Changes to the Interest-Rate Reaction Function Used in the Tealbook

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I. Introduction

The upper-left panel of Figure 1 shows a sizeable gap between the median path of the federal funds rate (FFR) in the March SEP (the blue dots) and the prescriptions of the inertial Taylor (1999) rule used by the staff to construct its baseline forecast, based on the output and inflation gaps projected in the March Tealbook (the solid black line). Motivated by this gap, this memo describes changes to the interest-rate reaction function used in the staff's projection that take effect starting in the June round.

The staff's inertial Taylor rule has previously assumed a constant intercept, but will now allow for a time varying intercept. Specifically, the inertial Taylor rule used in past Tealbooks assumed a constant intercept term, r^*, equal to the long-run equilibrium real FFR:

$$R_t = 0.85R_{t-1} + 0.15\{r^* + \pi_t + 0.5(\pi_t - \pi^{LR}) + gap_t\}.^2$$

The new rule introduces two changes. First, it replaces r^* with a time-varying value, r_t^*, that is assumed to be zero in the current quarter (2016:Q2), and to rise gradually to its long-run value of r^* in the fourth quarter of 2018. The second change is that staff now assumes that the long-run r^* is 1 percent, rather than the 1¼ percent value assumed in recent Tealbooks. This implies a long-run nominal FFR of 3 percent.

This memo provides some justification for the assumed path of r_t^*. Our adjustment is supported by the view that risk management considerations associated with the proximity to the effective lower bound (ELB) may be motivating Committee participants to prefer a more accommodative stance of policy than what is implied by inertial Taylor (1999) rule.[3] The time-varying intercept in the rule is also qualitatively consistent with FOMC communications suggesting that downside risks are likely to diminish as the labor market improves further and the inflation rate moves persistently toward 2 percent.

The remainder of this memo is organized as follows. Section II begins by showing that the median of FOMC participants' SEP submissions can be interpreted as indicating that they have in mind a more accommodative trajectory for monetary policy than is implied by the constant-intercept version of the inertial Taylor rule, and then discusses plausible reasons for wanting to deviate from that rule. Section III discusses our two changes to the baseline Taylor rule and their rationale in more detail. Finally, Section IV discusses implementation issues, including how to adjust the path of the intercept in response to economic developments.

[1] We thank Eric Engen, Eric Engstrom, Thomas Laubach, Steve Meyer, and David Wilcox for helpful comments and suggestions.

[2] The staff's inertial Taylor (1999) rule responds to core inflation. This choice was made in light of the tendency for current and near-term core inflation rates to outperform headline inflation rates as predictors of the medium-term behavior of headline inflation.

[3] See, for instance, the paper by Evans, Gourio, Fisher, and Krane (2015) titled "Risk Management for Monetary Policy near the Zero Lower Bound" and the paper by Gust, Johannsen and Lopez-Salido (2015) titled "Monetary Policy, Incomplete Information, and the Zero Lower Bound."

II. Reasons for the current disparity between Taylor-rule prescriptions and the SEP

FOMC participants may see as appropriate a different path for the FFR than the path assumed by the staff because they have a different outlook for economic activity, the labor market, and inflation, or because they believe a policy reaction function other than the inertial Taylor rule (1999) is appropriate. Figure 1 shows that there was some disparity between the March Tealbook baseline projections for the paths of inflation and the unemployment rate and the corresponding median SEP projections submitted for the March FOMC meeting (with the median SEP projection shown by the blue dots, and the staff forecast shown by the solid black lines).[4] In particular, the median SEP projections had inflation converging back to the Committee's longer-run objective of 2 percent somewhat more quickly than the staff forecast, even while projecting a smaller undershooting of the unemployment rate below its long-run natural rate (hence the smaller unemployment gap shown in the lower-right panel).

However, even taking account of differences in outlooks, FOMC participants generally appeared to envision a lower path of the policy rate than implied by the staff's inertial Taylor rule. To illustrate this point, the red squares in the upper-left panel of Figure 1 display the FFR projections that FOMC participants would derive if they mechanically applied the staff's inertial Taylor rule with a constant intercept term to their SEP projections for the inflation and unemployment gaps. These constructed FFR projections are appreciably above the actual SEP (median) projections, and lie close to the FFR path projected by staff.[5] Thus, one interpretation of these data is that the median FOMC participant favors a somewhat more accommodative reaction function than implied by the staff's benchmark rule.

FOMC participants may regard simple Taylor-style rules (such as those considered in the Monetary Policy Strategies section of Tealbook B) as useful guideposts in normal times, that is, when inflation expectations are firmly anchored near the central bank's objective, the balance of risks is close to symmetric, and monetary policy is unconstrained by the ELB. However, there are reasons to depart substantially from the prescriptions of a Taylor-type rule in favor of a more accommodative policy when coming out of a prolonged ELB episode. As highlighted in previous staff analysis, there is a material risk that even small negative shocks could push the policy rate back to the ELB, and hence have considerably larger adverse effects on output than in more normal times. Because this ELB-risk skews the probability distribution of output to the downside, it may be desirable to take out insurance against this risk by holding the funds rate path somewhat lower than would appropriate in the absence of this uncertainty.[6] This rationale is stronger to the extent that long-run inflation expectations drifted below the central bank's inflation target, because lower inflation expectations increase the output losses that occur in response to adverse shocks.

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[4] The median long-run value of the unemployment rate in the SEP (4.8 percent) is a bit lower than the staff's estimate of the natural rate (5.0 percent). The median SEP and staff unemployment gap estimates shown in the lower-right panel of Figure 1 use their respective estimates of those long-run values.

[5] We conduct a purely static calculation of the interest rate rule applied to given values for inflation and the output gap. Hence, we do not assume any dynamic feedback from the alternative interest rate path onto those variables. Also, the baseline policy rule responds to the staff's estimate of the output gap, a variable that is not included in the SEP. To construct a SEP-consistent measure of the output gap, we first assume that the SEP projections for the longer-run unemployment rate coincide with participants' estimates of the natural rate of unemployment. We then convert the resulting unemployment rate gaps into output gaps by applying the staff's estimate of Okun's law.

[6] In this vein, Basu and Bundick (2015) show how the ELB induces downward skewness in the probability distribution of consumption which depresses the equilibrium real interest rate. A recent FEDS paper by Hills, Nakata, and Schmidt (2016) also considers the ELB in a stochastic environment, and shows that the ELB induces a "deflationary bias," pushing inflation below target on average. One way to counter such a shortfall is via an intercept adjustment in the Taylor rule.

A time-varying intercept captures the idea that these risk-management considerations are likely to dissipate as the recovery strengthens and inflation moves durably to 2 percent. In any event, the evidence shown in the upper-left panel of the first exhibit suggests that the policy reaction function implicit in SEP participants submissions converges to the inertial Taylor rule (1999) by the end of the medium-term projection period.

III. Two modifications to the baseline rule, including a time-varying intercept

Based on these considerations, the staff will incorporate two modifications to the intercept of the inertial Taylor rule starting in the June Tealbook. First, the intercept will be time-varying and rise gradually to its long-run r^* value. Second, this long-run r^* will be assumed to be equal to 1 percent rather than the 1¼ percent embedded in recent Tealbooks (that is, from September 2015 to April 2016).

The modification to long-run r^* simply reflects a further reassessment of the effects of key factors that the staff sees as impinging on r^*. In general, these factors may include slower trend U.S. output growth (compared with the pre-crisis period) as well as domestic and foreign developments that influence global saving rates and risk tolerance. The staff has made several adjustments to long-run r^* over the past two years, most recently in September 2015 when the staff reduced its estimate from 1½ to 1¼ percent. While there is clearly much uncertainty associated with this estimate, the evidence that long-run r^* is likely to settle at a level well below historic norms seems, if anything, more compelling than when staff first implemented these adjustments a couple of years ago. In particular, U.S. forward interest rates at long maturities are very low in inflation-adjusted terms, suggesting that markets believe that short-term real interest rates are likely to remain low for a prolonged period. Moreover, the fall in U.S. long-run r^* seems partly driven by global developments that appear likely to have boosted the demand for safe assets, including U.S. Treasury securities, while also exacerbating savings-investment imbalances (including e.g., through population aging).

The adoption of a time-varying intercept is consistent with the view that the inertial Taylor (1999) rule offers a plausible description of monetary policy in normal times while recognizing that there are special—but ultimately transient—factors at play that warrant altering the rule for a time. The key challenge is to decide on a reasonable quantitative path for r_t^*, including its near-term values. In terms of economic narrative, the way that the staff Tealbook forecast has reacted to the change in policy rule is consistent with the interpretation that the lower near-term values of the nominal funds rate generated by the new rule simply represents a more accommodative stance of policy. A related interpretation—difficult to distinguish empirically from the first—is that the new path of the funds rate reflects an equilibrium real rate of interest that is currently in the vicinity of 0 percent and will move only gradually to its longer-run level. This interpretation draws on empirical estimates of the equilibrium real rate from a variety of econometric models, including those of Laubach and Williams (2015), as well as from the Federal Reserve System's suite of DSGE models. For example, estimates of the equilibrium real interest rate summarized in a March 2016 Tealbook box—derived from the EDO, NY-Fed, and Philadelphia Fed's DSGE models—clustered in the neighborhood of zero in 2016:Q1 and rose to (a median of) about 1 percent by the end of 2018. A long-run value of the real FFR of 1 percent is also consistent with the estimates of Johannsen and Mertens (2016).

An attractive feature of this intercept-adjusted version of the Taylor rule is that it implies the same dynamic responses as the usual constant-intercept Taylor rule (1999) to changes in the outlook or to alternative scenarios. Thus, the intercept-adjusted rule continues to raise nominal rates more than one for

one with inflation (that is, it satisfies the "Taylor principle"), while also remaining consistent with the spirit of the dual mandate insofar as it prescribes that the FFR responds to both inflation and resource utilization. Staff analysis has shown that the inertial Taylor rule generally has good stabilizing properties in the face of moderate (that is, not extreme) shocks to resource utilization and inflation.[7]

Figure 2 shows how the intercept adjustment will be implemented in the June Tealbook. As seen in the left panel, the intercept is assumed to be 0 percent in the current quarter and then to rise linearly (and thus gradually) to 1 percent over the staff's forecast horizon ending in 2018:Q4. The remaining panels of the figure show the results of a dynamic simulation of this intercept-adjusted inertial Taylor (1999) rule in the FRB/US model. As the upper-right panel shows, the intercept-adjusted rule would have prescribed a path for the FFR that is about 50 basis points lower than in the March Tealbook baseline by the end of this year, which would have been nearly in line with the March SEP. It is worth emphasizing that a low value of the intercept in the near-term is crucial for shifting down the FFR path by a substantial amount relative to the Tealbook baseline; for instance, assuming that only long-run r^* shifted down by 25 basis points relative to the March Tealbook (that is, to 100 basis points from 125 basis points) would have implied only a small downward shift in the in the near-term path of the FFR relative to the March Tealbook baseline.

IV. Implementation issues associated with adjusting the intercept

As noted above, the staff's baseline procedure in the June Tealbook will be to assume the intercept is zero in the current quarter, and then begins rising gradually towards 1 percent thereafter (reaching 1 percent in 2018:Q4). If the economy evolves roughly in line with our expectations, we intend to retain this path in subsequent Tealbooks (that is, the initial level of the intercept would be about 5 basis points in the July Tealbook, about 25 basis points in the December Tealbook, etc.). If economic developments and risks to the outlook evolve in a materially different way than we currently envision, then we will adjust the Taylor-rule intercept path up or down in an appropriate way.

Our memo concludes by outlining how these adjustments to the policy reaction function will affect the staff's outlook for output and inflation. Similar to the approach the staff took when last revising long-run r^* in September 2015, the change in long-run r^* will not affect the economic outcomes in the Tealbook: We simply view this adjustment as a further small recalibration of the amount of monetary accommodation required to attain the FOMC's dual mandate in the longer term.[8]

By contrast, the temporary adjustment to the intercept of the policy rule will translate into a modestly stronger economy and slightly higher inflation. This pass-through to economic conditions seems reasonable given that we are interpreting this adjustment as reflecting a shift toward a more

[7] For a discussion of the dynamic properties of the inertial Taylor (1999) rule and other simple rules, see the memo "An Overview of Simple Policy Rules and Their Use in Policymaking in Normal Times and Under Current Conditions" sent to the Committee on July 18, 2012, by Christopher Erceg, Jon Faust, Michael Kiley, Jean-Philippe Laforte, David López-Salido, Stephen Meyer, Edward Nelson, David Reifschneider, and Robert Tetlow.

[8] The staff is following a similar approach in adjusting term premiums on longer-term Treasury yields in the June Tealbook. In particular, although the staff is revising down its assessment about the long-run level of the term premiums, this revision is neither predicated on a change in the staff's assessment about U.S. long-run potential output growth, nor does it affect the staff's outlook for U.S. GDP. Instead, the change in term premiums reflects a re-think of what levels of term premiums are consistent with a given medium and longer run projection.

accommodative reaction function that takes account of factors—notably ELB-related risks—that FOMC participants regard as important determinants of appropriate policy.

Figure 2 shows how our changes to the policy reaction function—in particular, the temporarily lower intercept—affect output, unemployment, and inflation in the staff's FRB/US model. The difference in economic outcomes—depending on whether the short-term trajectory of rates is allowed to feed through into inflation and aggregate demand—is very small: The unemployment rate trajectory is somewhat lower than otherwise, while the path for PCE inflation is a tad higher.[9] Of course, the FRB/US model is only one of the models that the staff draws upon to assess the likely effects of a change in the policy stance. Hence, the economic effects should be regarded as simply illustrative of how the staff outlook will be adjusted.

[9] In a similar exercise, the staff used a preliminary version of the June Tealbook baseline—which builds in the new reaction function with a time-varying intercept—to compare economic outcomes to what would occur under a less accommodative rule in which the intercept were held constant at 1 percent. Under the less accommodative rule, the level of output would be about 0.1 percent lower and inflation 2 basis points lower by 2017.

References

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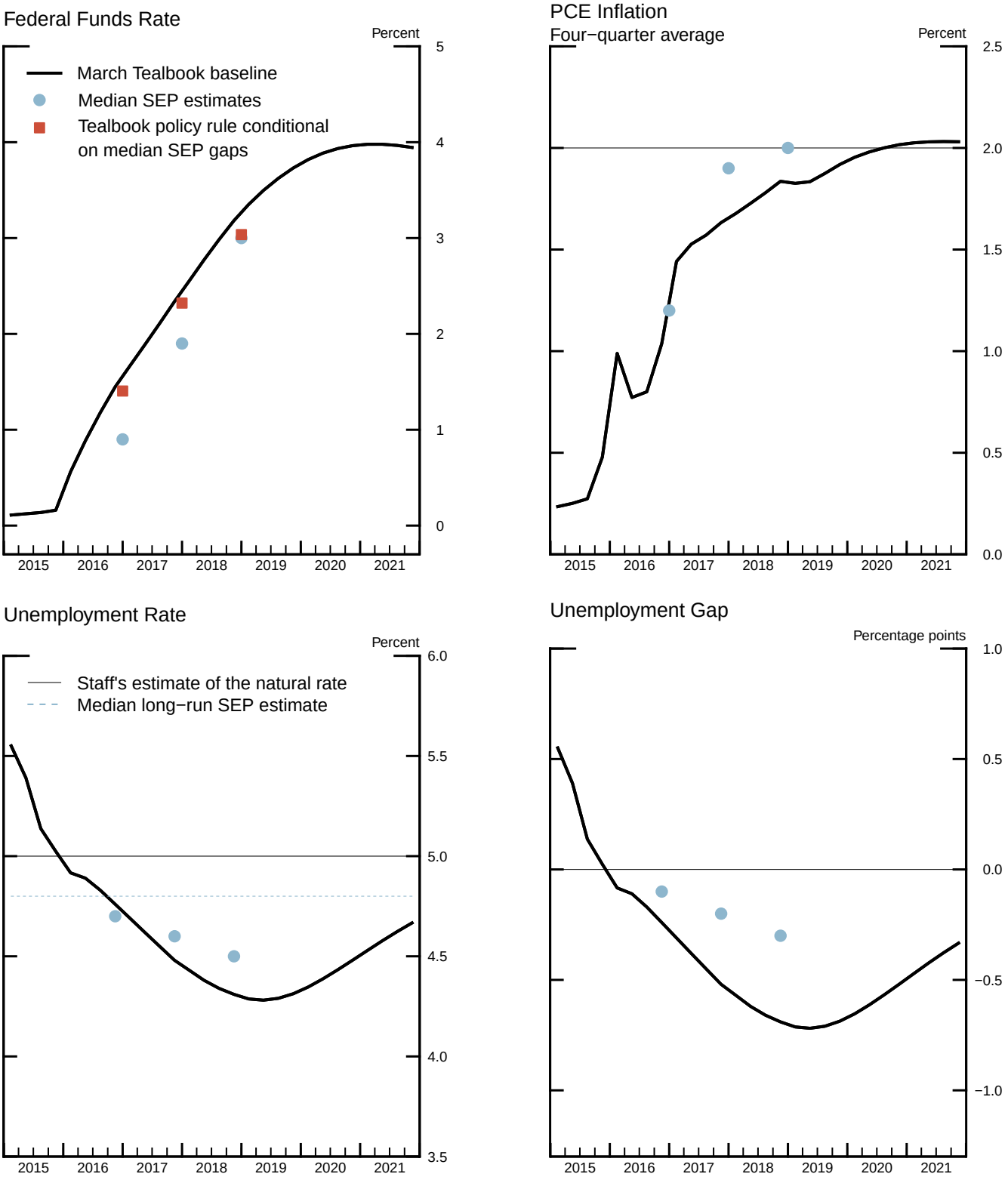
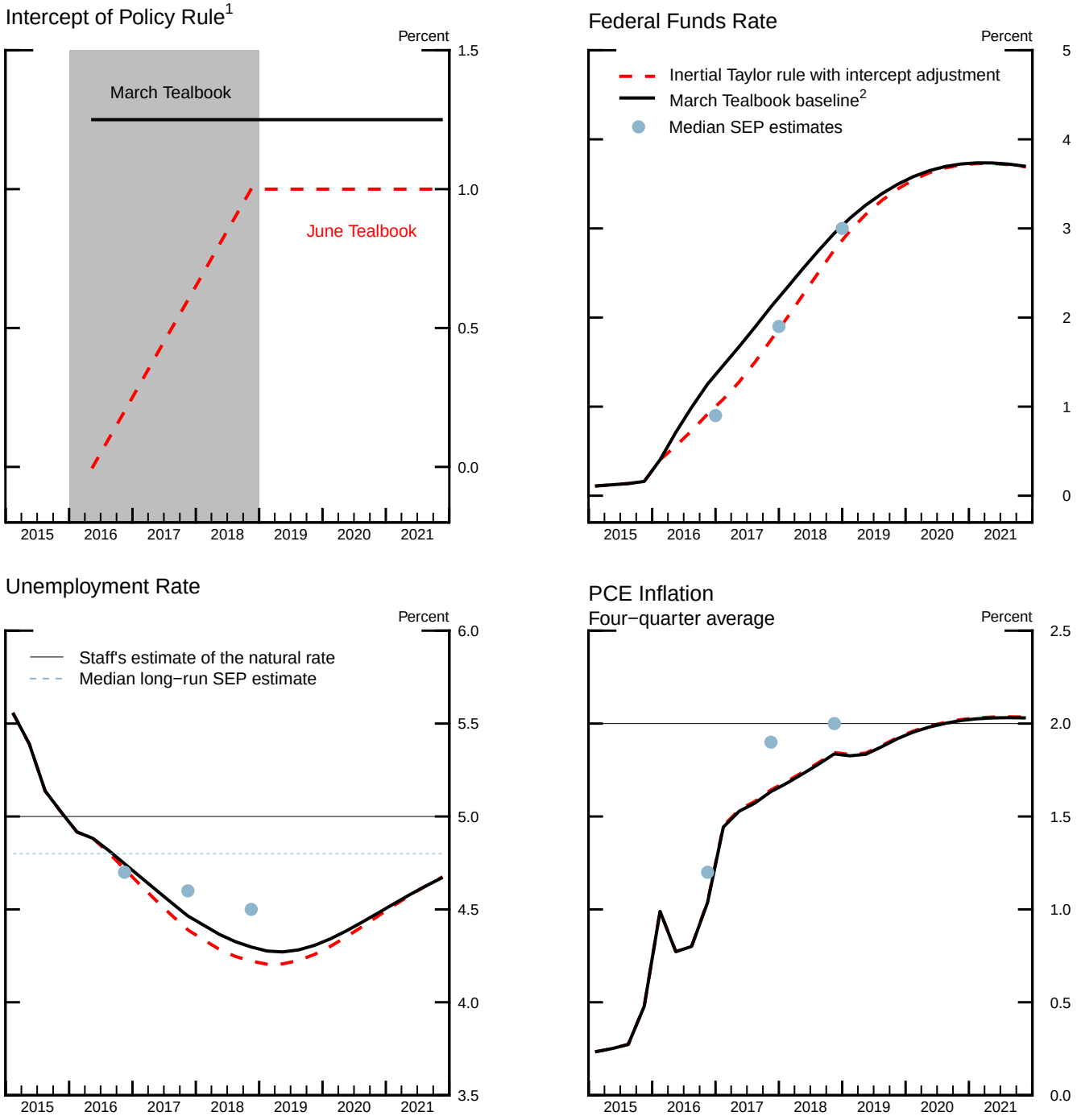
Figure 1: Comparison of March Tealbook and Median SEP Projections



The red squares in the upper−left panel show the prescriptions of the inertial Taylor (1999) rule conditional on the median estimates of the core inflation gap and the unemployment gap implied by the March SEP. The unemployment gaps of the Tealbook baseline and median SEP projections are measured with respect to the staff's estimate of the natural rate and the median long−run estimate of SEP respondents, respectively.

Figure 2: Judgmental Intercept Adjustment



1. The shaded area shows the period covered by the SEP. In our simulation with a judgemental intercept adjustment, we lower the intercept of the policy rule to zero in 2016:Q2, the first period in the FRB/US simulation. We then assume that the intercept rises in equal steps to its long−run value of 1 percent by 2018:Q4.

2. For the purposes of our simulation, we adjust the March Tealbook baseline projection in two ways. First, we recalculate the 2016:Q1 estimate of the federal funds rate to take into account the realized value up to the close of the March Tealbook, consistent with a procedure in use since the April Tealbook. Second, we adjust the intercept of the policy rule to be consistent with a long−run real federal funds rate of 1 percent.