Some Possible Adjustments to the Committee's Forward Guidance for the Federal Funds Rate

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I. Introduction

As the Chairman noted at the June press conference and in his Congressional testimony, the Committee is likely to begin to slow the monthly pace of its asset purchases later this year, and to end purchases altogether around the middle of 2014, if real activity and inflation evolve broadly in line with the outcomes that the Committee saw as most likely. The Chairman also indicated that the actual path of asset purchases will depend on the speed of the economy's progress toward the Committee's employment and inflation objectives. That said, some participants may be reluctant to expand the size of the Federal Reserve balance sheet much further even if employment growth were to slow markedly or if inflation were to remain low. Consequently, the Committee may be interested in evaluating other potential means of providing additional monetary policy accommodation.

This memo considers several possibilities for providing additional monetary stimulus by adjusting the Committee's current forward guidance for the federal funds rate. First, we analyze the effects of lowering the unemployment rate threshold to a value below 6½ percent. Second, with inflation having been very low recently, and with some members expressing concerns about the risk that inflation might continue to substantially undershoot the Committee's 2 percent objective, we examine the implications of adding what we call an inflation floor to the current set of thresholds. (An inflation floor would state that if projected inflation were below some specified value, then the target for the federal funds rate would remain at its effective lower bound even if the unemployment rate had moved below its threshold value.) Third, we discuss the possibility of extending the forward guidance, without changing or adding to the current thresholds, by providing more information about the likely pace of tightening after the federal funds rate is first raised from its effective lower bound.

In the following pages, we evaluate the potential macroeconomic effects of these adjustments to the current forward guidance for the future path of the federal funds rate. The analysis begins by exploring the predicted effects of these adjustments based on simulations of the staff's FRB/US model. Specifically, we first present illustrative simulations of various possible changes to the Committee's announced strategy for setting the funds rate in the future under a deterministic economic outlook—either the baseline forecast in the June Tealbook or a variant of that baseline that features a lower path for inflation. We then broaden our simulation analysis by evaluating the macroeconomic performance of alternative rules in response to a wide range of shocks to the baseline economic outlook. The final section of the memo discusses some communications challenges that would likely arise if the Committee altered its forward guidance for the federal funds rate, and offers some illustrative statement language that the Committee may wish to consider in light of these challenges.

Subject to the usual caveats that necessarily apply to any model-based analysis, the three main lessons from the simulations are:

- If the Committee decided to lower the threshold for the unemployment rate from 6½ percent to 6 percent or 5½ percent, it could effectively push out the liftoff date for the federal funds rate and generate a somewhat stronger economic recovery with somewhat higher inflation over the next few years.

- The introduction of an inflation floor would signal that, in the event of persistently low inflation, the federal funds rate would be kept at its effective lower bound considerably longer than the thresholds would suggest, assuming that market participants currently expect monetary policy to revert to the prescriptions of the inertial Taylor rule after liftoff. The resulting expectation that monetary policy will remain highly accommodative when inflation is projected to be low would cause the recovery to strengthen and would move inflation back toward the Committee's longer-run objective more quickly.

- To the extent that the Committee could effectively and credibly convey that the pace of increases in the federal funds rate after liftoff would be more gradual than currently anticipated by market participants, the Committee could obtain some further improvement in economic performance in the form of a more-rapid movement of unemployment toward its longer-run natural rate and of inflation toward the Committee's 2 percent longer-run objective.

II. Deterministic Simulation Results

In this section, we explore the potential macroeconomic effects of changing the Committee's current strategy for forward guidance about the federal funds rate target using simulations of the FRB/US model with the June Tealbook projection as our baseline. Specifically, we analyze the effects of:

1) lowering the current unemployment rate threshold from 6½ percent to either 6 percent or 5½ percent;
2) augmenting the current set of thresholds by including an inflation floor, whereby the target for the federal funds rate would remain at its effective lower bound even if the unemployment rate is below its threshold value, as long as inflation between one and two years ahead is projected to remain below some critical value (either 1¾ percent or 1½ percent in our analysis); and
3) providing more information about the likely pace of increases in the federal funds rate after liftoff, by publicly clarifying that the target for the federal funds rate will rise at an unusually gradual pace after liftoff until the unemployment rate has declined below 5½ percent, so long as projected inflation does not move appreciably above 2 percent.

Several assumptions and caveats to the analysis are worth highlighting. First, economic agents are assumed to be forward looking, and financial market participants are assumed to have rational expectations. Specifically, expectations of financial market participants are model-consistent, but in contrast, expectations of wage and price setters are derived from a small-scale

VAR model, not the full FRB/US model.[1] Second, the public is assumed to completely understand any announced change in monetary policy and to view it as fully credible. Finally, our results are obviously somewhat dependent on the structure of the FRB/US model and the use of the June Tealbook projection as a baseline. A key feature of this projection is that, consistent with the current thresholds, the FOMC keeps the funds rate near zero until after the unemployment rate threshold is crossed in early 2015. Thereafter, the funds rate is assumed to follow the prescriptions of the inertial version of the Taylor (1999) rule used in the Tealbook baseline.[2]

Lower unemployment rate threshold

We first consider the effects of lowering the unemployment rate threshold to either 6 percent or 5½ percent, while maintaining the threshold for projected inflation at 2½ percent. For comparison, the black lines in Figure 1 show the baseline projections for real GDP growth, unemployment, inflation, and the federal funds rate with the current threshold values. As illustrated by the blue and red lines in Figure 1, if the Committee chose a lower threshold for the unemployment rate, it would effectively signal a more accommodative stance than under the current 6½ percent threshold for the unemployment rate; the lower threshold results in a later liftoff date for the federal funds rate and hence a stronger pace of economic recovery and lower unemployment. Given the baseline outlook, the inflation threshold is not a binding constraint even with a lower unemployment threshold, although inflation does, for a few years, climb temporarily to a little above both the baseline forecast and the Committee's long-run inflation objective of 2 percent. The green lines show the effects of another variation in the Committee's forward guidance that would entail lowering the unemployment rate threshold to 5½ percent while also decreasing the inflation threshold to 2¼ percent when the unemployment rate is below 6½ percent (the current threshold) but still above 5½ percent (the new threshold). Under the baseline economic conditions, the results are little changed from simply lowering the unemployment threshold as the lower inflation threshold is not binding.

Adding an inflation floor to the current threshold settings

We next consider the implications of augmenting the current set of thresholds with an inflation floor. In particular, the Committee could indicate that if inflation was projected to be below this floor one to two years ahead, the target for the federal funds rate would remain at its effective lower bound even if the unemployment rate fell below its threshold value.

Under the baseline outlook, adding an inflation floor of 1½ percent or 1¾ percent would have no effect on the projected outcomes for real activity or inflation because the baseline outlook

[1] An alternative approach would have been to also assume model-consistent expectations in wage and price setting, which would have caused simulated inflation effects in response to an announced change in monetary policy to be more frontloaded but would have had essentially no effect on the response of real activity. Which assumption about expectations better characterizes actual inflation dynamics is an open question, but the advantage of the approach taken here is that it allows us to avoid computational convergence issues in the stochastic simulations.

[2] The inertial Taylor (1999) rule is defined as: $i(t) = 0.85\, i(t-1) + 0.15[r^* + 1.5\, \pi(t) - 0.5\, \pi^* - gap(t)]$, where the nominal federal funds rate target is i, the equilibrium real short-term interest rate is r^*, the inflation rate is π, the inflation target is π^*, and gap is the output gap (the percent difference between actual real GDP and its potential level).

anticipates that inflation will rise toward the Committee's longer-run inflation objective; in particular, by early 2015 (when the unemployment threshold is crossed in the baseline scenario), baseline projected inflation from early 2016 to early 2017 will have already surpassed either candidate floor value. But if the outlook were to change and the Committee and the public came to expect inflation to remain low or to fall further, then the inflation floor could matter—a possibility illustrated by the blue lines in Figure 2. In this low-inflation scenario, the recent low readings on prices are assumed to be a harbinger of persistent disinflationary forces that push inflation below 1 percent next year and cause it to remain quite low for several years. Policymakers and financial market participants respond to this development by gradually revising down their medium-term projections for inflation. In the absence of an inflation floor (the blue lines), the somewhat higher level of unemployment in the scenario relative to baseline (the black lines) delays liftoff of the federal funds rate only until late 2015. In contrast, (as shown by the green lines) the federal funds rate remains at the effective lower bound until 2017 when policymakers set an inflation floor equal to 1¾ percent. Given the forward-looking nature of financial markets, this more aggressive policy causes long-term interest rates to move even lower in response to the disinflationary surprise, with the result that real activity is somewhat stronger than it otherwise would be and inflation moves back towards 2 percent somewhat more quickly.

A more gradual liftoff in the federal funds rate after crossing a current threshold

Expectations about the longer-run path of the federal funds rate play an important role in economic decisions carried out today, and thus the effective stimulus imparted by any given settings for the thresholds depends importantly upon market participants' perceptions of the likely behavior of the federal funds rate after a threshold condition is satisfied.[3] To this point, we have assumed that, after a threshold has been crossed, the FOMC follows the prescriptions of the version of the inertial Taylor (1999) rule used in the staff's baseline Tealbook forecast, and that market participants share this assumption. In contrast, we next assume that the Committee credibly announces its intention after liftoff to pursue a more gradual pace of tightening than that envisioned under the baseline scenario. Under this more-gradual policy, the federal funds rate does not rise above 1 percent until the unemployment rate falls below 5½ percent, under the assumptions in the baseline forecast. Thereafter, we assume that the federal funds rate follows the prescriptions of the baseline rule.[4] Importantly for this analysis, the public is assumed to anticipate the baseline funds rate policy prior to the announcement, and then to revise its expectations for interest rates and other factors to be consistent with the more gradual strategy.

Figure 3 illustrates the potential implications of this modification to policy, again with the unemployment rate threshold at 6½ percent and the projected inflation threshold at 2½ percent (shown by the black lines). The blue lines show outcomes when the public fully accepts that the FOMC will raise the federal funds rate more gradually than assumed in the baseline after a threshold is crossed. As the figure shows, the federal funds rate lifts off from its effective lower

[3] This point was highlighted in the memo from Board staff titled *Background Material for Thresholds Discussion* that was sent to the Committee in preparation for the FOMC meeting in October 2012.

[4] Specifically, the rule used once a threshold is crossed but before the unemployment rate falls below 5½ percent is $i(t) = 0.92\, i(t-1) + 0.08[r^* + 1.5\, \pi(t) - 0.5\, \pi^* - gap(t)]$; this rule has the same long-run coefficients as the baseline inertial rule but employs a larger inertia parameter (.92 compared to .85).

bound at about the same time as in the baseline but then rises more gradually, thus promoting a somewhat faster recovery, accompanied by modestly higher inflation.

For comparison purposes, Figure 3 also presents the results from an immediate and permanent shift to a nominal income targeting rule (the red lines).[5] Under the baseline outlook, a fully credible shift to nominal GDP targeting that is completely understood by the public would reduce the unemployment rate faster than the adjustments to forward guidance discussed so far and lead to a greater (but still transitory) overshooting of inflation.

III. Stochastic Simulation Results

To this point, we have examined how the adjustments to forward guidance described earlier affect real economic activity, inflation, and interest rates mostly under baseline conditions. We now broaden the analysis by evaluating macroeconomic performance under these policy changes in response to a wide range of shocks to the economy. To do this, we run simulations of the FRB/US model in which the model is repeatedly subjected to shocks of the sort experienced since the late 1960s. This stochastic-simulation approach allows us to construct probability distributions for future economic conditions, conditional on the particular characterization of monetary policy used in the simulations and the dynamics of the model.[6] By repeating this exercise using various assumptions about forward guidance, we explore how changes in that guidance influence average macroeconomic performance and the likelihood that the federal funds rate will begin to increase from its effective lower bound by a particular date.[7]

As might be expected, the parameters of forward guidance policy can have a noticeable effect on the timing of the onset of increases in the federal funds rate. Figure 4 shows simulated probability distributions for the date of liftoff under various settings for forward guidance, conditional on monetary policy eventually reverting to the prescriptions of the baseline version of the inertial Taylor (1999) rule.[8] The black lines in the top and bottom panels of the figure report the simulated probability distribution for the date of liftoff when policymakers follow the

[5] The nominal income targeting rule, which responds to the nominal income gap, is defined as: $i(t) = 0.75\, i(t-1) + 0.25[r^* + \pi(t) + yn(t) - yn^*(t)]$, where the nominal federal funds rate target is i, the equilibrium real short-term interest rate is r^*, the inflation rate is π, and the nominal income gap is the difference between nominal income yn (measured as 100 times the log of the level of nominal GDP) and a target value yn^* (measured as 100 times the log of target nominal GDP). Target nominal GDP in the fourth quarter of 2007 is set equal to the staff's estimate of potential real GDP in that quarter multiplied by the GDP deflator in that quarter; subsequently, target nominal GDP grows 2 percentage points per year faster than the staff's estimate of potential real GDP.

[6] The stochastic simulations are run by shocking various components of aggregate spending, productivity and hiring, wages and prices, asset prices, and other factors from 2013:Q2 through 2018:Q4, with the shocks in each quarter randomly drawn from the 1969-2009 set of FRB/US model equation residuals; 4,000 replications of these simulations are used to construct probability distributions for various economic and financial variables, conditional on a given characterization of monetary policy. We maintain our baseline assumptions for expectations formation discussed earlier, in that financial market participants have model-consistent expectations while other agents base their expectations on the predictions of a small-scale VAR model. However, the shocks are assumed to be unanticipated by all agents.

[7] Comparative results for a nominal income targeting rule are not shown in the stochastic simulations because we had computational convergence issues in these simulations with this rule, and time constraints were such that we could not resolve these problems in time for this memo.

[8] The distributions plotted in Figure 4 are smoothed versions of the raw histograms from the stochastic simulation results using a cubic spline.

current settings for the thresholds, while the blue and red lines in the top panel show the effects of lowering the unemployment threshold to 6 percent and 5½ percent, respectively. Not surprisingly, as the unemployment threshold declines, the probability distribution shifts to the right. As shown in the bottom panel, augmenting the baseline settings for forward guidance by adding an inflation floor of 1½ percent (the red line) or 1¾ percent (the green line) also shifts the probability distribution for the date of liftoff out somewhat, indicating a slightly more accommodative monetary policy than assumed in the baseline. The blue line in the lower panel shows the implications of effectively communicating a more gradual policy for liftoff after one of the current baseline settings for the thresholds is crossed. An understanding by market participants that liftoff from the effective lower bound will be gradual under some circumstances can, under rational expectations, affect the date of that liftoff; in this instance however, this modification to announced policy does not materially change the expected time for liftoff of the funds rate.

An important question is whether the adjustments to forward guidance analyzed here would improve macroeconomic performance under a range of economic conditions, not just those characterizing the baseline outlook. Tables 1 and 2 provide additional statistics from the stochastic simulations regarding the expected date of liftoff along with information about economic conditions under the various assumptions about forward guidance. We also assess the macroeconomic effects of these adjustments using a loss function such as the one that underlies the optimal policy paths reported in Book B of the Tealbook. [9]

Some key findings from this analysis are:

- The lower unemployment rate thresholds analyzed here push out the median liftoff date by one to two quarters relative to the baseline, while the inflation floors or a policy promising a somewhat more gradual rise in the funds rate after the onset of tightening only slightly change the median liftoff date. An inflation floor of 1½ percent or 1¾ percent does not change the median liftoff date much because the frequency of the inflation floor being binding is significantly less than 50 percent in each case.

- As shown in the far-right columns of Table 2, mean and median losses tend to decrease as the unemployment threshold declines to 5½ percent. Moreover, in more than half of the individual simulations, lowering the unemployment threshold leads to smaller losses than would have occurred under the baseline threshold settings.

- Mean and median losses with inflation floors are slightly less than those found with the current forward guidance. Also, setting an inflation floor leads to smaller losses in more than 60 percent of the individual simulations and may be effective in reducing the risk of adverse downside events although the magnitude of the reductions in losses is not large.

[9] Policymakers' "losses" are assumed to equal the cumulative sum from the mid-2013 through the end of 2018 of squared deviations of headline PCE inflation from 2 percent, squared deviations of the unemployment rate from its natural rate, and squared quarterly changes in the federal funds rate.

- Given the conditions specified in the baseline scenario, the unemployment threshold is the most likely one to be crossed first and lead to liftoff.[10]

- In situations where the unemployment rate is the first threshold crossed, the mean rate of actual inflation at the time of crossing increases as the setting of the unemployment threshold decreases. In contrast, the introduction of inflation floors or announcing a more gradual post-liftoff policy has little effect on the mean inflation rate at crossing. In all instances, the upper bound of the interquartile range for the inflation rate when the unemployment threshold is crossed is close to the Committee's longer-run inflation objective of 2 percent.

- As shown in the first several columns of Table 2, a lower unemployment threshold, an inflation floor, or a more gradual liftoff policy have modest effects on the expected value of both inflation and unemployment over the medium term.

All told, the adjustments to forward guidance policy analyzed in this memo appear likely to help improve economic performance modestly under the important assumption that adjustments to forward guidance about the federal funds rate are completely understood and fully credible.

IV. Communications Challenges

As discussed in the staff's October 2012 memo on thresholds, the economic effects of forward guidance will depend on how quickly and completely financial market participants and the general public understand the guidance (in the sense of understanding what actions the Committee will take in response to a range of economic and financial developments), on the extent to which they comprehend the implications of those policy responses for the economy, and on the degree to which they believe that the FOMC will do what the guidance promises.

The potential changes in forward guidance that are discussed above raise three communications challenges. First, changes or additions to the thresholds, unless accompanied by a straightforward explanation of the reasons for the change and its implications, could result in greater confusion rather than greater clarity about the Committee's intentions, objectives, and concerns. For example, reducing the unemployment threshold from 6½ percent to 5½ percent while leaving the projected inflation threshold unchanged at 2½ percent could be taken as indicating that the Committee has concluded that it can drive unemployment down to 5½ percent without risking elevated inflation. Or it could be interpreted as signaling that the Committee has decided to keep short-term interest rates near zero until inflation rises above 2½ percent. These two interpretations seem likely to have different implications for longer-term interest rates. Second, some of the potential changes discussed in this memo could lead the public to conclude that the Committee has become more worried about adverse outcomes. For example, committing to keep the federal funds rate near zero as long as inflation between one and two years ahead is projected to remain below 1½ percent, regardless of the level of the unemployment rate, might be taken to mean that the Committee sees a substantial risk that inflation will remain below 1½ percent in coming years. Third, altering the existing forward guidance could undercut the credibility of that guidance: Market participants and other members

[10] In Table 1, the percentage of crossings caused by the unemployment rate and the percentage caused by projected inflation usually sum to more than 100 percent because both thresholds are sometimes reached simultaneously.

of the public might conclude that a change in the forward guidance today opens the door to further changes if the Committee later comes to see the guidance as inconvenient. For example, reducing the unemployment threshold today might raise the perceived odds that the threshold will be raised later, undercutting the stimulative effects of the lower threshold.

On the positive side, the changes in forward guidance discussed in this memo have the potential to make clearer the state-contingent nature of the Committee's intentions. For example, a threshold for unemployment could be combined with a floor for inflation in a manner that would clarify the conditions under which crossing the unemployment threshold would or would not quickly lead to an increase in the target for the federal funds rate. If market participants and the public understand how the Committee forms its inflation projections (or if the Committee releases, after each meeting, an inflation projection that corresponds to the inflation threshold and floor), such two-part forward guidance could help economic agents assess the Committee's likely future actions once the unemployment rate is approaching 6½ percent. Similarly, forward guidance that clearly describes the conditions that would lead the Committee to increase its target for the funds rate gradually (or rapidly) once lift-off occurs could help economic agents understand and estimate the probabilities of various potential policy paths. To the extent that such forward guidance leads market participants to conclude that the Committee is likely to maintain an accommodative policy stance longer than they had been expecting, the modified guidance could result in more accommodative financial conditions in the near term. However, forward guidance that can be interpreted in more than one way is less likely to improve the public's understanding of monetary policy. For example, the meaning of a state-contingent "gradual increase" in the federal funds rate may be unclear unless the Committee announces a specific policy rule. A shift to nominal income targeting likely would require not only substantial changes in the statement but also a major communications effort.

The following paragraphs present illustrative examples of statement language that would correspond to the policy "rules" shown in the earlier sections of this memo. In all cases, the statement language would likely need to be accompanied by some further explanation, either by the Chairman in a post-meeting press conference, or in the Committee's minutes, or both.

Reducing the unemployment threshold

The Committee's policy statement currently contains:

> ". . . the Committee decided to keep the target range for the federal funds rate at 0 to 1/4 percent and currently anticipates that this exceptionally low range for the federal funds rate will be appropriate at least as long as the unemployment rate remains above 6-1/2 percent, inflation between one and two years ahead is projected to be no more than a half percentage point above the Committee's 2 percent longer-run goal, and longer-term inflation expectations continue to be well anchored."

The model simulations summarized above indicate that a reduction in the unemployment threshold, if fully understood and fully credible, could provide additional stimulus by signaling a decision to keep the funds rate at its current level even longer than implied by the existing thresholds. If the Committee chose to do so, it would be simple to replace "6-1/2 percent" with

"6 percent" or "5-1/2 percent." If members were concerned that the public might interpret a lower unemployment threshold as signaling a greater tolerance for above-target inflation, and wanted to mitigate that risk, the Committee could lower the unemployment threshold and simultaneously turn the inflation threshold into a trigger by adding "provided that" before the inflation language:

> ". . . and currently anticipates that this exceptionally low range for the federal funds rate will be appropriate at least as long as the unemployment rate remains above **[6 | 5-1/2]** percent, **[provided that]** inflation between one and two years ahead is projected to be no more than a half percentage point above the Committee's 2 percent longer-run goal and longer-term inflation expectations continue to be well anchored."

Specifying a two-stage unemployment threshold and inflation threshold

Rather than reducing the unemployment threshold to 5½ percent, the Committee might prefer to leave the existing thresholds as they are, but to provide additional guidance about its intentions for the federal funds rate once the unemployment rate crosses the 6½ percent threshold. The Committee could, for example, indicate that it will not increase its target for the funds rate even after the unemployment rate goes below 6½ percent unless failing to raise the target would be likely to cause inflation to overshoot 2 percent by more than a modest amount. Statement language for such two-stage forward guidance might be:

> ". . . the Committee decided to keep the target range for the federal funds rate at 0 to 1/4 percent and currently anticipates that this exceptionally low range for the federal funds rate will be appropriate at least as long as the unemployment rate remains above 6-1/2 percent, inflation between one and two years ahead is projected to be no more than a half percentage point above the Committee's 2 percent longer-run goal, and longer-term inflation expectations continue to be well anchored. **In addition, the Committee anticipates that it would maintain this target range for the federal funds rate after the unemployment rate drops below 6-1/2 percent and while it remains above 5-1/2 percent, if inflation between one and two years ahead is projected to be no more than a quarter percentage point above the Committee's 2 percent longer-run goal and longer-term inflation expectations remain well anchored."**

Allowing projected inflation to overshoot 2 percent by a half percentage point when the unemployment rate is between 6½ percent and 5½ percent clearly would be equivalent to reducing the unemployment threshold to 5½ percent while making no other changes to the forward guidance. Allowing only a quarter point of headroom for inflation once the 6½ percent unemployment threshold is crossed would make it more likely that the inflation threshold would bind, and thus—as indicated by the simulations reported earlier—would mean less additional stimulus *ex ante* than would be provided by allowing a half point of headroom. But the tighter inflation threshold might be seen as limiting the risk of an increase in expected inflation as the unemployment rate approaches its long run normal level.

Specifying an inflation floor

If the Committee saw a significant risk that inflation will remain appreciably below its 2 percent target in coming years even as unemployment continues to decline, and wanted to signal that progress toward maximum employment would not lead to less accommodative monetary policy if inflation were to remain persistently (and significantly) below 2 percent, it could specify an inflation floor. For example, the Committee could state that:

> ". . . the Committee decided to keep the target range for the federal funds rate at 0 to 1/4 percent and currently anticipates that this exceptionally low range for the federal funds rate will be appropriate at least as long as the unemployment rate remains above 6-1/2 percent, inflation between one and two years ahead is projected to be no more than a half percentage point above the Committee's 2 percent longer-run goal, and longer-term inflation expectations continue to be well anchored. In determining how long to maintain a highly accommodative stance of monetary policy **after a threshold has been crossed**, the Committee will also consider other information, including additional measures of labor market conditions, indicators of inflation pressures and inflation expectations, and readings on financial developments. **In particular the Committee would be unlikely to increase its target for the federal funds rate when the unemployment rate reaches or goes below 6-1/2 percent if inflation between one and two years ahead is projected to be below [1-1/2 | 1-3/4] percent.**"

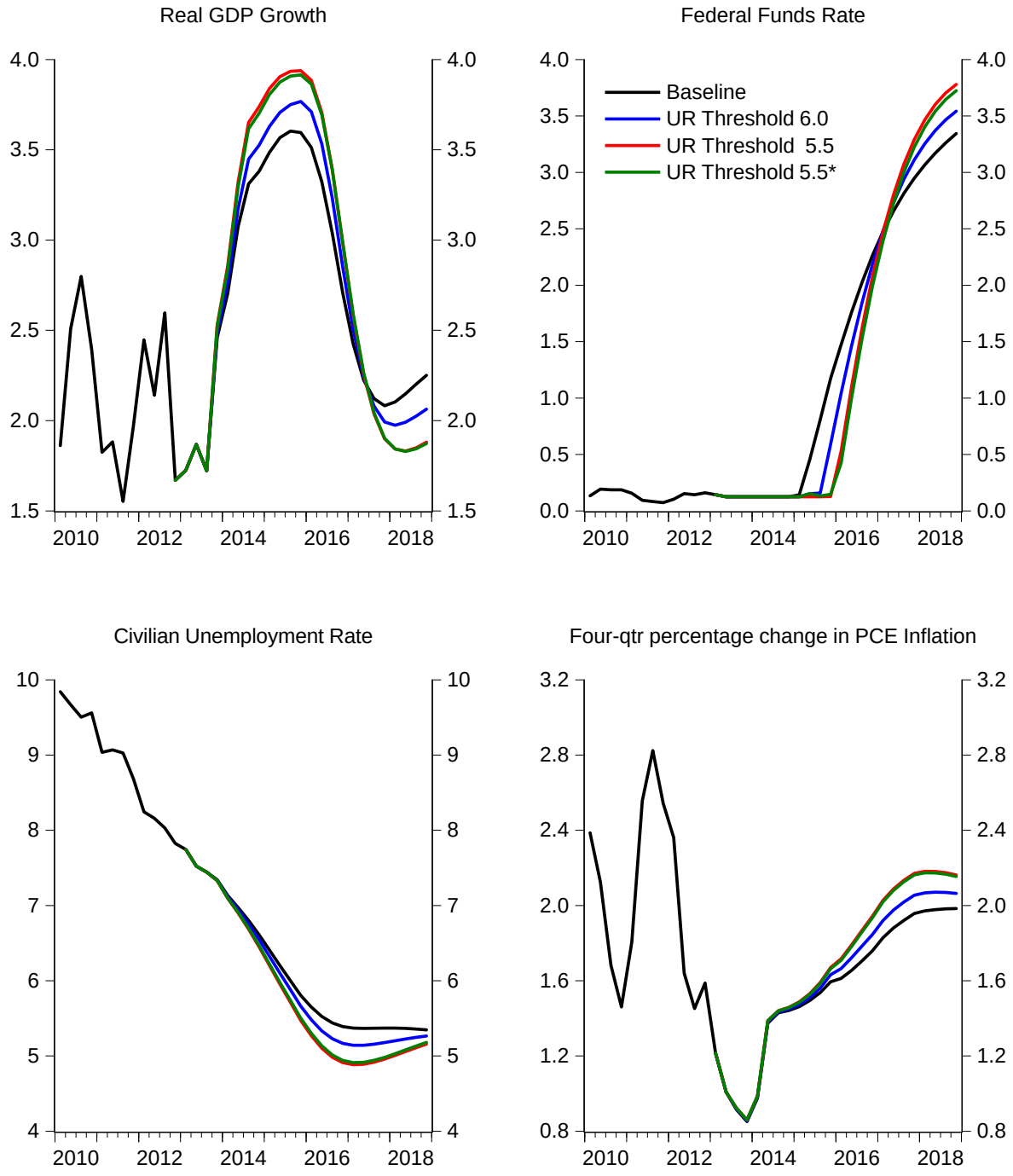
As shown earlier, FRB/US simulations suggest that adding an inflation floor would not provide significant additional stimulus except perhaps when there is an appreciable risk that inflation will run well below the Committee's 2 percent goal for a considerable time.

Specifying a gradual liftoff from the effective lower bound

Although the model simulations summarized earlier suggest there would be macroeconomic benefits from committing to increase the federal funds rate even more gradually than prescribed by the inertial Taylor 1999 rule that underlies the staff baseline forecast, communicating such a highly inertial state-contingent rule to market participants and the public would be challenging. Perhaps qualitative language along the following lines, if coupled with a more detailed explanation by the Chairman or in the minutes, would convey the Committee's intent:

> "When the Committee decides to begin to remove policy accommodation, **after a threshold has been crossed,** it will take a balanced approach consistent with its longer-run goals of maximum employment and inflation of 2 percent. **So long as inflation remains near the Committee's longer-run objective and inflation expectations remain well anchored, increases in the federal funds rate, once they begin, are likely to be [quite] gradual until [the unemployment rate is nearing its longer-run normal level | the economy is nearing maximum employment].**

Figure 1: Implications of Unemployment and Inflation Thresholds



*The scenario in green assumes an inflation threshold of 2.25 when the unemployment rate is less than 6.5 percent but greater than 5.5 percent.

Figure 2: Inflation Floor under Low Inflation Scenarios

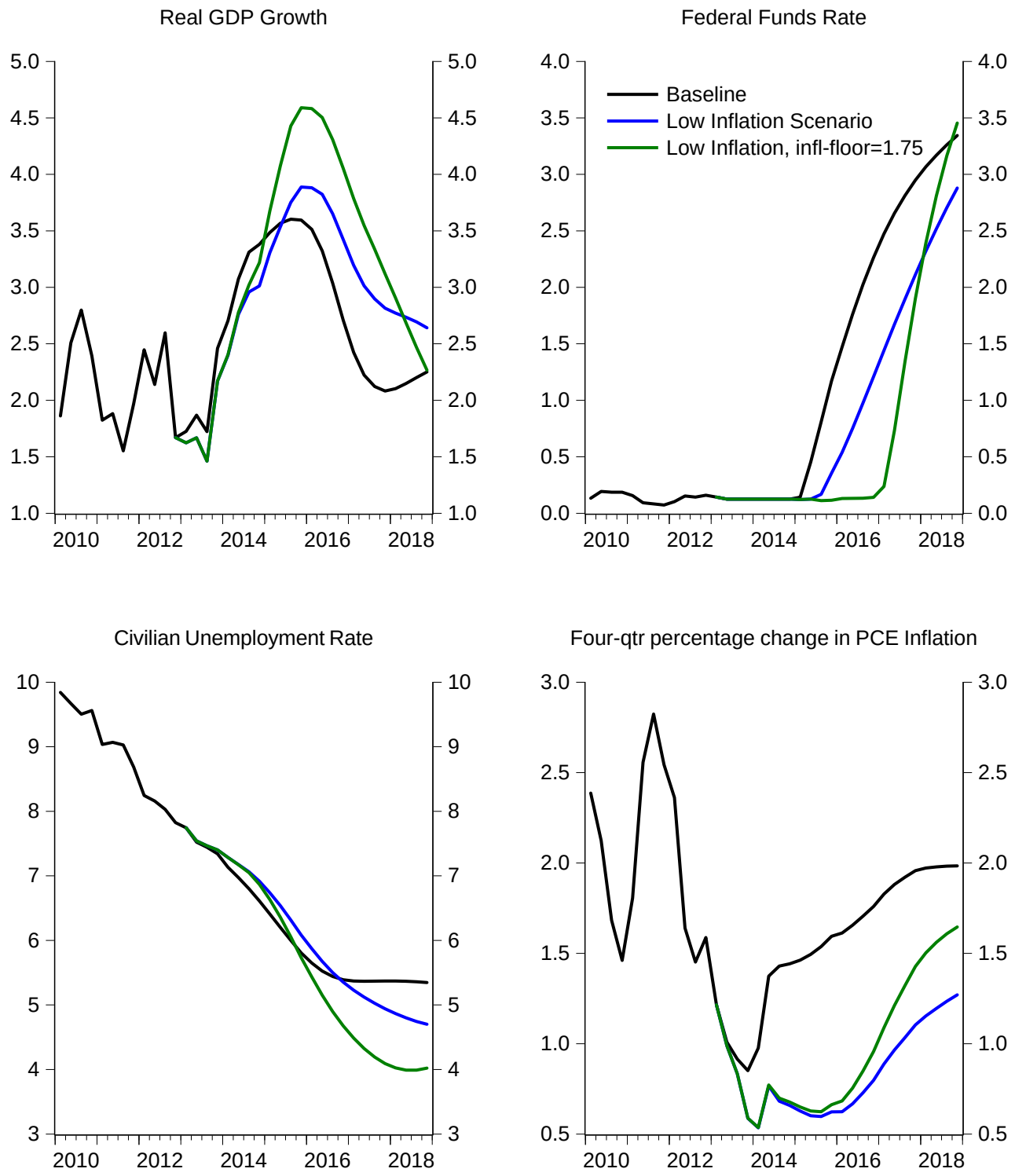


Figure 3: Implications of More Gradual Liftoff and Nominal Income Targeting

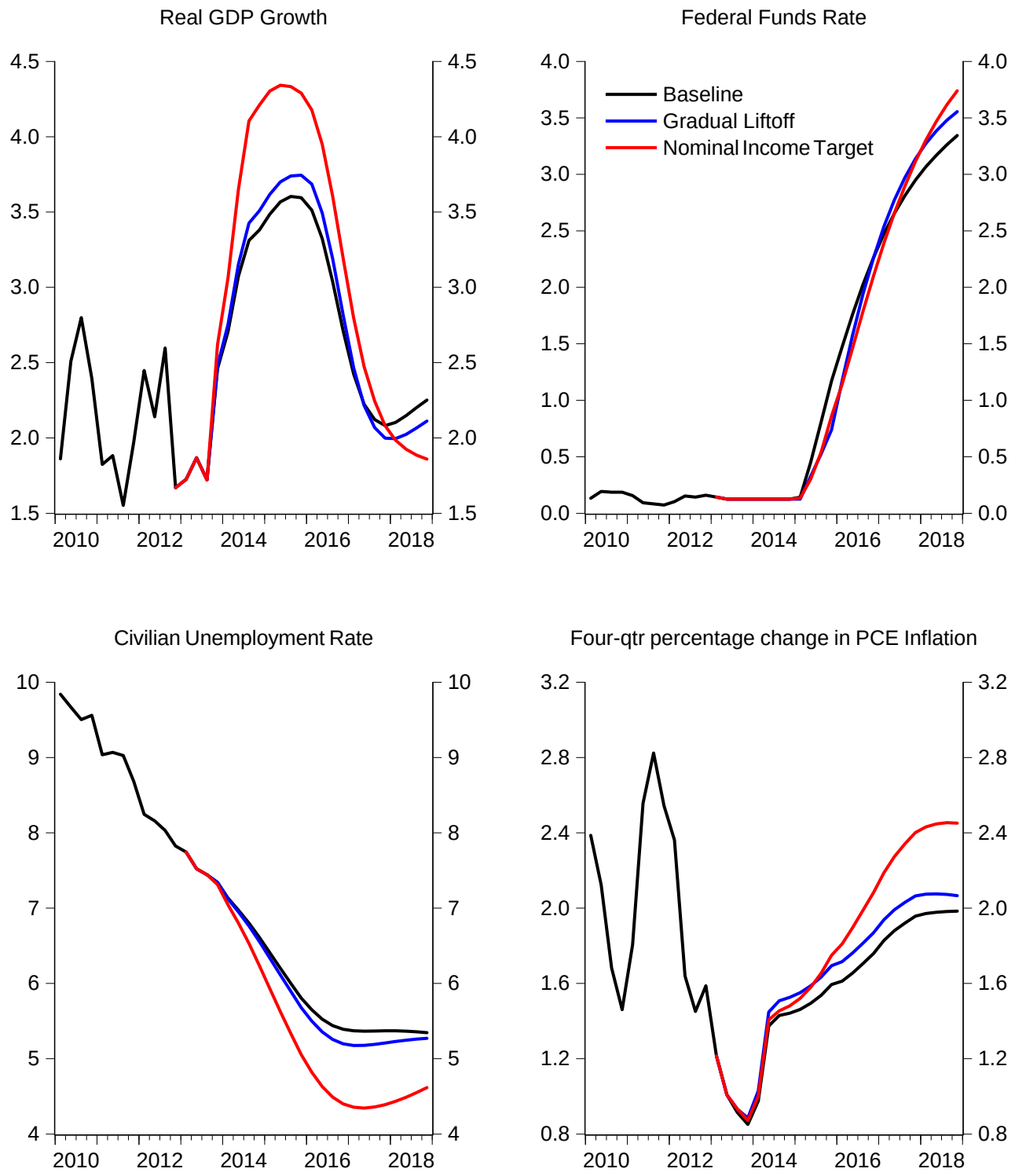
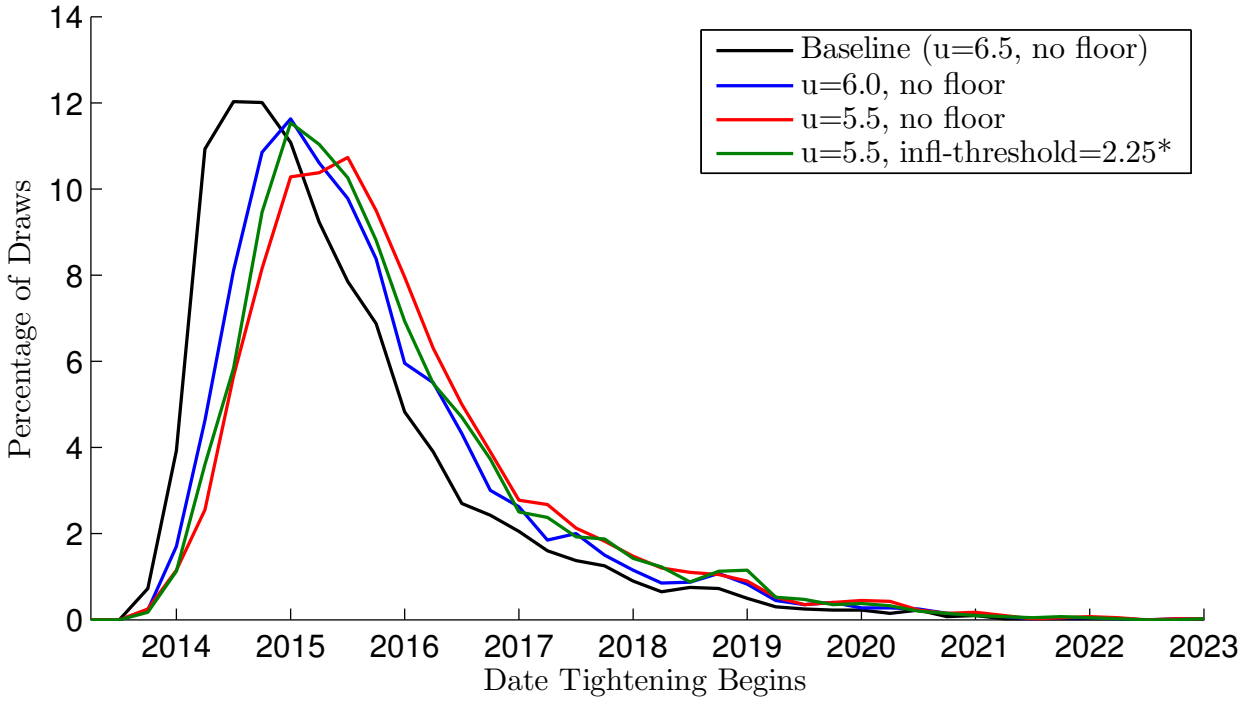


Figure 4: Simulated Probability Distribution for the Date at which Tightening Begins under Different Unemployment Thresholds and Inflation Floor Settings



* This scenario assumes an inflation threshold of 2.25 when the unemployment rate is less than 6.5 percent but greater than 5.5 percent.

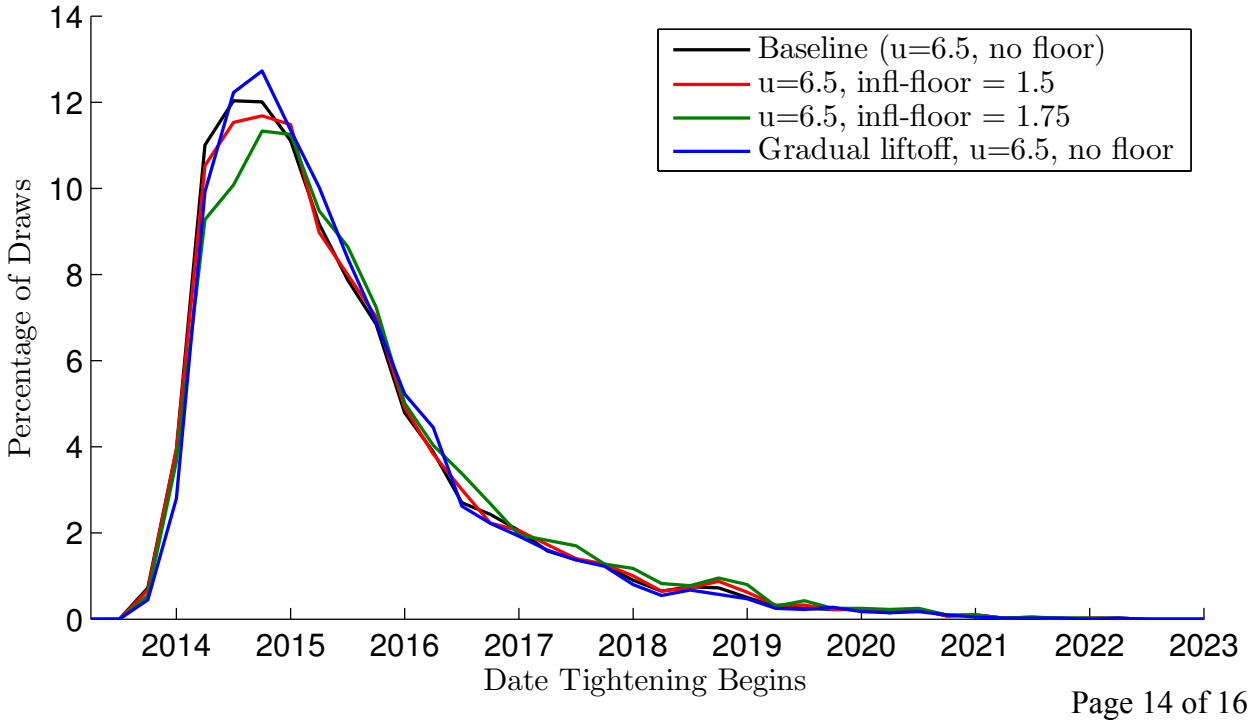


Table 1. Influence of Unemployment Threshold and Inflation Floor Settings On the Expected Timing of Threshold Crossing and Related Factors, Derived from Stochastic Simulations of the FRB/US Model[1]

	Median Date of:		Percentage of Crossings Caused By Reaching the:[2]		Actual Inflation Rate When the Unemployment Threshold is Crossed		Unemployment Rate When the Projected Inflation Threshold is Crossed	
	Crossing	Liftoff	Unemployment Threshold	Projected Inflation Threshold	Mean	Interquartile Range	Mean	Interquartile Range
Unemployment Threshold								
U = 6.5, no π floor	2015q1	2015q1	95.95	6.75	1.38	(0.73, 1.97)	6.66	(6.31, 7.06)
U = 6.0, no π floor	2015q3	2015q3	89.54	16.13	1.51	(0.87, 2.14)	6.27	(5.85, 6.67)
U = 5.5, no π floor	2015q4	2015q4	75.74	34.94	1.62	(0.98, 2.25)	5.90	(5.40, 6.36)
U = 5.5, π thresh=2.25 when 5.5<UR<6.5	2015q3	2015q3	51.84	51.61	1.56	(0.93, 2.19)	6.06	(5.76, 6.31)
Inflation Floor[3]								
U = 6.5, π floor = 1.75	2015q1	2015q2	95.96	6.79	1.38	(0.73, 1.97)	6.66	(6.30, 7.05)
U = 6.5, π floor = 1.50	2015q1	2015q2	95.94	6.77	1.38	(0.73, 1.97)	6.66	(6.31, 7.06)
More Gradual Liftoff								
U = 6.5, no π floor	2015q1	2015q2	95.48	7.48	1.38	(0.74, 1.97)	6.69	(6.29, 7.04)

1. The threshold on inflation is set to 2.5 percent in all of these simulations with the exception of the last row in the Unemployment Threshold panel.
2. Percentage of crossings caused by each threshold sums to more than 100 percent because both thresholds are sometimes crossed simultaneously.
3. The proportion of simulations in which the inflation floor condition becomes binding is 33 percent with the 1.75 percent floor and 12 percent with the 1.50 percent floor.

Table 2. Macroeconomic Performance Under Unemployment Threshold and Inflation Floor Settings and Post-Crossing Policy Rules, Based on Stochastic Simulations of the FRB/US Model[1]

	Actual PCE Inflation[2]		Unemployment Rate[2]		Policymaker Loss[3]		Welfare
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Median	Improvement Share[4]
Unemployment Threshold							
U = 6.5, no π floor	2.11	1.17	5.14	1.36	87.79	75.62	n.a.
U = 6.0, no π floor	2.17	1.17	5.09	1.36	86.34	74.92	58.35
U = 5.5, no π floor	2.24	1.17	5.01	1.35	85.34	74.45	53.68
U = 5.5, π thresh=2.25 when 5.5<UR<6.5	2.21	1.17	5.01	1.38	87.34	75.31	46.26
Inflation Floor[3]							
U = 6.5, π floor = 1.75	2.13	1.17	5.13	1.37	87.68	75.60	64.55
U = 6.5, π floor = 1.50	2.12	1.17	5.14	1.36	87.77	75.61	65.88
More Gradual Liftoff							
U = 6.5, no π floor	2.14	1.17	5.16	1.33	85.08	73.58	80.03

1. The threshold on inflation is set to 2.5 percent in all of these simulations with the exception of the last row in the Unemployment Threshold panel.
2. Means and standard deviations based on simulated values for four-quarter PCE inflation and the unemployment rate in 2018Q4, the date at which the mean differences of inflation from 2 percent and the unemployment rate from its natural rate are the greatest.
3. Policymaker loss equals the cumulative sum from 2013Q2 to 2018Q4 of squared deviations of the unemployment rate from its natural rate, squared deviations of total PCE inflation from 2 percent, and squared quarterly changes in the federal funds rate, all discounted at a 4 percent annual rate.
4. Proportion of simulations in which policymaker loss is less than what would occur if policy followed the baseline monetary policy rule with 6.5 percent unemployment threshold, 2.5 percent inflation threshold and no inflation floors.
5. The proportion of simulations in which the inflation floor condition becomes binding is 33 percent with the 1.75 percent floor and 12 percent with the 1.50 percent floor.