, October 2010 Tealbook Part A. In October 2010, the staff assumed that the FOMC held the fed funds rate at zero slightly longer than would be implied by the Taylor (1993) Rule.
Table 3: FOMC Staff’s Projections

<table>
<thead>
<tr>
<th></th>
<th>2009:IV proj. for UR</th>
<th>2009:IV proj. for $\pi$</th>
<th>2010:IV proj. for UR</th>
<th>2010:IV proj. for $\pi$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010:IV</td>
<td>9.5</td>
<td>1.4</td>
<td>9.7</td>
<td>1.3</td>
</tr>
<tr>
<td>2011:IV</td>
<td>8.2</td>
<td>1.0</td>
<td>9.0</td>
<td>1.1</td>
</tr>
<tr>
<td>2012:IV</td>
<td>6.1</td>
<td>1.2</td>
<td>7.9</td>
<td>1.1</td>
</tr>
<tr>
<td>2013:IV</td>
<td>4.9</td>
<td>1.4</td>
<td>7.1</td>
<td>1.2</td>
</tr>
<tr>
<td>2014:IV</td>
<td>4.7</td>
<td>1.6</td>
<td>6.1</td>
<td>1.4</td>
</tr>
<tr>
<td>2015:IV</td>
<td>NA</td>
<td>NA</td>
<td>5.2</td>
<td>1.6</td>
</tr>
</tbody>
</table>

Like the projections included in Tables 1 and 2, the staff outlook features a slow decline in the unemployment rate, coupled with a slow increase in the inflation rate (back to, in this case, the staff’s assumed target of 2%). There are some slight differences - for example, the FOMC is aiming for a somewhat faster return of inflation to target than is reflected in the staff outlook. However, overall, the FOMC’s monetary policy target closely tracks the staff’s Taylor Rule-based forecast.

The November 2009 and November 2010 SEPs do report that a number of FOMC participants believe that, under appropriate monetary policy, the fed funds rate should rise more rapidly than is expected by staff.\(^\text{17}\) But only a couple of these participants explicitly suggest deviating from the Taylor Rule.\(^\text{18}\) Rather, participants seem to arrive at their preferred interest rate path by plugging sub-2% long-run targets for inflation and/or stronger inflation/unemployment outlooks into the same rule used by staff.\(^\text{19}\) And, as I noted above, those

\(^\text{17}\)See page 19(20) of the November 2009 (2010) SEP.
\(^\text{18}\)More specifically, participants 5 and 16 in November 2009.
\(^\text{19}\)To be specific: in November 2009, participants 2, 4, 5, 6, 7, 9, 10, 11, 13, 16, and 17 stated that they would prefer to raise rates more rapidly than in the staff outlook. Participants 2, 6, 7, 10, 11 and 13 have stronger inflation forecasts than do the staff. Participants 4 and 9 have long-term inflation goals of 1.5%, not 2%. Participant 17 has a stronger growth forecast than does the staff. Participants 5 and 16 favor the use of a different rule for monetary policy, in the sense that they would like to raise rates to head off potential financial imbalances. In November 2010, participants 1, 7, 10, 12, 14, and 15 stated that they would either prefer to raise rates more rapidly or undertake a smaller amount of asset purchases than in the staff outlook. All of them had a lower long-run inflation target than 2%.
participants with 2% inflation targets also prefer a slow recovery that is close to the staff’s benchmark (Taylor Rule-based) outlook.

Why did the Taylor Rule imply such a slow recovery? The Taylor Rule is designed to eliminate gaps between inflation gaps (between current inflation and a 2% target) and output/unemployment gaps. However, the Rule constrains the size of the FOMC’s response to these gaps; in particular, it precludes the FOMC from rapidly cutting interest rates until all gaps are eliminated.\footnote{Here, I assume (as is true in New Keynesian models and the Fed’s FRB-US model) that the FOMC’s current interest rate choices have \textit{some} effect on current outcomes. In contrast, Svensson (1997) assumes that current monetary policy choices have no impact on macroeconomic outcomes for two years.} In this sense, the Taylor Rule represents a constraint on the FOMC’s interest rate response to inflation and activity gaps.

Mathematically, we can think of the Taylor Rule as being the result of the Committee’s putting some weight on an implicit objective of keeping the fed funds rate close to its historically normal level. To be more concrete, suppose that the central bank has a quadratic loss function with weight on both inflation gaps and interest rate gaps:

\[-(\pi - \pi^*)^2 - \lambda (i - i^*)^2\]

Suppose as well that the current inflation rate is (well-approximated by) an affine function of the current interest rate:

\[\pi = \alpha - \beta i\]

Then the bank’s optimal interest rate choice would be to set the interest rate equal to:

\[(\pi - \pi^*)\beta = \lambda(i - i^*)\]

which can be written as an interest rate rule:

\[i = i^* + \beta \lambda^{-1}(\pi - \pi^*)\]
The slope in this last relationship converges to infinity as the weight in the objective on interest rate gaps converges to zero. Basically, an interest rate rule like the Taylor Rule calls for the Fed to trade off its pursuit of mandated goals against the objective of keeping the level of accommodation close to its long-run average.

2.4 The Taylor Rule and the Forward Guidance Deficit

As of November 2009, the FOMC had already lowered the target range for the fed funds rate to near zero and had bought a large amount of long-term assets. What else could the Committee have possibly done to stimulate inflation and employment? In this subsection, I argue that staff analysis at the time suggested that the FOMC could have facilitated a faster economic recovery by using forward guidance that clearly indicated its intention to be much more patient in its removal of accommodation than was implied by the Taylor Rule.

Throughout the November 2009-November 2010 time frame, the Committee provided a qualitative form of forward guidance, saying that it anticipated that the fed funds rate would remain extraordinarily low for “an extended period.” As William Dudley, vice-chair of the FOMC noted, this phrase was widely understood as meaning that “no tightening was likely for more than six months.”

The Committee was concerned throughout this period that this forward guidance would be regarded as a commitment, while it was only meant as a forecast.

In November 2010, staff presented a policy option under which the FOMC would adopt a stronger form of forward guidance. According to this guidance, the FOMC would state that it intended to keep the fed funds rate extraordinarily low at least until mid-2012. The proposed guidance came with a number of escape clauses, designed to prepare the public for the possibility that the FOMC might raise the fed funds rate more rapidly. Only two participants

21November 2009 FOMC transcript, p. 168. See also the results of the primary dealer survey reported on p. 5 of December 2009 transcript.

22See, for example, Bernanke, p. 119 of March 2010 FOMC transcript: “… this is clearly not a fixed time commitment. It is a conditional statement …. I would just ask ... that everybody emphasize in talking about this publicly that it is conditional and that we are tying our policy to the state of the economy.”
spoke in favor of this change in forward guidance. In the end, the Committee followed the lead of Chairman Ben Bernanke and Governor Janet Yellen, who felt that including this language in the statement would add little accommodation given current market expectations of the initial date of lift-off.

Actually, the staff’s analysis at the two November meetings supported the adoption of much more aggressive forms of forward guidance than the mid-2012 date. The staff routinely provided forecasts of the optimal path of fed funds rate target choices that were based on the benchmark FRB-US model. In both November 2009 and November 2010, these optimal control exercises resulted in interest rate paths that stayed at a quarter percent until the unemployment rate fell to about 5%. This delay in the initiation of interest rate increases provides considerably more monetary accommodation than results from following the recommendations of the Taylor Rule.

Interestingly, these 2009-10 optimal control prescriptions are both relatively close to what the FOMC actually ended up doing: it did not raise the fed funds rate target range from its 2008 level until the unemployment rate was 5%. But the policy is much more stimulative in the model because people know well in advance that the Fed intends to keep interest rates low until the unemployment rate hits 5%. They certainly did not have that knowledge in the early days of the recovery: In late 2009, Blue Chip forecasters expected that the FOMC would first raise interest rates when the unemployment rate was near 10%.

Over two years later, in December 2012, the FOMC implemented a new kind of forward guidance that committed to keeping the fed funds rate extraordinarily low at least as long as

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23 In an earlier draft, I mistakenly wrote that there was no support. That mistake is somewhat ironic, because along with Sandra Pianalto, then the President of the Federal Reserve Bank of Cleveland, I was actually one of the two participants who spoke in favor of adding this language to the statement. (See pp. 149-150 and p. 167 of the November 2010 FOMC meeting transcript.)

24 The term “optimal” refers to minimizing a loss function that puts equal weight on squared deviations of inflation from 2%, squared deviations of the unemployment rate from the natural rate, and squared interest rate changes. The last term is motivated by the staff’s desire to capture the FOMC’s apparent aversion to interest rate changes. See Svensson and Tetlow (2005) for an extensive analysis of the optimal policy projections made by FOMC staff.

25 This is a description of the relevant graphs on p. 25 of the November 2009 Bluebook and p. 3 of Part B of the November 2010 Tealbook.

26 Bernanke (2012, fn. 25).
as the unemployment rate stayed above a particular numerical threshold (and as long as inflation and inflation expectations stayed under control). The staff analysis available at the November 2009 and 2010 meetings suggests that their forecasts for both unemployment and inflation would have been considerably more optimistic had the FOMC chosen to implement an aggressive form of threshold-based forward guidance at either of those meetings.

More specifically, suppose that the FOMC had announced sometime in 2010 that its intention was to keep the fed funds rate extraordinarily low at least until the unemployment rate reached 5% (as long as inflation and inflation expectations stayed under control). According to the staff’s optimal control exercises in late 2009 and in late 2010, this aggressive forward guidance would have brought the unemployment rate back to pre-crisis levels about one year earlier than under the staff’s benchmark outlook, while the inflation rate would have returned to target within the forecast horizon.²⁷

So: why did the FOMC not adopt these stronger forms of forward guidance? There is little by way of an explicit answer in the available transcripts. We shall see later that participants expressed significant concerns about the costs associated with asset purchases. But there are no similar mentions of costs associated with aggressive forward guidance. It seems instead that specific and strong forms of forward guidance were viewed as simply being too far outside the box in 2009 and 2010. The box was centered on (if not defined by) the staff’s benchmark outlook for the Committee’s future choices for the fed funds rate target. And, as I discussed earlier, that benchmark outlook was based on the presumption that the Committee would follow the Taylor Rule.²⁸

²⁷To the extent that one views asset purchases as being stimulative, this forecast underestimates what the FOMC could have expected to achieve using its tools. And there is another, more subtle, reason why the forecast underestimates what the FOMC could achieve in terms of unemployment and inflation. In the optimal control exercise, the staff uses a loss function that puts substantial weight on interest rate changes. That loss function leads the FOMC to begin to raise rates too early and too slowly, relative to the optimal path under a loss function that doesn’t put any weight on interest rate changes. Like the staff’s baseline FRB-US model, this comparison abstracts from the possibility that a faster recovery would have had permanent positive effects on the long-run level of economic activity. Chairman Ben Bernanke discusses this benefit of additional stimulus in some detail on page 99 of the November 2010 transcript.

²⁸See p. 30 of November 2010 FOMC transcript, footnote 4.
2.5 Asset Purchases

The FOMC relied heavily on long-term asset purchases as a form of monetary stimulus during the recovery. The staff regularly presented possible options to the Committee that featured more aggressive use of this tool. For example, in November 2009, the staff presented a policy option to the FOMC according to which the Committee would have lengthened the duration of an ongoing asset purchase program. The staff argued that doing so would allow the FOMC to accelerate the economy’s return to full employment, guard against downside risks, and raise unduly low inflation. No participant spoke in support of this policy option.29

After the November 2010 meeting, the FOMC announced that it would purchase $600 billion of long-term assets in a policy action that became known as QE2 (to refer to a second round of “quantitative easing”). However, within the meeting, staff presented a policy option under which the Committee would have bought $1 trillion of long-term assets.30 Again, they argued that this step would allow the Committee to accelerate the pace of the recovery in both inflation and employment. No participant openly supported this policy option (and only one, Participant 8, endorsed it in his or her SEP submission).31

There were a number of reasons behind the Committee’s reluctance to undertake a larger

29From October 2009 Bluebook, p. 41: “The Committee may view the staff’s economic outlook, with its very protracted return to full employment, as producing unacceptably poor outcomes given the Committee’s dual mandate. Or participants might believe there remains a non-negligible risk that the economy could suffer a relapse and fall back into recession next year when some of the lending facilities and other government programs wind down. Policymakers may also be troubled by continued inflation readings well below the inflation objectives implicit in the majority of their longer-run projections. For these reasons, they may judge that additional monetary stimulus would be appropriate. The Committee might conclude that an effective way to provide such stimulus would be to expand the amount of agency MBS purchases and to extend the timeframe for conducting agency MBS and agency debt transactions (thereby allowing a higher amount of agency debt to be bought without causing market disruption).”

30From October 2010 Tealbook B, p. 18: “Policymakers may believe that without fairly aggressive policy action soon, both employment and inflation will likely be below the Committee’s objectives for these variables for a very substantial period. Moreover, they may be worried that very low inflation poses significant risks to the recovery. If so, the Committee may wish to provide more substantial policy accommodation at this meeting, as in Alternative A [which involved purchasing $1 trillion of long-term assets, rather than $600 billion]. Committee members may, like the staff, expect the economic recovery to remain quite gradual, even with the additional $600 billion expansion of the Federal Reserve’s balance sheet envisioned in Alternative B. In the staff’s baseline projection, the unemployment rate does not fall below 9 percent until 2012, and inflation remains below levels that the Committee sees as consistent with its objectives for much longer. Members may see such outcomes as unacceptable.”

31The staff presented another option, under which the Committee would not undertake any new asset purchases. A couple of participants spoke in favor of this option.
asset purchase program. In a non-routine October 2010 FOMC meeting about potential forms of additional accommodation, I pointed out that the theoretical literature offered little support for the use of asset purchases as way to provide accommodation. I also suggested five immediate risks associated with the use of asset purchases:32

- There was likely to be huge market uncertainty about the eventual stock of our purchases (which, according to the FOMC, was what mattered for the stimulus).

- Other large holders of long-term Treasuries could offset the FOMC’s policy action by markedly reducing their positions.

- There could be an untoward response in the value of the dollar relative to other currencies.

- If the Federal Reserve’s balance sheet ever grew to be $3 trillion to $4 trillion in size, the FOMC might not have the tools necessary to raise rates when desired.

- The Fed is taking duration risk onto the balance sheet of taxpayers. They might not be too pleased about the Fed’s doing so.

I would say that, six years later, the risks that I mentioned have largely proven to be manageable or insubstantial. (The last issue seems still up in the air.) But I would still argue that, as of late 2010, the downsides of asset purchases seemed large when the baseline economic theory suggested their upside was near zero.33

32See pp. 19-22 of the October 2010 FOMC transcript. I focus on my own remarks for what should be obvious reasons. I was certainly not the only participant at the meeting to express concerns about the downside risks associated with asset purchases. At an earlier meeting, in December 2009, Chairman Ben Bernanke expressed his concern that additional asset purchases could destabilize inflation expectations or lead to undesirably sharp upward movements in commodity prices (p. 135 of transcript). Arguably, the latter actually did come to pass in the first half of 2011 after the FOMC launched QE2.

33The baseline economic theory that I have in mind is Eggertsson and Woodford (2003), which builds on the work of Wallace (1981). In these papers, through a Ricardian Equivalence argument, long-term asset purchases have no impact on long-term yields. There is much empirical work based on central bank asset purchase programs (both here and elsewhere) that suggests that, in fact, the purchases did lead to a decline in long-term yields. As Woodford (2012) points out, it is a distinct question whether this decline in long-term yields was associated with an increase in economic activity. I would guardedly endorse Bernanke’s (2012) conclusion that, “Overall, however, a balanced reading of the evidence supports the conclusion that central bank securities purchases have provided meaningful support to the economic recovery while mitigating deflationary risks.”
In the above discussion of risks, I have not described any financial stability concerns with the use of asset purchases (or forward guidance). It’s important to keep in mind that I’m discussing a period in which the unemployment rate was generally well above 9%. It was hard to see any signs of “overheating” or “froth” in financial markets. Much of the Committee’s discussion was about the magnitude of the downward pressures on inflation generated by economic slack. (See December 2009 FOMC meeting for a particularly thorough staff briefing along these lines.) The situation was quite different in, say, mid-2013 when the FOMC publicly began to discuss its plans for tapering asset purchases.34

2.6 Risk of Ineffectiveness: Applying the Brainard Principle

Many observers in 2009-10, including several FOMC participants, suggested that there was a material risk that monetary policy would be less effective than during more normal economic times. To what extent does this kind of risk justify the FOMC’s policy choices? We can address this question using the framework of Brainard (1967), who considered the problem of a policymaker who is choosing an action designed to keep the economy close to a target, but is uncertain about the effects of the policy action. Brainard’s analysis shows that it is optimal for that policymaker to only partially offset shocks to the economy. Why doesn’t the policymaker aim instead to offset a larger fraction of the shocks to the economy? Being more aggressive has little impact on the policymaker’s performance if the policy action turns out to be ineffective. But being more aggressive will lead the policymaker to miss by a lot if the action turns out to be effective. This last consideration deters the policymaker from seeking to engage in more complete offset.

Somewhat more formally: suppose the policymaker believes that inflation \( \pi = \alpha a + \varepsilon \), where \( a \) is the level of accommodation, and \( (\alpha, \varepsilon) \) are independent random variables. Assume that the policymaker expects inflationary pressures to be unusually low, so that \( E(\varepsilon) < \)

---

34Thomas Hoenig, President of the Federal Reserve Bank of Kansas City, argued both publicly and privately in favor of tighter monetary policy in 2010 because of concerns about financial stability. See, for example, p. 33 of October 2010 transcript. But he was largely alone on the FOMC in making those arguments at this time.
\( \pi^* \). Assume too that policy effectiveness \( \alpha \) equals \( \alpha_{NORM} \) with probability \( p \) and \( \alpha_L \) with probability \( 1 - p \), where \( \alpha_{NORM} > \alpha_L > 0 \). The policymaker seeks to choose \( a \) so as to minimize the expected squared deviation of inflation from its target \( \pi^* \). The first order condition for this problem is given by:

\[
p \alpha_{NORM} (\alpha_{NORM} a + E(\varepsilon) - \pi^*) + (1 - p) \alpha_L (\alpha_L a + E(\varepsilon) - \pi^*) = 0
\]

which implies that:

\[
E(\pi - \pi^*) = p(\alpha_{NORM} a + E(\varepsilon) - \pi^*) + (1 - p)(\alpha_L a + E(\varepsilon) - \pi^*) < 0
\]

Was this kind of uncertainty responsible for FOMC policymakers aiming for a modest recovery? To me, the evidence in the transcripts from 2009 and 2010 suggests not.\(^{35}\) Several FOMC principals did express concern that monetary policy might not be all that effective relative to historical norms (and I say as much above when I discuss asset purchases). In light of this risk, Brainard’s results imply that it would have been appropriate for the FOMC to undershoot its inflation and employment objectives. However, Brainard’s analysis also implies that the risk of policy ineffectiveness should have led Committee members to favor unusually high levels of accommodation - just not high enough to hit inflation and employment targets. (Thus, in the above example, the choice of accommodation is equal to:

\[
a = \frac{(p \alpha_{NORM} + (1 - p) \alpha_L)(\pi^* - E(\varepsilon))}{p \alpha_{NORM}^2 + (1 - p) \alpha_L^2}
\]

which is the desired level when \( p = 1 \).) But, as we have seen, the Committee was loath (during this period) to adopt a more accommodative stance than the historically based prescriptions of the Taylor Rule.

\(^{35}\)See Williams (2013) for a countervailing perspective.
2.7 An Analogy: The Fed’s Great Depression Policy Error

In this subsection, I briefly recapitulate Brunner and Meltzer’s classic (1968) analysis of the Federal Reserve’s policy error during the early part of the Great Depression. My basic point is that, just as in 2009-10, the Federal Reserve’s decision-making in 1929-30 was overly influenced by its pre-downturn decision framework. (To be clear, the the policy error in 1929-30 led to a macroeconomic catastrophe compared to what happened in 2009-10 and thereafter.)

Brunner and Meltzer argue that, during the 1920s, the Federal Reserve developed a framework to guide its decision-making about monetary policy that was sketched in the Board of Governors’ tenth annual report (for the year 1923). A core element of this framework is that the presumption that banks only borrowed reserves from the Fed when they needed those reserves to meet large deposit outflows. This presumption allowed policymakers to use borrowed reserves as a signal about the relative tightness of monetary policy. High amounts of borrowed reserves, especially if interest rates were high, signaled that money demand was high relative to supply, and the stance of policy was tight. Low amounts of borrowed reserves, especially if interest rates were low, signaled that money demand was low relative to supply, and the stance of policy was easy. In his magisterial history of the Federal Reserve, Meltzer summarizes this framework as saying that “if borrowing and interest rates were low, policy was easy; if the two were high, policy was tight.”\footnote{Meltzer (2003, p. 164).} Brunner and Meltzer refer to this framework as the Riefler-Burgess doctrine, in honor of two Federal Reserve staff economists\footnote{More specifically, Winfield Riefler (a Board staff economist) and W. Randolph Burgess (a Federal Reserve Bank of New York staff economist)} who played a key role in its development.\footnote{Meltzer (2003, p. 161) notes that Benjamin Strong, the first governor of the Federal Reserve Bank of New York, also contributed to the development of the Riefler-Burgess framework.}

Brunner and Meltzer argue that Federal Reserve decision-makers turned to the Riefler-Burgess doctrine during the early part of the Depression to help guide their thinking about monetary policy. For example, toward the end of 1930, member bank borrowing from the
Federal Reserve was low relative to historical norms, even though interest rates were also unusually low. These metrics led many Reserve Bank leaders to conclude that monetary policy was easy - so easy, that in September 1930, the Federal Reserve strongly considered selling securities as a way to tighten monetary policy during a period of rampant deflation.

Meltzer (2003) summarizes the Federal Reserve’s thinking in the 1929-30 period as follows, “People see most clearly what they are trained or disposed to see. The Riefler-Burgess ... doctrine ... was not a mechanical formula directing Federal Reserve policy, but it directed attention to member bank borrowing and market interest rates as measures of tightness and ease. In 1929-30, most members of the Federal Reserve Board and governors of the reserve banks accepted this framework. They believed that they had acted decisively to ease credit conditions, and on their measures they had.” 39 This description, with the obvious substitutions, seems apt for the 2009-10 period as well.

2.8 Summary

In 2009 and 2010, the FOMC’s desired recovery path for inflation and unemployment was close to the staff’s benchmark outlook for those variables. In essence, the FOMC was targeting the staff forecast, which was based on the presumption that the Committee would use the Taylor Rule to make its interest rate choices. The resulting reliance on the Taylor Rule led the Committee to aim for a slow recovery in both inflation and unemployment.

Staff analysis in November 2009 and November 2010 made clear to the Committee that it did have ways available to provide additional stimulus to the economy. 40 These stimulative steps received little support within the FOMC. In terms of asset purchases, one can trace much of the FOMC’s hesitancy to the risks of the tool itself. However, in terms of forward guidance, the FOMC’s reluctance seems in no little part due to its unwillingness to commit to a pronounced deviation from the staff’s benchmark outlook for the fed funds rate path.

40There are many other steps that the Federal Reserve could have taken, including, for example, raising its inflation target. I have focused on the two tools that were recommended to the FOMC by its staff.
I believe that Chairman Bernanke summarized the sentiments of almost all meeting participants when he said at the December 2009 FOMC meeting\textsuperscript{41}, “... it’s good for confidence and good for predictability for us to begin to normalize policy, to begin to operate in a way that people are more familiar with.” (italics mine).

The FOMC seems likely to be just as guarded in its responses to future downturns. Recently, Chair Janet Yellen of the FOMC described how she foresaw the Committee responding to a future recessionary shock (Yellen, 2016). That response again treated (a slightly more aggressive version of) the Taylor Rule as being a key benchmark for FOMC policy choices. The result (according to model-based simulations in this recent paper by Reifschneider (2016) and as depicted in Figure 2 of Yellen (2016)) is that the unemployment rate would be above desirable levels for four years and the inflation rate would be below target for over a decade. The Federal Reserve should instead contemplate responding to future shocks using a discretionary framework of the kind described by Alichi, et al (2015).

3 Modeling Rules versus Discretion

In the preceding section, I described how the FOMC could have achieved its inflation and employment objectives more rapidly if it had been willing to deviate more from its pre-crisis reaction function, as proxied by the Taylor Rule. Of course, the Taylor Rule is only one possible rule. In this section, I describe a simple model that will allow for a more general comparison of central bank discretion with central bank rules.

3.1 Environment

Consider the following three stage environment, in which the stages are indexed 0, 1, 2. In the final stage 2, inflation $\pi$ is realized. It is the sum of four components:

$$\pi = x_R + x_{NR} + a + \varepsilon$$

\textsuperscript{41}Page 136 of the December 2009 FOMC meeting transcript.
The first component ($x_R$) is a signal that is revealed at the beginning of the intermediate stage 1 that is rulable - that is, it can be encoded into a policy rule.\footnote{This component could include a host of “forward-looking” variables, like consumption or stock prices.} The second component ($x_{NR}$) is a signal that is observed (at least by the central bank and possibly to others) at the beginning of stage 1, but is non-rulable (cannot be written into a rule). The third component ($a$) is the level of accommodation determined by the central bank in stage 1. The final component ($\varepsilon$) is a random shock to inflation that is realized in stage 2.

It is common knowledge in stage 0 that the continuous density of $x$, over its support $X_R$, is given by $g$. For now, I will assume that it is also common knowledge in stage 0 that, conditional on $x_R$, $(x_{NR}, \varepsilon)$ are mutually independent mean zero random variables with respective supports $X_{NR}$ and $E$. Their respective continuous densities, conditional on $x_R$, are represented by $f(. | x_R)$ and $h(. | x_R)$. I assume that $(X_R, X_{NR}, E)$ are all intervals in the real line.

The objective function of the central bank is defined over inflation and is known to be:

$$-(\pi - \pi_{CB})^2$$

The objective function of society over inflation is known to be:

$$-(\pi - \pi_{SOC})^2$$

These objective functions allow for the possibility that the central bank’s inflation target $\pi_{CB}$ is distinct from that society’s inflation target $\pi_{SOC}$.

### 3.2 Interpretation of the Environment

There are three main attributes of the environment. The first is that the central bank has information $x_{NR}$ available that is useful in forecasting inflation, but cannot be used as the basis of a policy rule. The idea behind $y$ being non-rulable is that it is a complicated
function of possibly many time-varying factors on inflation (thus, $x_{NR} = \theta' \beta$, where $\theta$ and $\beta$ are both very long vectors). This emphasis on the importance of non-rulable information is consistent with the fact that most central banks base their inflation forecasts on objects like potential output and the natural rate of interest that are complex functions of observable and unobservable data (like staff judgments of various kinds). I view this modeling as being a simple way to formalize Svensson (2003)’s observation that “central banks have developed very elaborate and complex decision-making processes, where large amounts of information are collected, processed, and analyzed, and where considerable judgment is exercised.”

The second is that the central bank’s objective for inflation could differ from that of society’s. There are many possible reasons for this bias, like political economy effects of various kinds. However, it could simply be that the central bank’s horizon is short-run, while society’s is long-run. In this way, the model can capture the effects of time inconsistency.43

The final attribute of import is that society has no way to offer outcome-contingent rewards or punishments to the central banker. In elegant work, Walsh (1995) showed how such rewards/punishments can be used to align a central banker’s incentives with society’s. However, it does seem challenging to implement such schemes in reality (at least in the US).

3.3 Delegation Games

My results are about delegation games, in which the central bank can directly choose the level of accommodation from a set of possibilities. In this subsection, I show that any equilibrium outcome of any game played by the central bank in this environment is an equilibrium outcome of a delegation game.

I define a game to be a pair $(C, \alpha)$. Here, the first component $C$ is a correspondence from the set $X_R$ of realizations of the rulable signal into some set $\Gamma$ of actions for the central

43To be a little more precise: this one-period model is meant to capture the central bank’s decision problem after the private sector has made its decisions that feed into inflation within the current period. This timing means that the central bank’s objective in this decision problem does not include the impact of its reaction function on the private sector’s expectations - exactly the time consistency problem highlighted originally by Kydland and Prescott (1977).
The game component $\alpha$ is a continuous outcome function that maps $(\Gamma \times X_R)$ into the real line; given the rulable signal, it describes the accommodation resulting from the central bank’s choice of $\gamma$. The set of equilibria $EQM(C, \alpha)$ to the game $(C, \alpha)$ consists of all functions $\gamma^*: X_R \times X_{NR} \rightarrow \Gamma$ such that $\gamma^*$ is the central bank’s best response as a function of the rulable and non-rulable signals $(x_R, x_{NR})$ about inflation:

$$\gamma^*(x_R, x_{NR}) \in \arg\max_{\gamma \in C(x_R)} - \int_{\varepsilon \in E} (\alpha(\gamma, x_R) + x_R + x_{NR} + \varepsilon - \pi_{SOC})^2 h(\varepsilon|x_R) d\varepsilon$$

I define a delegation game to be a game $(C, \alpha)$ in which the range $\Gamma$ of the correspondence $C$ is a subset of the real line and the outcome function $\alpha(\gamma, x_R) = \gamma$. In a delegation game, the central bank directly chooses an accommodation level from a set of possibilities that can vary with the rulable information $x_R$.

The following proposition shows that there is no loss in generality in restricting attention to the equilibrium outcomes of delegation games.

**Proposition 1.** Consider a game $(C, \alpha)$ in which $\gamma^* \in EQM(C, \alpha)$. Then, let $\Gamma' = \cup_{x_R \in X_R} \cup_{x_{NR} \in X_{NR}} \alpha(\gamma^*(x_R, x_{NR}), x_R)$. Define the delegation game $(C', \alpha')$ by

$$C'(x_R) = \cup_{x_{NR}' \in X_{NR}} \alpha(\gamma^*(x_R, x_{NR}'), x_R)$$

$$\alpha'(\gamma, x_R) = \gamma$$

Then $\gamma'$ is an equilibrium to $(C', \alpha')$, where:

$$\gamma'(x_R, x_{NR}) = \alpha(\gamma^*(x_R, x_{NR}), x_R) \forall (x_R, x_{NR}) \in (X_R \times X_{NR})$$

**Proof.** For any $x_R$ in $X_R$ and any $x_{NR}$ in $X_{NR}$, we know that $\gamma^*(x_R, x_{NR}) \in C(x_R)$. If the central bank observes rulable information $x_R$ and non-rulable information $x_{NR}$, then the central bank weakly prefers the action $\gamma^*(x_R, x_{NR})$ to the action $\gamma^*(x_R, x_{NR}')$ for any $x_{NR}'$.
so that for any \((x_R, x_{NR}, x'_{NR})\):

\[
- \int \varepsilon \in E \left( x_R + x_{NR} + \varepsilon + \alpha(\gamma^\dagger(x_R, x_{NR}), x_R) - \pi_{SOC} \right)^2 h(\varepsilon|x_R) d\varepsilon \\
\geq - \int \varepsilon \in E \left( x_R + x_{NR} + \varepsilon + \alpha(\gamma^\dagger(x_R, x_{NR}), x_R) - \pi_{SOC} \right)^2 h(\varepsilon|x_R) d\varepsilon
\]

This inequality implies that for any \((x_R, x_{NR}, x'_{NR})\):

\[
- \int \varepsilon \in E \left( x_R + x_{NR} + \varepsilon + \alpha'(\gamma^\dagger(x_R, x_{NR}), x_R) - \pi_{SOC} \right)^2 h(\varepsilon|x_R) d\varepsilon \\
\geq - \int \varepsilon \in E \left( x_R + x_{NR} + \varepsilon + \alpha'(\gamma^\dagger(x_R, x_{NR}), x_R) - \pi_{SOC} \right)^2 h(\varepsilon|x_R) d\varepsilon
\]

Equivalently:

\[
- \int \varepsilon \in E \left( x_R + x_{NR} + \varepsilon + \alpha'(\gamma^\dagger(x_R, x_{NR}), x_R) - \pi_{SOC} \right)^2 h(\varepsilon|x_R) d\varepsilon \\
= \max_{\gamma \in C'(x_R)} - \int \varepsilon \in E \left( x_R + x_{NR} + \varepsilon + \alpha'(\gamma, x_R) - \pi_{SOC} \right)^2 h(\varepsilon|x_R) d\varepsilon
\]

This proves the proposition’s claim that \(\gamma'\) is an equilibrium to the delegation game \((C', \alpha')\).

Proposition 1 is, essentially, an application of the revelation principle in this setting. In keeping with Proposition 1, I will focus on delegation games in the remainder of the paper. I will pose the rules versus discretion question as being about the nature of the restrictions embedded in the correspondence \(C\).

### 3.4 Kinds of Delegation Games

In light of Proposition 1, we can restrict attention to delegation games. There are three possible kinds of delegation games. The first kind are \textit{rules} that restrict the central bank’s choice to depend only on the rulable information \(x_R\) about future inflation.
**Definition 1.** Suppose \((C, \alpha)\) is a delegation game. The game is said to be a **rule** if \(C(x_R)\) is a singleton for almost all \(x_R\) in \(X_R\).

In a rule, the public knows exactly what the central bank will do as a function of the rulable variable \(x_R\).

The second kind of delegation game features discretion, in the sense that the central bank is always allowed to choose any level of accommodation.

**Definition 2.** Suppose \((C, \alpha)\) is a delegation game. The game is said to feature **discretion** if \(C(x_R)\) is the entire real line for almost all \(x_R\) in \(X_R\).

All other delegation games are said to feature **constrained discretion**.

**Definition 3.** Suppose \((C, \alpha)\) is a delegation game. The game is said to feature **constrained discretion** if, for some set of \(x_R\) in \(X_R\) that has positive measure, \(C(x_R)\) is a proper subset of the real line and if, for some set of \(x_R' \in X_R\) with positive measure, \(C(x_R')\) is not a singleton.

I will largely be interested in comparing outcomes under rules with outcomes under games that feature discretion. The following result will help in that investigation. Define the stage 0 social welfare associated with any rule \((C, \alpha)\) to be the expected value of the social planner’s objective implied by that rule:

\[
\mathbf{\hat{w}}_{X_R} = \mathbb{E}_{\pi_{SOC}} \left[ \int_{x_{NR} \in X_{NR}} \int_{\varepsilon \in \mathcal{E}} (x_R + x_{NR} + C(x_R) + \varepsilon - \pi_{SOC})^2 h(\varepsilon|x_R) f(x_{NR}|x_R) g(x_R) d\varepsilon dx_{NR} dx_R \right]
\]

**Proposition 2.** Consider the rule \((C^*, \alpha)\) such that \(C^*(x_R) = \pi_{SOC} - x_R\) for any \(x_R \in X_R\). No other rule has higher stage 0 social welfare.

**Proof.** Rewrite the stage 0 welfare associated with a rule \((C, \alpha)\) as:

\[
- \int_{x_R \in X_R} \int_{x_{NR} \in X_{NR}} \int_{\varepsilon \in \mathcal{E}} [(x_R + C(x_R) - \pi_{SOC})^2 + (x_{NR} + \varepsilon)^2] h(\varepsilon|x_R) f(x_{NR}|x_R) g(x_R) d\varepsilon dx_{NR} dx_R
- 2 \int_{x_R \in X_R} \int_{x_{NR} \in X_{NR}} \int_{\varepsilon \in \mathcal{E}} (x_R + C(x_R) - \pi_{SOC})(x_{NR} + \varepsilon) h(\varepsilon|x_R) f(x_{NR}|x_R) g(x_R) d\varepsilon dx_{NR} dx_R
\]
Recall that:

\[
\int_{x_{NR} \in X_{NR}} \int_{\varepsilon \in E} (x_{NR} + \varepsilon) h(\varepsilon|x_{R}) f(x_{NR}|x_{R}) d\varepsilon d x_{NR} = 0 \text{ for all } x_{R} \text{ in } X
\]

Hence, the stage 0 welfare can be expressed as:

\[
- \int_{x_{R} \in X_{R}} (x_{R} + C(x_{R}) - \pi_{SOC})^{2} g(x_{R}) d x_{R}
- \int_{x_{R} \in X_{R}} \int_{x_{NR} \in X_{NR}} \int_{\varepsilon \in E} (x_{NR} + \varepsilon)^{2} h(\varepsilon|x_{R}) f(x_{NR}|x_{R}) g(x_{R}) d\varepsilon d x_{NR} d x_{R}
\]

and this expression is maximized by setting the first integrand to zero - that is, setting \(C(x_{R}) = \pi_{SOC} - x_{R}\). \(\square\)

The best rule is to offset the inflationary pressures embedded in the rulable signal \(x_{R}\).

This rule provides stage 0 social welfare equal to:

\[
V_{opt}^{rule} = - \int_{x_{R} \in X_{R}} \int_{x_{NR} \in X_{NR}} \int_{\varepsilon \in E} (x_{NR} + \varepsilon)^{2} h(\varepsilon|x_{R}) f(x_{NR}|x_{R}) g(x_{R}) d\varepsilon d x_{NR} d x_{R}
- \int_{x_{R} \in X_{R}} \int_{\varepsilon \in E} \varepsilon^{2} h(\varepsilon|x_{R}) g(x_{R}) d\varepsilon d x_{R}
= - Var(x_{NR}) - Var(\varepsilon)
\]

Here, I use the notation \(Var(.)\) to refer to the variance of the relevant random variable, as of stage 0. The stage 0 social welfare is the negative of the sum of two components: the variance of the non-rulable inflation shock \(x_{NR}\) and the variance of the ex-post inflationary shock \(\varepsilon\).

4 Main Theoretical Results

We can now use the theoretical model described in the prior section to assess whether rules are superior to discretion, or vice-versa. The answers to this question generally trade off two
quantities: the magnitude of central bank bias versus the variance reduction gains associated with allowing the central bank to offset shocks to inflation that are hard to encode in rules.

Suppose first that there is no non-rulable information and no inflation bias. Then, discretion is equivalent to the best possible rule.

**Proposition 3.** Suppose $X_{NR} = \{0\}$, so that there is no non-rulable information, and $\pi_{CB} = \pi_{SOC}$, so that the central bank is unbiased. There is a unique equilibrium outcome to any delegation game with discretion and its stage 0 social welfare is equal to the stage 0 social welfare implied by the best possible rule.

*Proof.* Consider any delegation game $(C, \alpha)$. Then, in stage 1, the central bank solves the problem:

$$\max_{a \in C(x_R)} - \int_{\varepsilon \in E} (x_R + \varepsilon + a - \pi_{SOC})^2 h(\varepsilon|x_R) d\varepsilon$$

which can be rewritten as:

$$\max_{a \in C(x_R)} \left[ - \int_{\varepsilon \in E} \varepsilon^2 h(\varepsilon|x_R) d\varepsilon - (x_R + a - \pi_{SOC})^2 \right]$$

Suppose the delegation game features discretion, so that $C(x_R)$ is the entire real line. Then the unique solution to this problem would be to set:

$$a = \pi_{SOC} - x_R.$$ 

The stage 0 welfare associated with this equilibrium is easily seen to be $V_{\text{rule}}^{opt}$. 

The proposition demonstrates that, without any non-rulable information or bias, the best rule is equivalent to discretion.

At this point, it is worth noting something obvious that is often ignored. Many economists will airily say that, “Rules are better than discretion.” The above proposition makes clear how sloppy this language is. In the context without bias or non-rulable information, any rule other than the best one provides less stage 0 welfare. Hence, it is not true that rules are as
good as discretion. What’s true is that there is exactly one (carefully chosen) rule that does as well as discretion.

Suppose next that the central bank’s information about inflation is all rulable and that the central bank is biased. Then, discretion is worse in terms of stage 0 welfare than the best possible rule.

**Proposition 4.** Suppose $X_{NR} = \{0\}$, so that all available information about inflation is rulable, and $\pi_{CB} \neq \pi_{SOC}$, so that the central bank has an inflation bias. There is a unique equilibrium outcome to any delegation game that features discretion and its stage 0 social welfare is less than $V_{rule}^{opt}$ (the social welfare implied by the best possible rule).

**Proof.** Consider any delegation game $(C, \alpha)$. Then, in stage 1, the central bank solves the problem:

$$\max_{a \in C(x_R)} - \int_{\varepsilon \in E} (x_R + \varepsilon + a - \pi_{CB})^2 h(\varepsilon|x_R)d\varepsilon$$

which can be rewritten as:

$$\max_{a \in C(x_R)} \left[ - \int_{\varepsilon \in E} \varepsilon^2 h(\varepsilon|x_R)d\varepsilon - (x_R + a - \pi_{CB})^2 \right].$$

Suppose the delegation game features discretion. Then the unique solution to the central bank’s stage 1 problem is:

$$a = \pi_{CB} - x_R.$$ 

The stage 0 welfare associated with this equilibrium outcome is given by:

$$V_{rule}^{opt} - (\pi_{CB} - \pi_{SOC})^2$$

which equals:

$$V_{rule}^{opt} - (\pi_{CB} - \pi_{SOC})^2$$

□
In the case in which all information is rulable and the central bank is biased, discretion is strictly worse than the best rule. The sign of the bias doesn’t matter for this result.

The case considered in Proposition 4 is the one that most macroeconomists have in their mind when they think about the issue of rules versus discretion. The central bank is biased in its decision-making (because of time consistency and political economy considerations). Because of this bias, it is best to constrain the central bank by a rule.

However, in this paper, I explicitly allow for the possibility that the central bank has information about inflation that cannot be written into a rule. As above, the problem with discretion is that the central bank will systematically aim to generate suboptimally high inflation. But there is a benefit to discretion: the central bank can use this flexibility to offset the impact of inflationary pressures that can’t be encoded into a rule. Intuitively, if the bias is sufficiently small, then the benefit of discretion outweighs the relevant cost. The following proposition provides the precise way to do the comparison when the relevant objectives are quadratic.

**Proposition 5.** Suppose:

\[ \text{Var}(x_R) > (\pi_{CB} - \pi_{SOC})^2 \]

Then the unique equilibrium outcome implied by a delegation game with discretion has higher stage 0 welfare than the best rule.

**Proof.** Consider a delegation game with discretion. In stage 1, the central bank observes \((x_R, x_{NR})\) and then solves the problem:

\[
\max_{a \in \mathbb{R}} - \int_{\varepsilon \in E} (x_R + x_{NR} + a + \varepsilon - \pi_{CB})^2 h(\varepsilon|x_R) d\varepsilon
\]

The maximand in this problem can be rewritten as:

\[
- \int_{\varepsilon \in E} \varepsilon^2 h(\varepsilon|x_R) d\varepsilon - \int_{\varepsilon \in E} (x_R + x_{NR} + a - \pi_{CB})^2 h(\varepsilon|x_R) d\varepsilon
\]
The solution is to set \( a = \pi_{CB} - x_R - x_{NR} \). The stage 0 social welfare associated with this equilibrium is given by:

\[
- \int_{x_R \in X_R} \int_{\varepsilon \in E} \varepsilon^2 h(\varepsilon|x_R)g(x_R)d\varepsilon dx_R - (\pi_{SOC} - \pi_{CB})^2
\]

which can be rewritten as:

\[
V_{\text{rule}}^{\text{opt}} + \int_{x_R \in X_R} \int_{x_{NR} \in X_{NR}} x_{NR}^2 f(x_{NR}|x_R)g(x_R)dx_{NR}dx_R - (\pi_{SOC} - \pi_{CB})^2
\]

which proves the proposition.

The next proposition shows that the reverse is true: in terms of stage 0 welfare, the best possible rule is better than discretion if the bias is sufficiently large in absolute value.

**Proposition 6.** Suppose:

\[
\text{Var}(x_{NR}) < (\pi_{CB} - \pi_{SOC})^2
\]

Then the unique equilibrium outcome implied by any delegation game that features discretion has lower stage 0 welfare than the best rule.

**Proof.** Same as the proof of Proposition 5. 

The proposition shows that, if the bias is sufficiently large relative to the non-rulable information available to the central bank about inflation, then the best possible rule is better than discretion. (Again, I want to stress that the proposition only applies to the best possible rule (and to a set of rules in the neighborhood of the best possible rule). It does not apply to all possible rules.)

The above propositions all assume that, in stage 0, society was able to form a prior distribution over possible realizations of the central bank’s non-rulable information. However, given the nebulous nature of that information, it may well be more reasonable to assume that society wants to formulate a delegation game that is robust to extreme outcomes of
the central bank’s non-rulable information. To be more precise, suppose that a game has an
equilibrium outcome given by \( a^*(x_R, y_{NR}) \). Then define the robust social welfare from that
outcome to be:

\[
\min_{x_{NR} \in X_{NR}} \int_{x_R \in X_R} (x_R + x_{NR} + a^*(x_R, x_{NR}) - \pi_{SOC})^2 g(x_R) dx_R - \int_{x_R \in X_R} \int_{\varepsilon \in E} \varepsilon^2 h(\varepsilon | x_R) g(x_R) d\varepsilon dx_R
\]

It is simple to show that, with respect to robust social welfare, discretion is better than any
rule as long as the largest possible non-rulable inflation shock is larger in absolute value than
the central bank’s inflation bias.

**Proposition 7.** Suppose \( X_{NR} = [-M, M] \) and \( |\pi_{CB} - \pi_{SOC}| < M \). Then, the robust so-
cial welfare implied by any rule is less than the robust social welfare implied by the unique
equilibrium outcome of a delegation game that features discretion.

**Proof.** In a delegation game with discretion, the unique equilibrium outcome is given by
\( a^*(x_R, x_{NR}) = \pi_{CB} - x_R - x_{NR} \). The robust social welfare is:

\[
-(\pi_{SOC} - \pi_{CB})^2 - \int_{x_R \in X} \int_{\varepsilon \in E} \varepsilon^2 h(\varepsilon | x_R) g(x_R) d\varepsilon dx_R
\]

In a delegation game that’s a rule, the robust social welfare is

\[
\min_{x_{NR} \in X_{NR}} \int_{x_R \in X} (x_R + x_{NR} + C(x_R) - \pi_{SOC})^2 g(x_R) dx_R - \int_{x_R \in X} \int_{\varepsilon \in E} \varepsilon^2 h(\varepsilon | x_R) g(x_R) d\varepsilon dx_R
\]

The concavity of the objective with respect to \( x_{NR} \) means that this robust social welfare can
be rewritten as:

\[
-\int_{x_R \in X_R} \int_{\varepsilon \in E} \varepsilon^2 h(\varepsilon | x_R) g(x_R) d\varepsilon dx_R + \min_{x_{NR} \in [-M, M]} -(x_R + x_{NR} + C(x_R) - \pi_{SOC})^2 g(x_R) dx_R
\]
The second term can be rewritten as:

$$-M^2 - \int_{x_R \in X_R} (x_R + C(x_R) - \pi_{SOC})^2 g(x_R) dx_R + \min_{x_{NR} \in \{-M, M\}} -2 x_{NR} \int (x_R + C(x_R) - \pi_{SOC}) g(x_R) dx_R$$

The last term is non-positive. Hence, the best rule is to set $C(x_R) = \pi_{SOC} - x_R$ and gives rise to robust social welfare $-M^2$, which is less than the robust social welfare arising from discretion $-(\pi_{SOC} - \pi_{CB})^2$. This proves the proposition.

As long it is possible that non-rulable inflationary pressures ever exceed the central bank’s bias in absolute value, discretion is more robust than any rule.

It is easy to summarize the main theoretical findings. If the bias of the central bank exceeds the standard deviation of the central bank’s non-rulable information, then the best possible rule is better than discretion. If the bias of the central bank is lower than the standard deviation of the central bank’s non-rulable information, then all rules are worse than discretion. Perhaps most importantly, if the largest realization of the central bank’s rulable information exceeds its bias in absolute value, then discretion is more robust than any rule.

5 Discussion

In this section, I discuss some aspects of the theoretical results derived above.

5.1 Inflationary Bias?

The propositions in the previous section show that rules are dominated by discretion, as long as the central bank’s inflationary bias is small in absolute value. In this subsection, I argue that the evidence suggests that the Federal Open Market Committee’s inflation bias has been, at most, only modestly above zero over the past two decades.\textsuperscript{44}

\textsuperscript{44}The concerns about bias, both in the media and in the academe, usually focus on the possibility that the FOMC has a positive inflation bias. So, I don’t present evidence against the hypothesis that the FOMC’s
To make this argument, I need to first establish a benchmark for the socially optimal level of inflation. In many countries (such as Canada and the United Kingdom), elected governments have established what are intended to be long-term targets for inflation. Presumably, these targets can be seen as being relatively good proxies for socially optimal inflation. In the US, no such target has been established. However, in early 2012, the Federal Open Market Committee formally established a long-term goal of keeping PCE inflation at 2%. Congress has, as yet, made no attempt to modify this target. So, I will treat the 2% target as being equivalent to the socially desirable level of inflation ($\pi_{SOC}$).

We can gauge the FOMC’s inflation bias in two different ways: in terms of the the Committee’s inflation objectives and in terms of actual outcomes. In terms of the former, in the last meeting of each year, the Committee’s staff provide inflation forecasts for the upcoming two years. These forecasts are conditioned on the staff’s best projection of what the Committee will actually do. Since 1997, the one-to-two year ahead inflation forecasts have only rarely exceeded 2% and have never been as high as 2 1/4 percent. Hence, the staff did not see the FOMC as aiming for inflation well above 2%. Since 2007, the FOMC participants have submitted their own end-of-year inflation forecasts. As discussed earlier, these forecasts are conditioned on each participant’s own assessment of appropriate monetary policy. The midpoint of the central tendency of the one-to-two-year ahead PCE inflation forecasts (constructed by discarding the three highest and three lowest forecasts) never exceeded 2% (even during periods of high unemployment).\footnote{See Kocherlakota (2012).}

So, there is little evidence in the FOMC’s projections for inflation that the Committee is aiming for inflation to be materially above 2%. If we look at outcomes, we get a similar conclusion. Over the past twenty years, the sixty-month trailing average PCE inflation rate has never been above 3%. Even here, most of the upward misses with respect to inflation can be attributed to the surprisingly large run-up in oil prices in 2008. Over the past twenty

\footnote{See https://www.federalreserve.gov/monetarypolicy/files/FOMC_LongerRunGoals_20160126.pdf for the most recent version of this statement.}

\footnote{inflation bias was highly negative.}
years, the sixty-month trailing average core PCE inflation rate (which excludes goods and services related to food and energy) has never exceeded 2 1/4 %.

Of course, inflation rose to unacceptably high levels during the 1970s. However, since that period, much has changed in terms of FOMC practice. Perhaps most notably, both Chairman William Martin and Chairman Arthur Burns interacted relatively closely with the White House compared to Chair Janet Yellen or her immediate predecessors. The Federal Reserve is consequently much more independent of the short-term political pressures that often are argued to have been responsible for at least part of the Great Inflation.\footnote{See Meltzer (2010).}

\subsection*{5.2 Communication Challenges with Rules}

It is often argued that rules enhance the public’s understanding of monetary policy.\footnote{See Taylor (2015, point 2) for example. Note that Taylor (2015) is based on Taylor (1997).} I use the above theoretical framework to demonstrate that rules (or any form of constraint on discretion) make such communication more challenging. My basic point is that a discretionary central bank automatically reveals all of its information about inflation. A rule-constrained central bank must seek other ways to reveal that information.

In a world with discretion, the central bank sets the level of accommodation so that:

\[ a^\ast(x_R, x_{NR}) = \pi_{CB} - x_R - x_{NR} \]

The variable \( x_R \) is known to the public, but the non-rulable information \( x_{NR} \) may or may not be. The choice of accommodation, in and of itself, reveals \( (\pi_{CB} - x_{NR}) \). If the central bank’s bias is known (as I assume above), then the choice of accommodation reveals the non-rulable information \( x_{NR} \).

In contrast, if the central bank is using a rule, the choice of accommodation reveals nothing about \( x_{NR} \). It may well be true, though, that the central bank would like to reveal at least some of its private information about inflation, so as to reduce the private sector’s uncertainty.
about inflation. The central bank would then need to supplement its choice of accommodation with separate communication about $x_{NR}$. In this sense, rules - or any constraints on central bank accommodation - serve to increase the central bank’s communication challenge.

Thus, in this simple framework, discretion automatically reveals more information to the public than does a rule. Why then do observers often argue\textsuperscript{49} that rules reduce uncertainty relative to discretion? From an ex-ante perspective, revealing more information in stage 1 does create more uncertainty in stage 0. In stage 0, the public knows that the central bank operating with discretion will reveal $(a^*, x_R, x_{NR})$ in stage 1. A central bank operating under a rule only reveals $(a^*, x_R)$ (plus whatever it announces about $x_{NR}$) in stage 1 to the public. Under discretion, the public has more information in stage 1 about what will happen in stage 2. But the extra information in stage 1 means that the public necessarily has more uncertainty in stage 0 about what will transpire in stage 1. The critics of central bank discretion are averse to this increased ex-ante uncertainty generated by interim central bank information revelation. But as long as the public can make effective use of the information revealed by the central bank’s action, this revelation has clear societal benefits.

Let me put this less technically and more directly. The critics of central bank discretion typically treat variations around their preferred rule as largely due to random errors generated by the central bank’s incompetence. But it seems much more reasonable to treat those deviations from the rule as purposive responses to information that has not been encoded into the rule. Once we take that perspective, the central bank’s freedom to deviate from the rule can be seen as a valuable source of information to the public.

6 Conclusions

There is a broad academic macroeconomic consensus that monetary policy should be constrained by rules. In this paper, I argue instead that there are good reasons to believe that societies will achieve better outcomes if central banks are given complete discretion to pur-

\textsuperscript{49}See Taylor (2015, point 4) for example.
sue well-specified goals. Theoretically, discretion allows central banks to take advantage of information about the macro-economy that is hard to write into rules. Empirically, being willing to deviate more materially from the exit strategy implied by the Taylor Rule would have allowed the FOMC to pursue a more rapid recovery from the Great Recession.

I do show that if central banks have a sufficiently large pro-inflation bias, there exists a set of rules that dominates discretion. (However, it is still not true that all rules dominate discretion.) I argue in the paper that, over the past twenty years, the FOMC has shown little if any pro-inflation bias. But this claim would be much less true in other periods in history (like the 1970s). What changes in institutional design have served to reduce the Federal Reserve’s inflationary bias to its current low level? I say little about this issue in the paper, beyond referring to increased independence from the White House. However, it is a key question for future work along these lines.

The House of Representatives has passed legislation that would require the FOMC to treat the Taylor Rule as a key benchmark in its decision-making about policy. The analysis in this paper implies that this move by the House is a mistake. It is true that the Taylor Rule was arguably associated with good macroeconomic outcomes during a limited period of US economic history. But so was the Riefler-Burgess framework! Enshrining the Taylor Rule in statute can only hamstring the Federal Reserve’s response to currently unanticipated events. The House would be much better off requiring the FOMC to communicate a collective forecast for employment and prices, and to explain clearly why policy is not being used to close any gaps between that forecast and the Committee’s ostensible goals. Congress should re-orient its perspective about what constitutes appropriate monetary policy away from the FOMC’s choice of its instruments and toward the FOMC’s pursuit of its goals. Such a change in focus would incentivize the Committee to pursue rapid recoveries in unemployment and inflation, rather than allow it to stick closely to its prior reaction function.

50Specifically, see Section 2 of H. R. 3189, the Fed Oversight Reform and Modernization Act of 2015.
References


