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An Overview of Simple Policy Rules and their Use in Policymaking in Normal Times and Under Current Conditions[1]

I. Introduction

Simple policy rules have attracted broad interest because they can provide a clear and easy-to-understand benchmark for adjustments to the short-term interest rate. If a rule were judged to be sufficiently consistent with the FOMC's overall strategy for achieving its objectives for inflation and unemployment, the rule could play a prominent role in deliberations. The rule could also be part of a broad-based communications effort, providing a link between the economic outlook and likely path of the policy rate, and making policy more predictable and more effective. In addition, some have argued that by constraining discretion, a rule could impose a useful discipline on Committee actions.

While simple rules already play a role in the Committee's deliberations, FOMC participants and other analysts have expressed substantial disagreement about the merits of closely adhering to any particular simple rule. The main purpose of this memo is to provide background material that the FOMC might find useful in considering the merits of elevating a specific rule (or set of rules) to a more prominent role in the policy process.

We take as our starting point the general view from the research literature that a variety of simple rules perform reasonably well in a variety of models and are plausible candidates for elevation to some more prominent role in the policy process. From this starting point, we provide background on three issues the FOMC probably would want to consider if it were to move toward placing a greater emphasis on some rule as part of its overall monetary policy strategy:

How responsive should policy rules be to the level of resource slack?

The choice here is mainly a matter of policymakers' objectives. The research literature suggests that a substantial response to the level of resource slack is appropriate if policymakers put substantial weight on minimizing both deviations of inflation from its target and deviations of unemployment from its sustainable rate. This general result follows even in the presence of substantial problems measuring resource slack, but we provide some details and caveats below.

What if any history dependence or inertia should the rule embed?

Rules that display history-dependence, or inertia, are those in which a change in the policy rate today signals a persistent change in the stance of policy. As noted in several recent memos to the FOMC, the benefits of history dependence can be substantial in normal times and even larger when the policy rate is at the effective lower bound. Indeed, the claim that simple rules perform well across a broad range of models receives clearest support in research that allows for some degree of inertia in the rules. Of course, the benefits of inertia depend not only on the central

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bank setting policy in a manner consistent with the rule but also on the public believing that the central bank will do so.

Do rules provide a reliable guide to the timing and pace of policy firming under current conditions?

The available theory and evidence on simple rules deal most fully with the implications of such rules when the policy rate is far from the effective lower bound. Unfortunately, several important considerations suggest that simple rules that are quite reliable in normal times may be less reliable under conditions such as those we face now. Nonetheless, even if simple rules do not give reliable advice at present, they still could be an important part of a policy framework. For example, the FOMC might wish to frame policy by first pointing to a rule that would prevail in normal times, and then explaining why policy currently differs from that prescribed by rule and how policy would evolve toward the rule's prescriptions as the recovery continues.

As the situation presently confronting us demonstrates, the FOMC might judge it inappropriate to rigidly follow any simple policy rule in all conditions. Thus, the Committee might want to complement a simple rule with a framework for determining when deviations would be appropriate. In the final section of this memo, we provide a brief discussion of forecast-based rules as a possible complement to conventional simple rules.

II. Some Illustrative Simple Rules—Definitions and Historical Prescriptions

While our review covers the general topic of simple rules, we focus, for concreteness, on the rules reported in Tealbook Book B, plus what we term the inertial Taylor 1999 rule:[2]

Taylor (1993): $R_t = 2.25 + \pi_t + 0.5(\pi_t - \pi^*) + 0.5gap_t$

Taylor (1999): $R_t = 2.25 + \pi_t + 0.5(\pi_t - \pi^*) + 1.0gap_t$

Inertial Taylor (1999): $R_t = 0.85R_{t-1} + 0.15[2.25 + \pi_t + 0.5(\pi_t - \pi^*) + 1.0gap_t]$

Outcome-based: $R_t = 0.81R_{t-1} + 0.19[2.25 + \pi_t + 0.73(\pi_t - \pi^*) + .94\, gap_{t-1} + 2.72\, \Delta gap_{t-1} + 2.05\, \Delta R_{t-1}]$

First-difference: $R_t = R_{t-1} + 0.5(\pi_{t+3|t} - \pi^*) + 0.5\Delta^4 gap_{t+3|t}$

Nominal income targeting: $R_t = 0.75\, R_{t-1} + 0.25\, (2.25 + \pi^* + yn_t - yn_t^*)$

[2] In the equations, R is the federal funds rate; π is the four-quarter rate of core PCE inflation measured on a trailing basis; in the first-difference rule, $\pi_{t+3|t}$ is the three-quarters-ahead projection of the four-quarter rate of headline inflation; π^* is 2, the Committee's inflation target; and *gap* is the staff estimate of the output gap (either measured contemporaneously or projected four quarters ahead). All of these variables are expressed in percentage points. In the nominal income targeting rule yn_t is 100 times the log of the level of nominal GDP and yn_t^* is 100 times the log of potential nominal GDP, where potential nominal GDP is defined as potential real GDP multiplied by a price target that is equal to the actual GDP price index in the fourth quarter of 2007 and that rises thereafter at a steady rate of 2 percent per year.

A few points are worth highlighting. As emphasized by Taylor and others, a good rule obeys the "Taylor principle": policymakers must ultimately raise the *real* interest rate in response to increases in inflation in order to ensure inflation stability. The rules listed above all have this feature.

These rules exhibit important differences from one another, and these differences illustrate many of the properties that the research literature has shown to be important. One key dimension on which the rules differ is the nature and extent of responsiveness to economic slack; Taylor (1993) is less responsive to slack than the next three rules.[3] The first-difference rule responds only to the forecasted change in slack, while the nominal income targeting rule responds to slack only indirectly. In addition, all the rules except Taylor (1993) and (1999) exhibit significant inertia in their policy prescriptions due to their responses to lagged interest rates and, perhaps, other lagged economic conditions. Indeed, the inertial Taylor (1999) rule simply adds a lagged federal funds rate to Taylor (1999); loosely speaking, the outcome-based rule can be seen of as a version of the Taylor (1999) rule augmented by terms in the change in the policy rate and gap. The rules differ in some other noteworthy respects: The outcome-based rule has coefficients estimated on real-time data to reflect the observed behavior of the FOMC from 1988 to 2006; the first-difference rule is specified in terms of forecasts rather than outcomes; and the nominal income targeting rule responds to the level of nominal income, and so can be viewed as a form of flexible price-level targeting.

Figure 1 shows the actual federal funds rate target and the rate that these rules would have prescribed based on the "real-time" data that were available to policymakers at each FOMC meeting from 1987 to 2007. (We omit results for the nominal income targeting rule because including them in the figure would require resolving subtle issues relating to historical re-basing and redefinitions.) While the rules' prescriptions sometimes differ appreciably, they all do a reasonable job of capturing the broad characteristics of the Committee's historical behavior. Nonetheless, the Taylor (1999) rule tracks historical policy behavior better than Taylor (1993), perhaps suggesting that the larger response to resource utilization in the 1999 specification better reflects FOMC's approach to the dual mandate over this period. As is apparent by comparing the bottom three panels with the first two, the three rules that embed substantial dependence on the lagged federal funds rate—the inertial Taylor, outcome-based, and first-difference rules—track historical movements in the funds rate much more closely.

The underlying reason why inertial rules track better is open to question. The better tracking performance might suggest that the FOMC actually placed significant weight on past policy in setting current policy—either because policymakers prefer to avoid large changes and reversals in the policy rate, or as something of a hedge against uncertainty and the policy errors that a less gradualist policy response might uncover. Alternatively, the better tracking of inertial rules might arise if the Committee were actually setting policy in a non-inertial manner but responding to some persistent variable that was omitted from the rule. Evidence suggests the each story played some role, but we do not take a strong position on the source of this historical

[3] What we are calling the Taylor (1993) and (1999) rules in this memo are those traditionally shown in the Tealbook and do not correspond exactly to what Taylor proposed and/or has advocated. Some of the properties, such as the ability to track historical policy behavior (discussed below), differ somewhat across versions of these rules.

phenomenon.[4] Overall, however, inertial rules come closer to replicating movements in the federal funds rate during the 20 years before the recent recession.

III. Simple Policy Rules as Tools for Achieving the Dual Mandate

To achieve the FOMC's 2 percent inflation objective on average, a policy rule must satisfy the Taylor principle. The remaining aspects of the design and calibration of the policy rule mainly determine the variability of inflation, resource utilization, and interest rates that will be implied by the rule. Given the extent of uncertainty and disagreement regarding the true structure of the economy, the robustness of the performance of policy rules across different macroeconomic models is a critically important characteristic and the subject of considerable research. The literature on this and other topics related to simple policy rules—which was recently reviewed by Taylor and Williams (2011)—has identified several features that govern how rules perform across a range of conventional models. A general result from the literature is that a complicated rule that is optimized to perform best in a particular model may perform very poorly when evaluated in other conventional models. The literature has, however, identified a variety of simple policy rules that are robust in the sense that they perform well across a range of models.

We highlight three key choices that determine the implications of a simple rule for economic performance. First, what weight should be placed on the output gap? Second, how much inertia or history dependence should the rule exhibit? Third, should the arguments of the rule be current outcomes or forecasts?

Before turning to the results, it is important to emphasize two features of most existing work in this area. First, the research literature assumes that the central bank can, if it chooses to do so, adhere to any feasible rule—even if it has an incentive to deviate from the rules at times. We discuss the important issue of commitment below. Second, the research literature mainly focuses on the performance of rules in conditions similar to those that prevailed from the mid-1980s to the recent crisis, during which cyclical fluctuations in the economy were modest by historical standards, and the federal funds rate was well above its effective lower bound. Later sections of this memo will consider some of the implications for rules of today's unusual economic circumstances.

How responsive should policy rules be to the level of resource slack?

The appropriate response to the output gap depends importantly on how the policymakers choose to balance the elements of the dual mandate. For a given model, a more aggressive response to resource utilization can help stabilize both economic activity *and* inflation in response to adverse shifts in aggregate demand. Inflation shocks and other supply shocks, however, can introduce a tradeoff: A more aggressive response to the gap will increase the volatility of inflation even while reducing the volatility of the gap.[5] Given this tradeoff, the choice of the coefficient on

[4] Rudebusch (2006) presents arguments and evidence against true inertia as the primary explanation. English, W. Nelson, and Sack (2003) argue that both inertia and other causes seem to be at work. As emphasized below, inertia would be consistent with optimal policy in many models.

[5] This occurs because adverse inflation shocks tend to raise inflation and lower economic activity, and a larger response to slack cushions the impact on resource utilization but amplifies the effect on inflation.

resource utilization in a simple rule essentially amounts to quantifying the term "balanced approach" in the consensus statement. As an empirical matter, a sizable weight on the output gap, such as the unit coefficient in the Taylor (1999) rule, seems to provide a better representation of the FOMC's behavior over the last 25 years than does the smaller coefficient in the Taylor (1993) rule.[6] At the same time, it is worth noting that a large coefficient on the output gap need not reflect a taste for reducing output variability *per se*—if the gap predicts future inflation, a strong response to the output gap may reflect a desire to stabilize inflation.

Most model-based work has abstracted from difficulties in measuring resource utilization, and research has shown that allowing for realistic measurement problems tends to reduce the appropriate response to measured slack. The most categorical response to difficulties measuring the output gap would be to follow a rule that does not respond to the *level* of the gap at all. For example, the first difference rule responds to the change in, rather than the level of, the output gap. Generally speaking, the change in the gap mainly reflects changes in output and so is largely invariant to mismeasurement of potential output. "Change rules" such as the first difference rule have been shown to be robust to measurement error (and model misspecification) and to give satisfactory performance in many models in which agents' decisions are sufficiently forward looking. In less-forward-looking models and in models in which the output gap is very persistent, however, the performance of change rules is not as good and can even be destabilizing.[7]

Perhaps the most relevant examination of this measurement issue is the paper by Orphanides, Porter, Reifschneider, Tetlow and Finan (2000), which was originally presented to the FOMC in June 1999.[8] This work supports the view that mismeasurement calls for a lower weight on resource utilization than would otherwise be appropriate, but concludes that significant weight should be placed on the measured level of slack unless mismeasurement is at the more extreme end of the plausible range.[9] Other researchers have documented similar results and shown that responding only to changes in resource utilization and not to the level may be quite costly when the policy rate is near the effective lower bound (Billi, 2011). We take up the effective lower bound issue more fully below.

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[6] Given that the real activity leg of the dual mandate is expressed in terms of employment, not output, participants may prefer to specify a policy rule in terms of the unemployment gap instead of the output gap. Using Okun's law, setting the coefficient on the unemployment gap in a rule to 2.2 would yield macroeconomic outcomes roughly equal to those obtained with a rule that incorporated a 1.0 coefficient on the output gap.

[7] Kuester (2012), Levin, Wieland, and Williams (1999), Orphanides (2001), Orphanides, Porter, Reifschneider, Tetlow and Finan (2000), Tetlow (2010) and Taylor and Williams (2011).

[8] Much research on this measurement issue presumes that the gap is measured in a particularly unsophisticated manner, perhaps exaggerating the role for measurement problems (Svensson and Woodford, 2003). Measurement error in Orphanides, Porter, Reifschneider, Tetlow and Finan is calibrated to the magnitude and persistence of the staff's historical errors in measuring the gap.

[9] For example, even under substantial measurement error, the optimal weight on the gap exceeds the weight in Taylor (1993) in most cases. Some intuition for this result is as follows. Under standard policymaker preferences, large gaps of either sign are more costly than small ones. When the true gap gets large enough, even a badly measured gap will tend to show the need for a policy response. Thus rules with some weight on the gap tend to respond in an appropriate way when a response is most warranted. The first difference rule ignores the level of the gap, and as large gaps start to close (as output growth increases), the rule tends to suggest tightening.

What if any history dependence or inertia should the rule embed?

Inertial rules, in which the lagged federal funds rate enters with a relatively high coefficient, may have substantial benefits in forward-looking models—that is, in models in which financial conditions, spending, and inflation depend importantly on long-term interest rates, expected income, and expected inflation.[10] When monetary policy displays inertia, a change in the federal funds rate today signals a persistent change in the stance of policy and will promote strong reactions of medium-term and long-term interest rates and in other expectational variables. Those reactions can deliver substantial stabilization benefits, as discussed in Levin, Wieland, and Williams (1999), Taylor and Williams (2011), and Woodford (2011). Conversely, inertia-free rules, such as Taylor (1993) and Taylor (1999) fall well short of attaining optimal outcomes in models containing forward-looking expectations—models such as FRB/US and the staff's DSGE models, SIGMA and EDO).[11] Levin and Williams (2003) find that a moderate degree of inertia, corresponding to a weight on the lagged federal funds rate of 0.6 or 0.7, performs reasonably well across a range of models, including those in which expectations are purely backward-looking as well as models with differing degrees of forward-looking behavior. Kuester (2012) also finds that moderate inertia works well in many models, but in some models, higher inertia retains substantial benefits.[12]

As noted in a memo distributed to the Committee last October, rules with other forms of history dependence, such as the nominal income targeting rule shown in the Tealbook, may perform significantly better than rules that simply put a positive coefficient on the lagged policy interest rate. Further, the benefits of this more general history dependence may be magnified at the effective lower bound.[13]

Up to this point, we have followed the literature in assuming that policymakers choose to strictly follow some feasible rule, even if there were substantial incentive to deviate at times. All of the rules we are discussing have the feature that the rule's prescriptions would deviate from what the policymaker would choose at a given moment under full discretion.[14] Indeed, an often-cited advantage of a rules-based approach is that it would present useful discipline on the exercise of discretion.

To obtain the benefits of history dependence, in particular, the FOMC would need to convince financial market participants, households, and firms that its plans to closely follow the rule

[10] On the optimality of inertia, see Woodford (2003). Note that in some models super-inertial rules with a coefficient greater than one on the lagged funds rate are optimal.
[11] This is a general result seen in previous memos to the FOMC. Levin and Williams (2003) show that a non-inertial Taylor rule performs relatively poorly in various forward looking models even if the coefficients on the gap and inflation are adjusted to optimal values.
[12] A very high degree of inertia can be destabilizing in models that are purely backward-looking or in which gap measurement errors are large and highly persistent. With that said, an important role for inertia depends on forward-looking behavior, not "rational expectations." For example, away from the context of rational expectations models, Bullard and Mitra (2007) and Tetlow and von zur Muehlen (2009) show that Taylor-type rules with a sizable lagged funds rate term make the model governed by the rule more amenable for learning by private agents than otherwise thereby enhancing the likelihood of achieving rational expectations equilibrium.
[13] For a more complete account of the benefits of history dependence, see Erceg, Kiley and Lopez-Salido, "Alternative Monetary Policy Frameworks," memo to the Federal Open Market Committee (October 6, 2011).
[14] That is, these rules generally do not correspond to the "full discretion" optimum in policy models.

would indeed be carried out. Because inertial rules at times involve at least modest anticipated overshooting and undershooting of the unemployment and inflation goals, it might be challenging to maintain the credibility required to align expectations with the FOMC's intentions.[15] The magnitude of this challenge is open to question, however. For example, in current Tealbook simulations even fully optimal policy involves very modest overshooting of the inflation and unemployment objectives in response to the conditions we currently face. Further, because inertial rules imply greater inflation, unemployment, and interest rate stability on average, despite occasional overshooting, such rules might become more easily sustained over time as their benefits become entrenched. It is worth noting that the Committee's recent consensus statement on longer-run goals and policy strategy, and its earlier statement on exit principles, illustrate the ability of the FOMC to take modest steps to constrain future discretion in order to favorably manage private-sector expectations.

Use contemporaneous measures or forecasts in the rule?

Whether the terms appearing in a rule should be contemporaneous values or forecasts of the output gap, inflation, and other variables is generally thought to be of somewhat less importance than the preceding two issues. Because the measures of the output gap typically used by central banks tend to evolve fairly smoothly, and because our ability to forecast movements in the gap over the medium term is limited, little is gained in moving beyond contemporaneous values or one-quarter-ahead projections of the gap.[16] However, the well-known noisy character of headline price measures makes the situation with inflation somewhat different. In several related contexts, the FOMC has chosen between two approaches—emphasizing medium-term headline inflation forecasts in order to "look through" transitory fluctuations due to volatile elements, or employing the recent average rate of core inflation as a proxy for the underlying or forecastable component of overall inflation.[17] Research suggests that the former approach has no clear advantage over the latter for the performance of simple rules, and may even lead to undesirable results in some cases (Taylor and Williams, 2011).[18] In any event, the first-difference rule in the Tealbook conditions on projected headline inflation, while the other Tealbook rules and the inertial Taylor (1999) rule condition on the change in core PCE prices over the previous four quarters. If the FOMC were to elevate the role of rules in its external communications, however, each of these approaches for responding to inflation would raise issues. On the one hand, tying policy only to policymakers' subjective forecasts could lead some in the public to question the credibility of the announced rationale for policy. On the other hand, tying policy to any inflation measure other than headline inflation might engender confusion about the actual goal of policy.

[15] Indeed, at any given time, it is the promise of future overshooting that is the source of benefits in the present. The present benefits, at times, substantially outweigh costs of modest overshooting.
[16] See Rudebusch and Svensson (1999), Levin, Wieland, and Williams (2003) and Orphanides and Williams (2007).
[17] Taylor's original rule focused on a broad measure of inflation including food and energy components. Research generally supports looking through transitory movements in these broad inflation measures. For a discussion of this issue, see Mishkin (2007), Bernanke (2010), and Dokko, Doyle, Kiley, Kim, Sherlund, Sim, and Van Den Heuvel (2011).
[18] Another alternative would be to consider trimmed-mean measures of underlying inflation; see Meyer and Pasaogullari (2010) and Detmeister (2012).

IV. Quantitative Implications of Following Simple rules in the Current Context

The results of the previous section describe rule performance when shocks are of the mild sort experienced during the 20 years before the financial crisis, with the result that the policy rate is almost always far enough from its effective lower bound that the bound can be largely ignored. In contrast, in this section we consider the prescriptions and economic implications of simple rules in today's highly unusual conditions—a situation in which the lessons gained from analyzing rules under "normal" conditions may no longer apply.

As can be seen in Figure 2, the six rules differ appreciably in their current prescriptions for the future path of the federal funds rate, conditional on the staff projections of real activity and inflation reported in the June Tealbook. As shown in the upper panel of the figure, these differences are quite marked when computed on "static" basis—that is to say, when no allowance is made for endogenous responses of real activity and inflation to differences in the current and expected stance of policy across the rules. Under this (admittedly extreme) assumption, the prescribed date for the onset of policy firming ranges from this summer in the case of the Taylor (1993) rule, to late 2013 in the case of the first-difference rule, to the second half of 2014 in the case of the outcome-based and Taylor 1999 rules, to mid-2015 in the case of the inertial Taylor (1999) rule, and as late as 2018 in the case of the nominal income targeting rule. But if we instead assume that private agents understand the full implications of the different rules for the evolution of the economy over time, and immediately adjust their expectations for the future accordingly when the FOMC announces that it will follow a particular rule—also a somewhat extreme assumption—then real activity and inflation respond in ways that greatly diminish the differences in the various projections of the prescribed funds rate. As shown in the bottom panel, under these "dynamic" assumptions the date of liftoff occurs in 2014 or early 2015 for most of the rules, although the Taylor (1993) rule still prescribes immediate tightening and the nominal income target rule delays it until 2015.[19]

As shown in Figure 3, the differences across rules in the date of initial firming and the subsequent pace of tightening have significant implications for the outlook for real activity and inflation. Generally speaking, rules that call for keeping the federal funds rate relatively low for a longer time yield a faster decline in the unemployment rate and an inflation rate closer to the Committee's objective. That said, none of the rules deliver a decline in the unemployment rate as rapid as that generated by an optimal-control policy of the type regularly reported in Tealbook Book B and illustrated by the black lines in Figure 3, although the nominal income targeting rule comes close.

The fact that current policy prescriptions vary considerably across rules reflects a more general phenomenon: If the Committee strictly adhered to the prescriptions of any of the rules considered in this memo, the projected timing and pace of policy firming would be quite sensitive to modest differences in views about the outlook, to modest changes over time in projections of real activity and inflation, and to the details of the rule.

[19] Although the nominal income targeting rule does not explicitly respond to the output gap, most of the current shortfall of nominal GDP from target reflects a large deviation of real GDP from potential, not a discrepancy between the price level and its pre-2008 trend.

First, participants' assessments of the appropriate time of firming would probably be quite sensitive to modest differences in views about the outlook, even when those differences are small relative to historical errors in forecasting real activity and inflation. The top panel of Figure 4 illustrates this sensitivity by showing the prescriptions of the outcome-based rule conditioned on alternative projections for inflation, economic slack, and other factors. These alternative projections, which reflect the range of views expressed in the Committee's June SEP submissions, are well within standard confidence intervals.[20] Importantly, this sensitivity of projected lift-off dates to small differences in the outlook is not limited to the outcome-based rule; as shown in Table 1, projected dates of the first increase in the federal funds rate vary considerably across economic scenarios for all the rules except Taylor (1993), which prescribes an immediate increase in the funds rate.[21]

Second, the projected date of initial firming could vary considerably from meeting to meeting in response to modest revisions in the outlook for real activity and inflation. Consider the recent evolution of the Tealbook assumption for the federal funds rate, which is based on the outcome-based rule. Last December, the Tealbook showed tightening beginning in early 2015. As the economic outlook improved somewhat over the next few months, the firming date moved up, reaching early 2014 by the April Tealbook. In the June Tealbook, however, the date of initial firming moved back to late 2014, largely in response to the worsening European situation. This sensitivity of the date of liftoff is also a feature of the other rules and of the optimal-control simulations reported in Tealbook Book B.

Third, given the uncertain nature of the outlook, the distribution of possible dates for the onset of firming under several rules would be widely dispersed over a span of two years or more—a feature not well-summarized by the modal date of first firming. To get a sense of the probability distribution of the date of first firming under different policy rules, we performed a set of stochastic simulations of the FRB/US model. The results suggest that, under the outcome-based rule and both the Taylor (1999) and inertial Taylor rules, the distribution of first firming would be widely dispersed; this dispersion is especially marked in the case of the inertial Taylor (1999) rule (Figure 5). Further, under some rules, an early lift-off is quite likely. For example, under the outcome-based rule and Taylor (1999) rule, we see that the modal (most likely) date of liftoff occurs during the second half of this year, almost 2 years before liftoff occurs conditional on the Tealbook baseline projection. In contrast, rules that incorporate greater history dependence and do not respond to transitory shocks to growth, such as the inertial Taylor rule, tend to involve later liftoff.

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[20] In the "modestly less slack" scenario, the output gap is about 1¼ percentage points narrower in 2013 than in the Tealbook baseline and 2¼ percentage points narrower in 2014. The "modestly less slack and higher inflation" scenario builds on the previous one by also assuming that core inflation stays close to 2 percent in 2013 and 2014, as compared to 1.7 percent in the Tealbook baseline. In the "modestly greater slack" scenario, the output gap is about ½ percentage point wider in 2013 than in the Tealbook forecast and 1 percentage point wider in 2014. The "modestly greater slack and lower R*" scenario incorporates the same assumptions for economic slack, and in addition assumes that the economy's long-run equilibrium real interest rate is 1¼ percent as compared to 2¼ percent in the baseline; the intercepts of the various policy rules are adjusted accordingly. In calibrating these scenarios to participants' June SEP submissions, we approximate output gaps by subtracting a participant's long-run unemployment rate projection from their medium-term unemployment projections, and multiplying the result by 2.2 (the Okun's Law coefficient).

[21] For simplicity, the results reported in Table 1 make no allowance for differences in monetary policy across the rules to influence real activity and inflation.

Fourth, the rules with a high probability of early liftoff generate a substantial likelihood of a near-term return to the effective lower bound. A corollary of the sensitivity of some of the simple rules to modest changes in economic conditions is that the rules may respond to a transitory improvement in real activity or an increase in inflation by calling for policy to begin to tighten, only to call for a return to the effective lower bound a few quarters later. In fact, stochastic simulations of FRB/US imply roughly a 50 percent probability that, under either the outcome-based rule or the Taylor 1999 rule, any liftoff of the federal funds rate that occurred by early 2013 would be followed by a return to the effective lower bound within four quarters. This reversal risk is, however, much less under the inertial Taylor 1999 rule. These results are reported in greater detail in a companion memo.[22]

V. Special Considerations Affecting Economic Performance Under Simple Rules in the Current Environment

In this section we lay out some arguments for why the special features of an economy that has spent an extended period at the effective lower bound may justify deviating from the prescriptions of simple rules—even rules viewed as dependable in normal times.

Rules versus optimal policy

A common result in the simple rules literature is that certain rules deliver nearly optimal results. When policy is constrained at the effective lower bound, however, outcomes under these rules may be very far from optimal. As noted in two recent memos to the Committee, in the present unusual environment, "optimal commitment" strategies—that is, strategies that manage private sector expectation through an explicit forward-looking plan for the policy rate—perform much better than most simple rules in achieving policy objectives consistent with the Committee's dual mandate.[23] These memos also suggested that much of the benefit of fully optimal, model-dependent policies could be captured by the nominal income targeting rule or similar rules.

The main lesson of this research is that by communicating and following through on a plan to deploy future stimulus, one can create substantial current benefits in these simulations—so long as the private sector expects the plans to be carried out.[24] The current benefits, in terms of lower unemployment, arise because policymakers communicate an intention to pursue at least modest and temporary overshooting of the employment and inflation objectives after the recovery takes hold. This overshooting lowers real interest rates and boosts expected incomes, contributing to near-term improvements in real activity and higher inflation. Obtaining these benefits depends

[22] C. Erceg, J. Faust, D. Lopez-Salido, E. Nelson, D. Reifschneider, and R. Tetlow, "Further Analysis of Simple Policy Rules in the Current Environment."
[23] See C. Erceg, M. Kiley and D. López-Salido, "Alternative Monetary Policy Frameworks," memo to the Federal Open Market Committee (October 6, 2011), and C. Erceg, M. Iacoviello, M. Kiley, and D. López-Salido, "Simple Rules and Optimal Policies in Staff Models," memo to the Federal Open Market Committee (March 2, 2012).
[24] This same logic explains why the optimal-control simulations reported in the June Tealbook call for keeping the funds rate exceptionally low until 2016. The logic also underlies the strategy proposed by Reifschneider and Williams (2000) that, as a recovery from an effective lower bound episode proceeds, monetary policy keep the funds rate lower than a rule would ordinarily call for in order to make up for past shortfalls in conventional monetary policy.

on financial markets, households, and firms being forward looking and on the FOMC being able to influence expectations for the future course of monetary policy.

Unconventional monetary policy

In this memo, we do not directly address the benefits and costs of balance sheet management and other unconventional policies, but staff estimates suggest that the balance sheet policies have provided appreciable stimulus to real activity and have helped to check disinflationary pressures even though they clearly have not generated a robust recovery.[25] Accordingly, the overall stance of monetary policy has been more stimulative than would be suggested by the level of the short-term interest rate alone. In such a situation, gauging the appropriateness of the overall stance of monetary policy by comparing the level of the nominal federal funds rate to, say, the prescriptions of some simple rule such as Taylor (1999) rule may be problematic unless some adjustment is made to capture the unconventional stimulus.

Under some simplifying assumptions, it is possible to derive and implement an appropriate "LSAP-adjusted" funds rate prescription from simple rules.[26] For example, if the 10-year Treasury rate is a complete summary measure of the effects of monetary policy, the adjustment requires an estimate of the effect of balance sheet policy on the term premium embedded in the 10-year rate, and a rule for converting the term premium effect into a funds rate shift that would provide an equivalent amount of easing. Under some additional assumptions, basing the path of the federal funds rate on such an adjusted rule would replicate the outcomes for real activity and inflation that would have occurred in a world in which conventional monetary policy were not constrained by the effective lower bound. However, the required assumptions needed to produce a correct LSAP adjustment to a policy rule are probably not met in practice, and as a result unadjusted rules may yield more appropriate policy guidance than adjusted rules at the current juncture.[27] In any case, as we note below, one might question the merits of adjusting for this one among many special factors operating at present.

Risk management considerations

The optimal control policies reported regularly in Tealbook Book B and discussed above abstract from uncertainty and, in general, these policies will be suboptimal if the effective lower bound leads to an asymmetric response of the economy to otherwise symmetric shocks. The basic idea is straightforward. Imagine an economy on the verge of rising above the effective lower bound and operating under a simple rule whenever not constrained by the bound. A positive shock to this economy will lead to a normal firming of policy; a symmetric negative shock, however, will lead to a less than symmetric amount of easing, so long as the limits and costs associated with unconventional tools imply that those tools are used less aggressively than the (unconstrained)

[25] For example, Chung et al. (2012) estimate that the unemployment rate would currently be 1½ percent higher, and inflation 1 percentage point lower, in the absence of the first two LSAP programs.
[26] For a discussion of these issues, see Edward Nelson and John Roberts, "Interpreting Interest Rate Policy Rule Prescriptions in the Presence of LSAPS," memo to the Federal Open Market Committee (March 2, 2012), and Jonathan Heathcote and Motohiro Yogo, "LSAP Adjustments to Interest Rate Policy Rules," memo to President Kocherlakota (April 10, 2012).
[27] See the companion memo, "Further Analysis of Simple Policy Rules in the Current Environment," for a further discussion of this issue.

federal funds rate would be used in normal times. If positive shocks are muted in a normal way, but negative shocks are not cushioned in a normal way, real activity is biased downward.

The literature on optimal policy design suggests that this risk-based consideration provides another reason to keep the policy rate at the effective lower bound for longer than would otherwise be appropriate.[28] In effect, a strategy of remaining lower for longer provides precautionary stimulus to offset the downward bias posed by the effective lower bound.

Altered dynamics of the macroeconomy

As noted above, much of the analysis of the performance of simple policy rules has been based on models that reflect the economy's cyclical dynamics in "normal" times. But FOMC participants and other analysts have emphasized several ways that economic dynamics may currently be different from normal. For example, there may have been significant impairments to the transmission mechanism that links movements in interest rates to real activity and inflation in recent years. One area in which impairment seems clear is housing, as reduced access to mortgage markets has prevented many households from taking advantage of exceptionally low interest rates. Weak household balance sheets and concerns about employment prospects may also have reduced the interest sensitivity of consumer spending, and heightened uncertainty may have done the same for business investment. A recent staff study found that the interest elasticity of aggregate demand has fallen modestly since the financial crisis.[29] An impairment of the transmission mechanism would call for a more accommodative conventional monetary policy than that implied by standard simple rules, all else equal.

Another unusual feature of the current environment is the persistent nature of various factors restraining the pace of the recovery, such as reduced credit availability, contractionary fiscal policy, and adverse foreign financial and economic developments. Some of these persistent headwinds may be thought of as implying a reduction in the economy's equilibrium real interest rate (R*), as least when evaluated over the medium term. A shift in R* would imply that the intercepts in many of the policy rules employed in the Tealbook are too high. Although the 2¼ percent figure assumed in the Tealbook is consistent with the average level of the real funds rate over the past forty years, private forecasters currently expect real short-term interest rates to stand at only 1½ percent early in the next decade, based on the March Blue Chip survey. Based on the June SEP submissions, most FOMC participants also view R* as below 2¼ percent—some markedly so.

Uncertainty about the supply side of the economy may also have important implications for the use of simple rules at the current juncture. For example, it may be that continued economic weakness could yet lead many workers to drop out of the labor force permanently, or might give rise to other forms of persistent supply-side damage. This adverse dynamic was not seen in

[28] More completely, as the economy approaches the bound, the optimal policy is more aggressively stimulative to avoid the difficulties at the bound. On exit from the bound, the central bank again remains more aggressively stimulative in order to raise the probability of breaking free from the bound. See, for instance, Orphanides and Wieland (2000), Kato and Nishiyama (2005), and Adam and Billi (2007).

[29] See Hess Chung, Geng Li, Ralf Meisenzahl, and Jeremy Rudd, "Are the Real Effects of Monetary Policy Currently Smaller than Usual?" memo to the Federal Open Market Committee (April 6, 2012).

previous U.S. downturns and, hence, played no role in conventional analyses of the performance of simple rules, but might suggest adjusting the normal-times prescriptions of a rule toward more accommodation.

How do all these factors add up?

Overall, there are several good reasons to believe that the prescriptions of simple rules should be adjusted in some way to reflect special factors currently at work. One natural approach might be to evaluate each of these considerations and to compute an overall adjustment taking account of all of them. However, doing so would require a large number of controversial decisions regarding the appropriate model to use, the effects of balance sheet tools on the economy, the extent of uncertainty about potential, special upside and downside risks, and so on. Further, implementing such specialized adjustments may well nullify the merits of the "simple" rules framework. It is largely for this reason that the staff reports the unadjusted prescriptions in Tealbook and strives to present information on factors the FOMC might want to consider in adjusting those prescriptions.

VI. Forecast-based Targeting as a Complement to Simple Rules

While simple policy rules have many virtues, they are obviously no panacea, and it would be useful to have a framework for evaluating when rigidly following a rule is inappropriate. The approach called forecast-based targeting deserves consideration as a complement to simple policy rules.[30] In general terms, to perform policy evaluation under this approach, one examines the forecasts of goal variables under various alternative policy paths, and chooses the policy delivering the forecasts that "look best" under the policy objectives.[31] What gives the idea substance is the fact that optimal policy generally has implications for how the forecasted paths of goal variables should evolve—and some of these properties hold robustly across a range of models.

For example, if policymaker preferences are symmetric, so that inflation and unemployment above or below objective are equally costly, then it will tend to be best to provide additional accommodation until the medium-term projections of inflation and employment lie on opposite sides of their long run objectives—i.e., when projected employment is below its objective (so that projected unemployment is elevated), then projected inflation should be (temporarily) above target.[32] One might complement rule-based prescriptions with analysis of whether the implied forecasts of unemployment and inflation satisfied conditions of this variety. In this way, key principles of optimality could be brought to bear as complements to policy benchmarks implied by simple rules.

[30] Bernanke (2004) refers to this approach as "forecast-based targeting;" Svensson (2003) instead uses the term "targeting rules."
[31] Svensson (2003) describes this perspective.
[32] For example see Woodford (2012).

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Figure 1. Federal Funds Rate Target versus Policy Rule Prescriptions

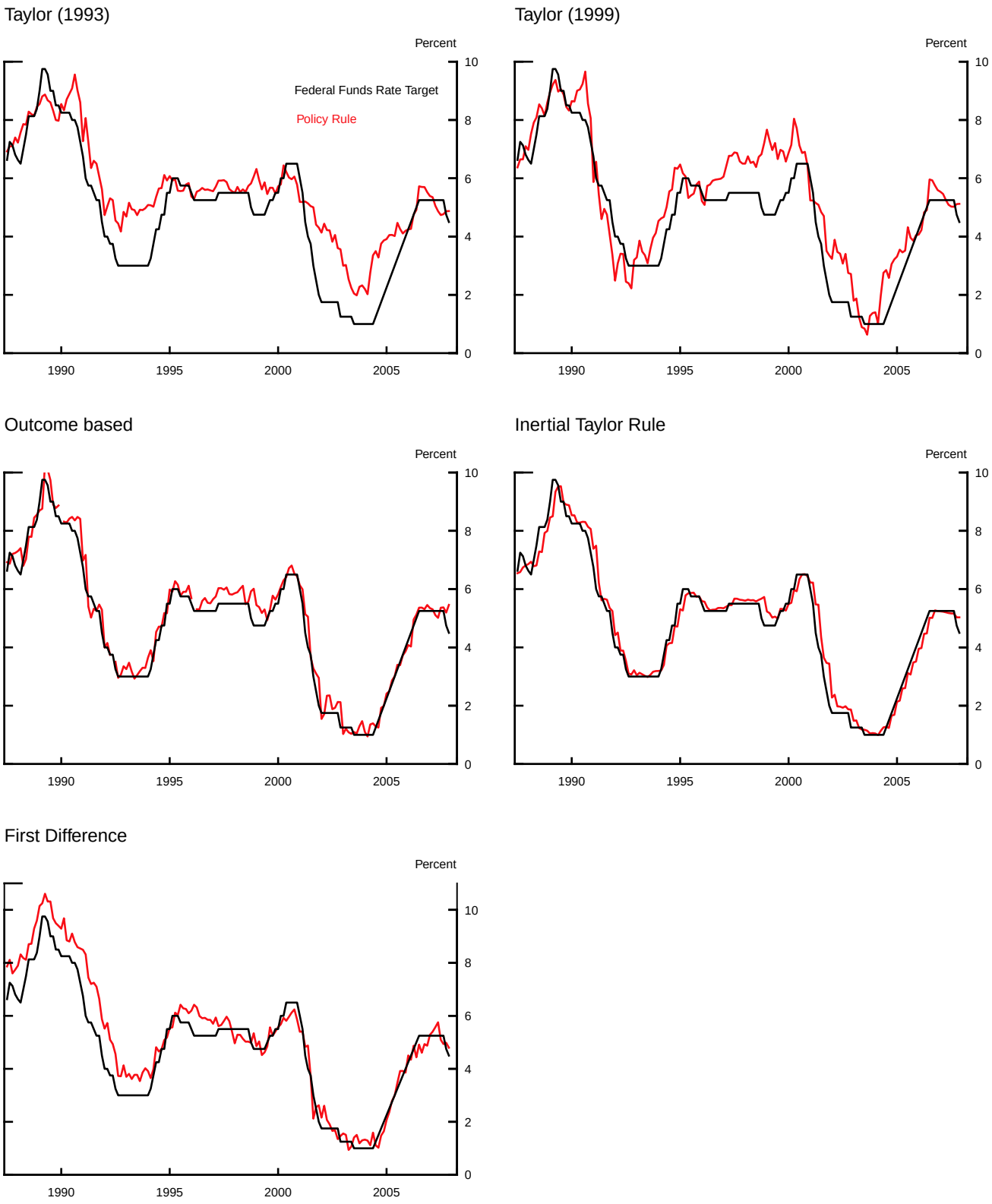
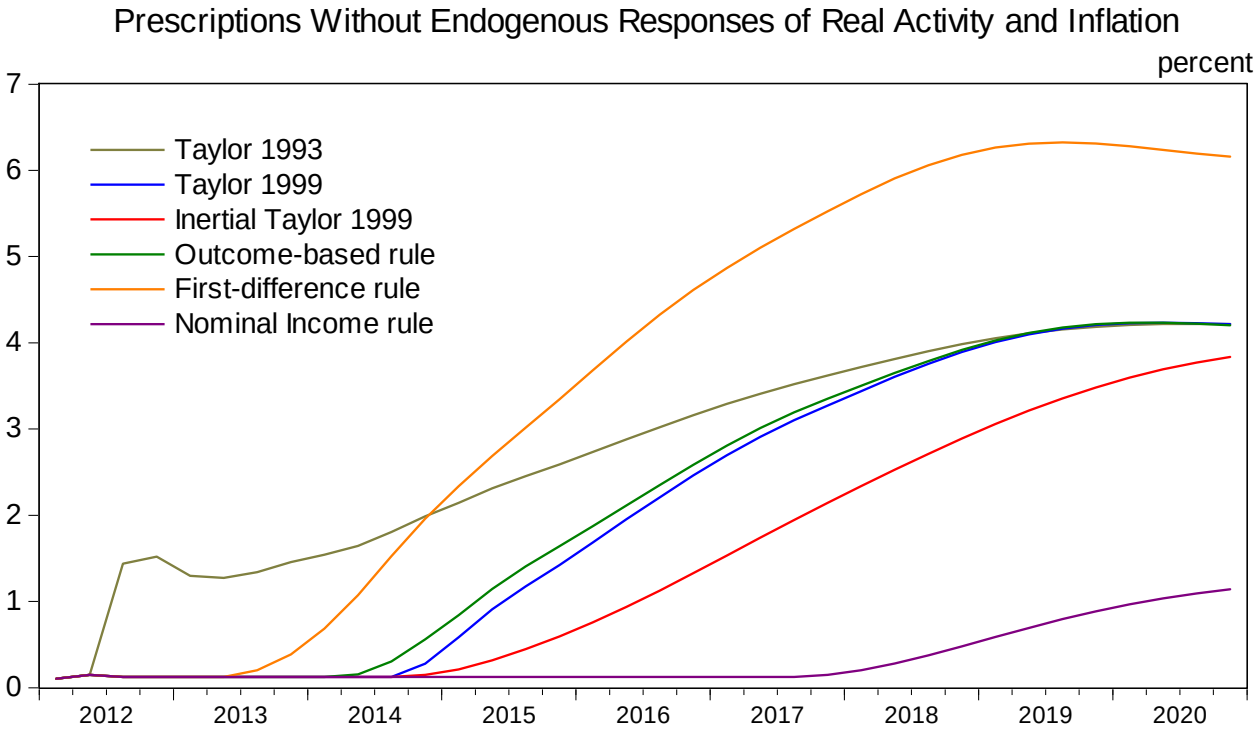


Figure 2
Policy Rule Prescriptions Conditional on the June Tealbook Projections



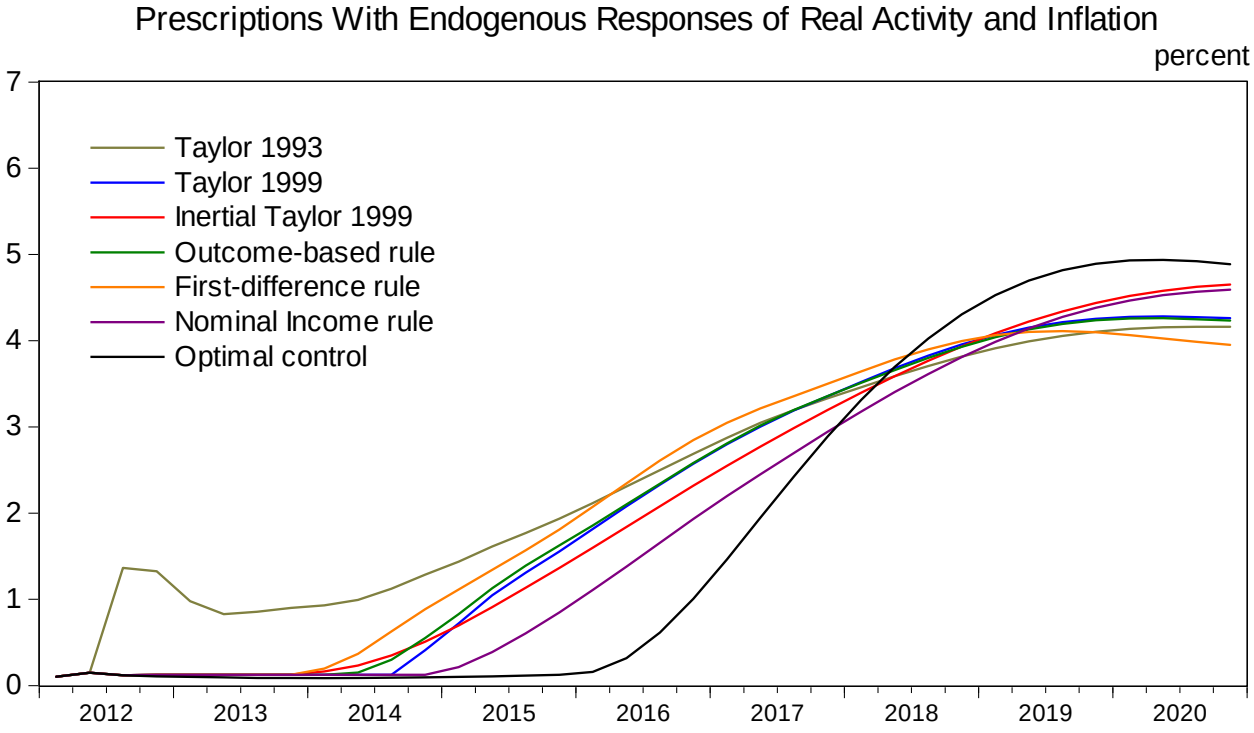
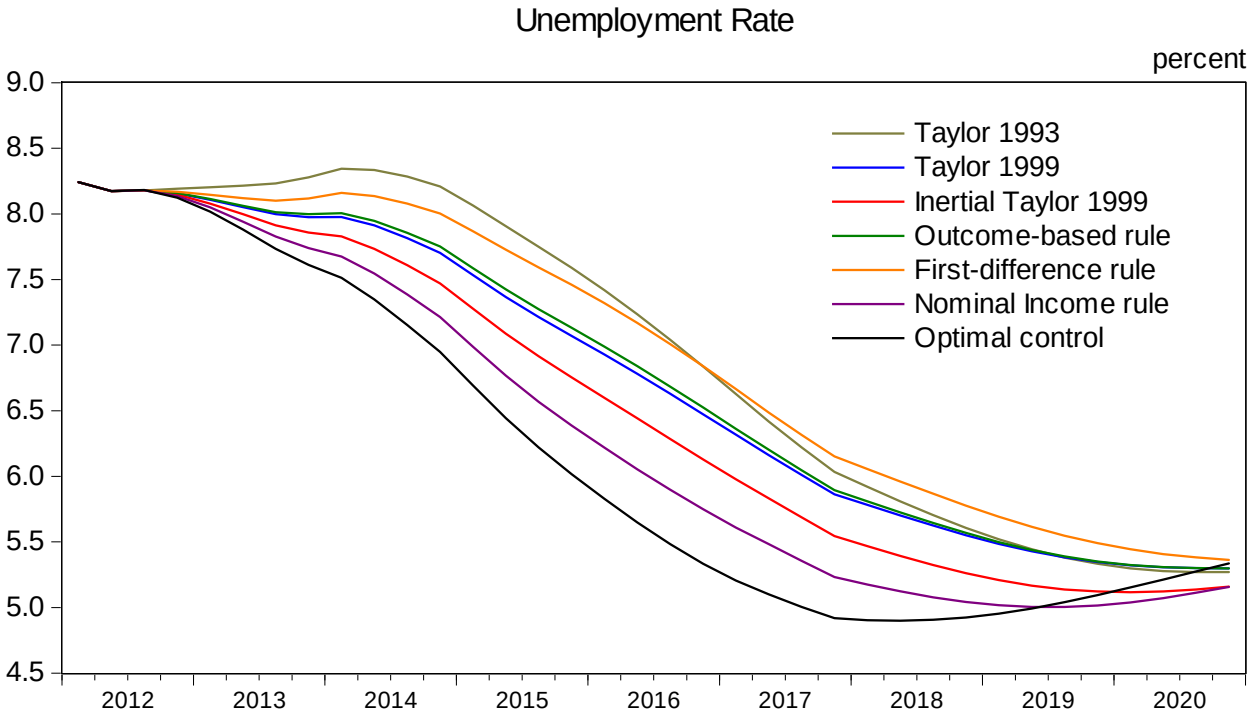


Figure 3
June Tealbook Outlook Under Alternative Monetary Policy Assumptions



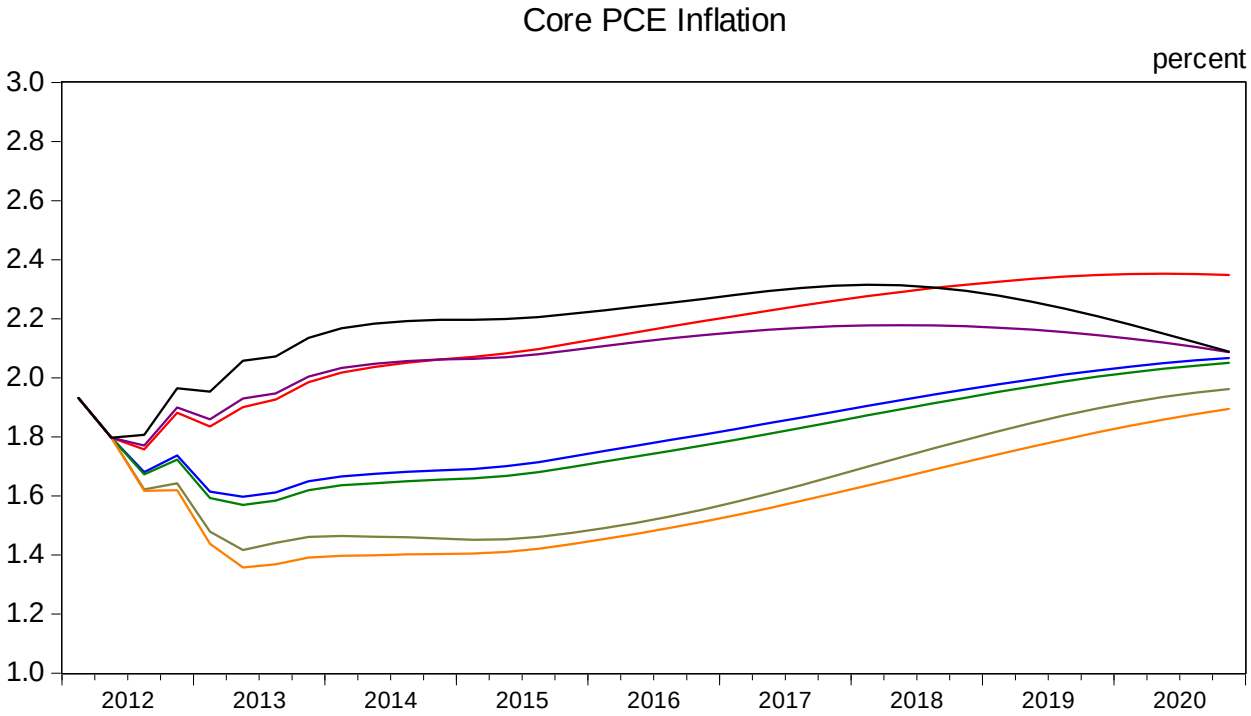


Figure 4. Outcome-Based Rule Prescriptions Under Different Assumptions for Future Inflation, Economic Slack, and the Equilbrium Real Funds Rate (R*)

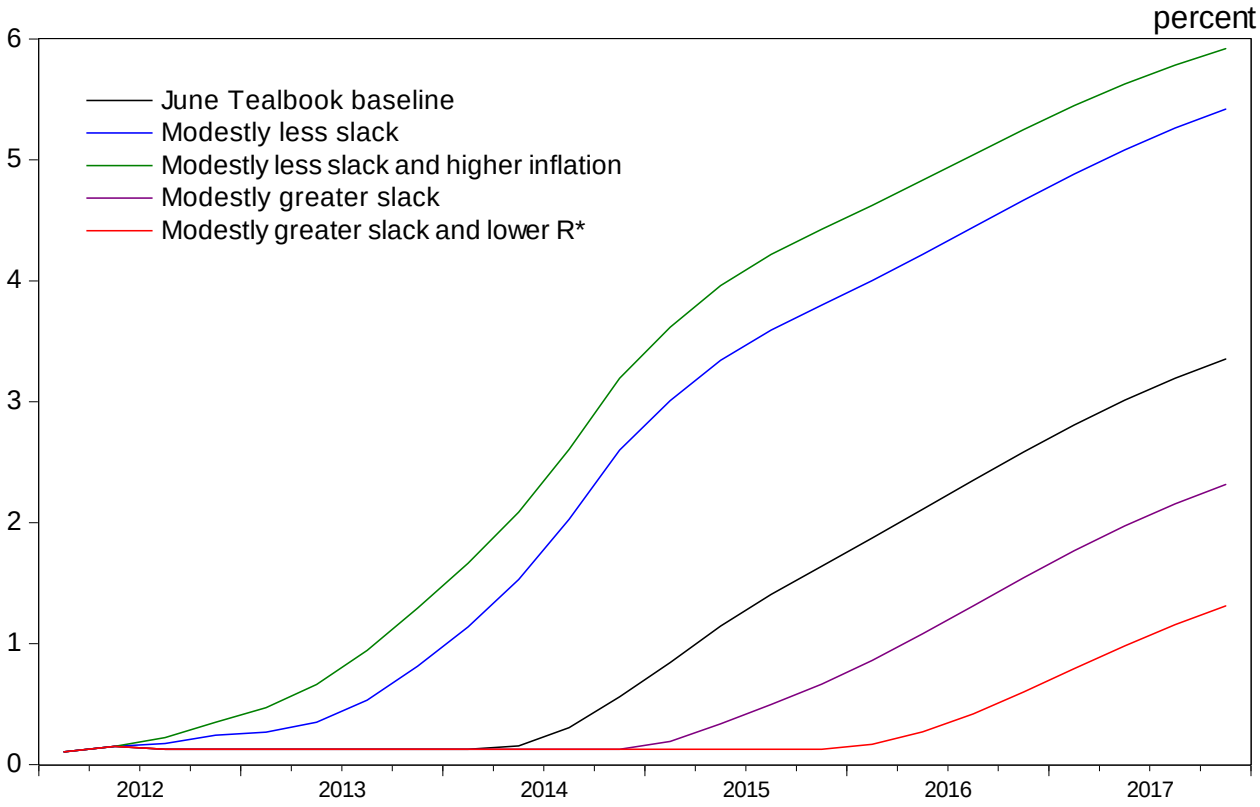


Table 1. Prescribed Liftoff Dates for the Federal Funds Rate
Under Alternative Policy Rules and Conditioning Assumptions

Economic scenario	Taylor 1993	Taylor 1999	Inertial Taylor 1999	Outcome-Based	First-Difference	Nominal Income Targeting
June Tealbook baseline	2012Q3	2014Q4	2015Q2	2014Q3	2013Q4	2018Q2
Modestly less slack	2012Q3	2013Q4	2014Q1	2013Q2	2012Q3	2015Q2
And higher inflation		2013Q2	2013Q4	2012Q4	2012Q3	2014Q4
Modestly greater slack	2012Q3	2015Q4	2016Q2	2015Q2	2014Q2	>2020Q4
And lower R*	2012Q3	2016Q4	2017Q2	2016Q2	2014Q2	>2030Q4

Note. Estimates assume no feedback to real activity and inflation from changes in monetary policy across rules. In the "modestly less slack" scenario, the output gap is about 1¼ percentage points narrower in 2013 than in the Tealbook baseline and 2¼ percentage points narrower in 2014. The "modestly less slack and higher inflation" scenario builds on the previous ones by also assuming that core inflation stays close to 2 percent in 2013 and 2014, as compared to 1.7 percent in the Tealbook baseline. In the "modestly greater slack" scenario, the output gap is about ½ percentage point wider in 2013 than in the Tealbook forecast and 1 percentage point wider in 2014. The "modestly greater slack and lower R*" scenario builds on the previous one by also assuming that the economy's long-run equilibrium real interest rate is 1¼ percent as compared to 2¼ percent in the baseline; the intercepts of the various policy rules are adjusted accordingly.

Figure 5
Probability of Liftoff on a Specified Date Under Different Rules