

An Inflation Floor and Post-liftoff Policy in Forward Guidance for the Federal Funds Rate

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I. Introduction and Summary of Conclusions

Despite comments to the contrary by the Chairman and other FOMC participants, market developments in recent months have suggested that investors believe that a decision to start slowing the pace of purchases could also signal an intention to raise the federal funds rate sooner than would otherwise be the case. As a result, the Committee may be interested in considering some additions to its current forward guidance for the federal funds rate in order to strengthen the state-contingent nature of that guidance and to convey to market participants that it is distinct from policy decisions regarding asset purchases.

As background for such consideration, this memo examines two possible additions to current forward guidance. With inflation quite low early this year and heightened concerns that inflation might persistently remain below the Committee's 2 percent objective, we first examine the implications of adding a so-called inflation floor to the current set of thresholds. (An inflation floor would state that if inflation was 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.) Second, we analyze the possibility of providing more information about the likely pace of tightening after the federal funds rate is first raised from its effective lower bound.

We evaluate the potential macroeconomic effects of these changes using simulations of the staff's FRB/US model. We first present illustrative simulations of the effects of these changes given a deterministic economic outlook—either the baseline forecast in the September Tealbook or a variant that features a lower path for inflation. We then broaden our simulation analysis by evaluating the macroeconomic performance of these proposed changes in stochastic simulations of the FRB/US model—that is, under a wide variety of shocks overlaid on the September baseline outlook. This latter analysis also permits an examination of the range of possible outcomes for two indicators of labor market conditions other than the unemployment rate—the pace of payroll employment gains and the labor force participation rate—at the time that the federal funds rate is prescribed to first increase from its effective lower bound (which is usually when the unemployment rate is just below 6½ percent). Finally, we discuss some communications challenges that would likely arise for each of these additions to the Committee's forward guidance for the federal funds rate and offer 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 main lessons from the simulation analysis are:

- 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 for longer than the

current thresholds would otherwise suggest. The resulting expectation that monetary policy will remain highly accommodative if inflation were to remain low would cause the recovery to strengthen a little and would move inflation back toward the Committee's longer-run objective a bit more quickly. Simulations of the FRB/US model analyzing the efficacy of using either projected headline inflation (similar to what is used for the inflation threshold) or realized core inflation in defining the inflation floor suggest that the two measures would have roughly similar effects on economic performance.

- A second issue pertains to the provision of additional forward guidance regarding the post-liftoff behavior of the federal funds rate. 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 otherwise anticipated by market participants, the Committee could obtain some further improvement in economic performance in the form of a slightly more-rapid decline in the unemployment rate toward its longer-run natural rate and a little faster movement of inflation up toward the Committee's longer-run objective of 2 percent.
- Under the threshold settings in the baseline or with the proposed additions to forward guidance discussed earlier, the current unemployment rate threshold of 6½ percent is crossed before the inflation threshold in almost all of the stochastic simulations. The FRB/US model simulations suggest that at the time when the federal funds rate is prescribed to begin to increase, other indicators of labor market conditions, such as the pace of employment gains and the labor force participation rate can vary markedly across the different simulations, sometimes confirming the message sent by the crossing of the unemployment threshold, and sometimes contradicting it; the wide range of possible outcomes present some communications issues for the Committee.

II. Additions to Forward Guidance Policy

We explore the potential macroeconomic effects of making some additions to the Committee's current strategy for forward guidance about the federal funds rate target using simulations of the FRB/US model with the September Tealbook projection as our baseline. Specifically, we analyze the effects of:¹

- 1) augmenting the current set of thresholds by including an inflation floor, whereby the target for the federal funds rate will remain at its effective lower bound even if the unemployment rate is below its threshold value, as long as inflation remains below some critical value (either 1½ percent or 1¾ percent in our analysis); we consider using either a projected measure of headline inflation one to two years ahead (similar to what is used for the current inflation threshold) or a realized measure of core inflation – in our analysis, core PCE inflation over the previous four quarters.
- 2) 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

¹ In a memo prepared for the Committee in July, we also analyzed the effects of lowering the unemployment rate threshold. See *Some Adjustments to the Committee's Forward Guidance for the Federal Funds Rate*, by Durdu, Engen, Meyer, and Tetlow (July 2013).

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 simulation analysis are worth highlighting. First, expectations of financial market participants are assumed to be model-consistent, while wage and price setters are also forward looking but their expectations are derived from a small-scale VAR model, rather than from the full FRB/US model.² Second, rational economic agents are assumed to completely understand any announced change in monetary policy and to view it as fully credible. Finally, as in any model-based analysis, our results are conditional on the structure of the FRB/US model and the use of the September Tealbook projection as the model's baseline.³

Because the effects of forward guidance depend on the assumed evolution of the economy, we examine them under the September Tealbook baseline and a specific alternative economic scenario, and also using stochastic simulations in which the model is repeatedly subjected to shocks of the sort experienced since the late 1960s. These stochastic simulations allow 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.⁴ By repeating this exercise using different assumptions about forward guidance, we explore how changes in that guidance influence average macroeconomic performance. In addition, our stochastic simulation analysis examines the possible range of outcomes for indicators of labor market conditions other than just the unemployment rate – specifically, the average monthly pace of employment gains and the labor force participation rate – at the time that the federal funds rate is prescribed to begin increasing.

² 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.

³ A feature of the September 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. 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).

⁴ The stochastic simulations are run by shocking various components of aggregate spending, productivity and employment, wages and prices, asset prices, and other factors from 2013:Q4 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.

A. Adding an inflation floor to the current threshold settings

Deterministic simulations

Under the baseline outlook, adding an inflation floor could, in principle, affect the baseline outlook, depending on both what measure of inflation is used and what value for the inflation floor is selected. For the deterministic simulations presented here, we focus on an inflation floor of 1½ percent, as a floor at that level would be symmetric with the 2½ percent inflation threshold around the Committee's longer-run objective. The September Tealbook forecast shows core inflation edging over 1½ percent in the first quarter of 2015, just as the unemployment threshold is crossed, but projected headline inflation exceeds 1½ percent one quarter later. Thus, a 1½ percent inflation floor would have little noticeable effect on policy or economic outcomes in the baseline.⁵

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 an inflation floor of 1½ percent would have noticeable effects. In this low-inflation scenario, persistent disinflationary forces 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 in figure 1), the low level of actual inflation in the scenario relative to baseline (the black lines) does not delay liftoff of the federal funds rate past early 2015, but the policy rate rises more gradually than in the baseline. In contrast, with an inflation floor equal to 1½ percent, using a measure of projected inflation one to two years ahead (the red dashed lines), the federal funds rate remains at its effective lower bound until the middle of 2016. Similarly, when policymakers define the 1½-percent inflation floor using realized core inflation over the previous four quarters (the green lines), the federal funds rate remains at its effective lower bound until later in 2016. Given the forward-looking nature of financial markets, this more aggressive policy (using either measure for the inflation floor) causes long-term interest rates to move lower than otherwise in response to the disinflationary surprise, with the result that real activity is a little stronger than it otherwise would be and inflation moves back towards 2 percent slightly more quickly.

Stochastic simulations

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 or the specific low-inflation scenario shown in figure 1. Tables 1 and 2 provide statistics from the stochastic simulations around the September baseline, on economic conditions under various assumptions about an inflation floor. We also assess the

⁵ However, the same cannot be said of a 1¾ percent inflation floor as neither realized core inflation nor projected headline inflation reaches 1¾ percent until much later in the baseline projection, which would keep the federal funds rate at its effective lower bound for quite some time.

macroeconomic effects of an inflation floor using a loss function such as the one that underlies the optimal policy paths reported in Book B of the Tealbook.⁶

Some of the key results in Table 1 and 2 are:

- An inflation floor only slightly changes 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.
- Mean and median policymaker losses with inflation floors using a projected measure of inflation are somewhat lower than those found using realized core inflation as the measure for the inflation floor whereas using projected inflation as the value for the floor has little effect on the mean and median of policymaker losses. That said, as indicated by the “Welfare Improvement Share,” setting an inflation floor using either measure leads to smaller losses in more than half of the individual simulations and may be effective in reducing the risk of adverse downside events.
- The introduction of an inflation floor has little effect on the mean inflation rate when the unemployment threshold is crossed. In all instances, the upper bound of the interquartile range for the inflation rate when the unemployment threshold is crossed is still somewhat below the Committee’s longer-run inflation objective of 2 percent.
- With the addition of an inflation floor, the unemployment rate threshold of 6½ percent is crossed first in almost 98 percent of the stochastic simulations, similar to the baseline.

Other labor market indicators in the stochastic simulations

In a stochastic economy, other indicators of labor market conditions, such as the pace of employment gains and the labor force participation rate, can send different messages than the unemployment rate does when the unemployment threshold is crossed. Figure 3 presents the distributions from the stochastic simulations of average monthly employment growth and the labor force participation rate at the time that the federal funds rate starts to rise (usually soon after the unemployment rate has reached 6½ percent) in the baseline, along with the bivariate distribution of these two labor market indicators in the bottom panel. In 27 percent of the stochastic simulations (the upper-right quadrant of the distribution in the lower panel), average monthly payroll gains are above 250,000 and the labor force participation rate is greater than 63.3 percent (these figures are the staff’s baseline forecast at the time of liftoff of the federal funds rate and are shown by the dashed red lines in the bottom panel). However, in 18 percent of the simulations (the lower-left quadrant of the distribution), job gains are slower and the labor force participation rate is lower than in the staff’s baseline projection at the time the federal funds rate begins to rise. These might be circumstances in which the Committee would choose to emphasize that the unemployment rate threshold is not a trigger and keep the federal funds rate at its effective lower bound for a little longer. In 49 percent of the simulations, the signals

⁶ 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.

from these other labor market indicators at the time the federal funds rate is set to increase are somewhat mixed, with the pace of monthly employment increases above 250,000 but the labor force participation rate below the baseline forecast of 63.3 percent. In about 6 percent of the simulations, the monthly pace of job gains is below 250,000 but the labor force participation rate is above 63.3 percent, which also may be situations in which the Committee elects to emphasize that the unemployment rate threshold is not a trigger. As shown in Table 3, the probabilities of being in different ranges of the bivariate distribution of employment increases and labor force participation are quite similar when the different inflation floor values and measures are included.⁷

B. Signaling a more gradual liftoff in the federal funds rate

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. 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.⁸ 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.

Deterministic simulations

Figure 2 illustrates the potential implications of effectively committing to a more gradual liftoff of the federal funds rate relative to the baseline. The black lines show the baseline paths, while the red dashed 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 indicates, the federal funds rate lifts off from its effective lower bound at about the same time as in the baseline but then rises more gradually until early 2016 (when the unemployment rate has reached 5½ percent), thus promoting a little faster recovery, accompanied by slightly higher inflation.

⁷ While we think these results are illustrative of the range of uncertainty in labor market outcomes, we note that the structure of the labor market sector in the FRB/US model does not contain the full range of detail as would a model that was devoted just to labor market phenomena. That said, the fundamental point that various dimensions of the labor market may become misaligned is one that transcends any reasonable model.

⁸ 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).

Stochastic simulations

As with the inflation-floor scenarios, we want to address whether promising a more gradual policy for increasing the federal funds rate after it begins to rise would improve macroeconomic performance under a range of economic conditions, not just those characterizing the baseline outlook. Tables 1 and 2 provide statistics from the stochastic simulations regarding the expected date of liftoff along with information about economic conditions and measures of policymaker losses.

Some of the key results are:

- Mean and median policymaker losses with a more gradual liftoff policy are less than those in the baseline. In addition, the gradual liftoff policy leads to smaller losses in more than half of the individual simulations.
- Promising a somewhat more gradual rise in the funds rate after the onset of tightening has no effect on the median liftoff date relative to the baseline.
- Committing to a more gradual liftoff of the federal funds rate has little effect on the mean inflation rate when the 6½ percent unemployment rate threshold is crossed. In all instances, the upper bound of the interquartile range for the inflation rate when the threshold is crossed is still somewhat below the Committee's longer-run inflation objective of 2 percent, and mean actual inflation at the end of 2018 is similar to that in the baseline and close to the Committee's objective.
- Under the more gradual liftoff policy, the unemployment rate threshold of 6½ percent is crossed first in almost 95 percent of the stochastic simulations.

Other labor market indicators in the stochastic simulations

The distributions from the stochastic simulations of average monthly employment growth and the labor force participation rate at the time that the federal funds rate starts to rise (usually soon after the unemployment rate has reached 6½ percent) under the more gradual liftoff policy are quite similar to those shown for the baseline in Figure 3. Moreover, as displayed in Table 3, the probabilities associated with the bivariate distribution of these labor market indicators are also about the same. Even with the promise of a more gradual liftoff of the federal funds rate after the unemployment threshold is crossed, as discussed earlier in regard to an inflation floor, there are a significant fraction of the simulations that could end up with circumstances for overall labor market conditions that may lead the Committee to emphasize that the unemployment rate threshold is not a trigger and keep the federal funds rate at its effective lower bound for a little longer.

III. Communications Challenges

The economic effects of forward guidance 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 additions to forward guidance discussed in this memo have the potential to make clearer the state-contingent nature of the Committee's intentions. For example, adding an inflation floor along with the existing threshold for the unemployment rate could clarify the conditions under which crossing the unemployment threshold would or would not 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—perhaps because the Committee regularly provides information on its 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 $6\frac{1}{2}$ percent. To the extent that additions to the current 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. Moreover, an inflation floor could make clear, in conjunction with the current inflation threshold, that the Committee is more committed to trying to achieve its longer-run inflation objective and is willing to defend that objective in a balanced manner in the face of inflation that is either too high or too low.

However, these potential changes in forward guidance raise a few communications challenges. First, additions to the existing 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, forward guidance that can be interpreted in more than one way is less likely to improve the public's understanding of monetary policy, and the meaning of a state-contingent "gradual increase" in the federal funds rate may be unclear unless the Committee announces a specific policy rule. Although the model simulations 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. Second, changing the forward guidance 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 $1\frac{1}{2}$ 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 $1\frac{1}{2}$ percent in coming years. Third, altering the existing forward guidance could undercut the credibility of forward guidance: Market participants and other members of the public might conclude that a change in the forward guidance today increases the possibility of further changes if the Committee later comes to see the guidance as inconvenient.

Specifying an inflation floor

If the Committee wanted to add an inflation floor using a projected inflation measure of 1½ percent to its forward guidance, it could do so by making the following changes to the guidance included in the September post-meeting statement:

“... 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. Once the unemployment rate reaches 6½ percent—and assuming that inflation remains well contained, as the Committee expects—the Committee will also consider other information a broad set of indicators in determining how long to maintain a highly accommodative stance of monetary policy an exceptionally low range for the federal funds rate. Relevant factors will include additional measures of labor market conditions such as the level and growth of employment, indicators of inflation pressures and inflation expectations, and readings on financial developments. In any case, the Committee anticipates that it will not raise its target for the federal funds rate if inflation between one and two years ahead is projected to be below [1½] percent.”

Specifying a gradual liftoff from the effective lower bound

Qualitative language along the following lines, perhaps coupled with a more detailed explanation by the Chairman or in the minutes, might convey the Committee's intent:

“When the Committee eventually decides to begin to remove policy accommodation, it will take a balanced approach consistent with to achieving its longer-run goals of maximum employment and inflation of 2 percent. In addition the Committee anticipates that the headwinds that have been restraining the economic recovery will abate only gradually. For this reason, achieving and maintaining maximum employment and price stability will likely require a patient policy approach that keeps the target for the federal funds rate below its longer-run normal value for some time.”

Figure 1: Inflation Floor of 1.5 percent under a Low Inflation Scenario

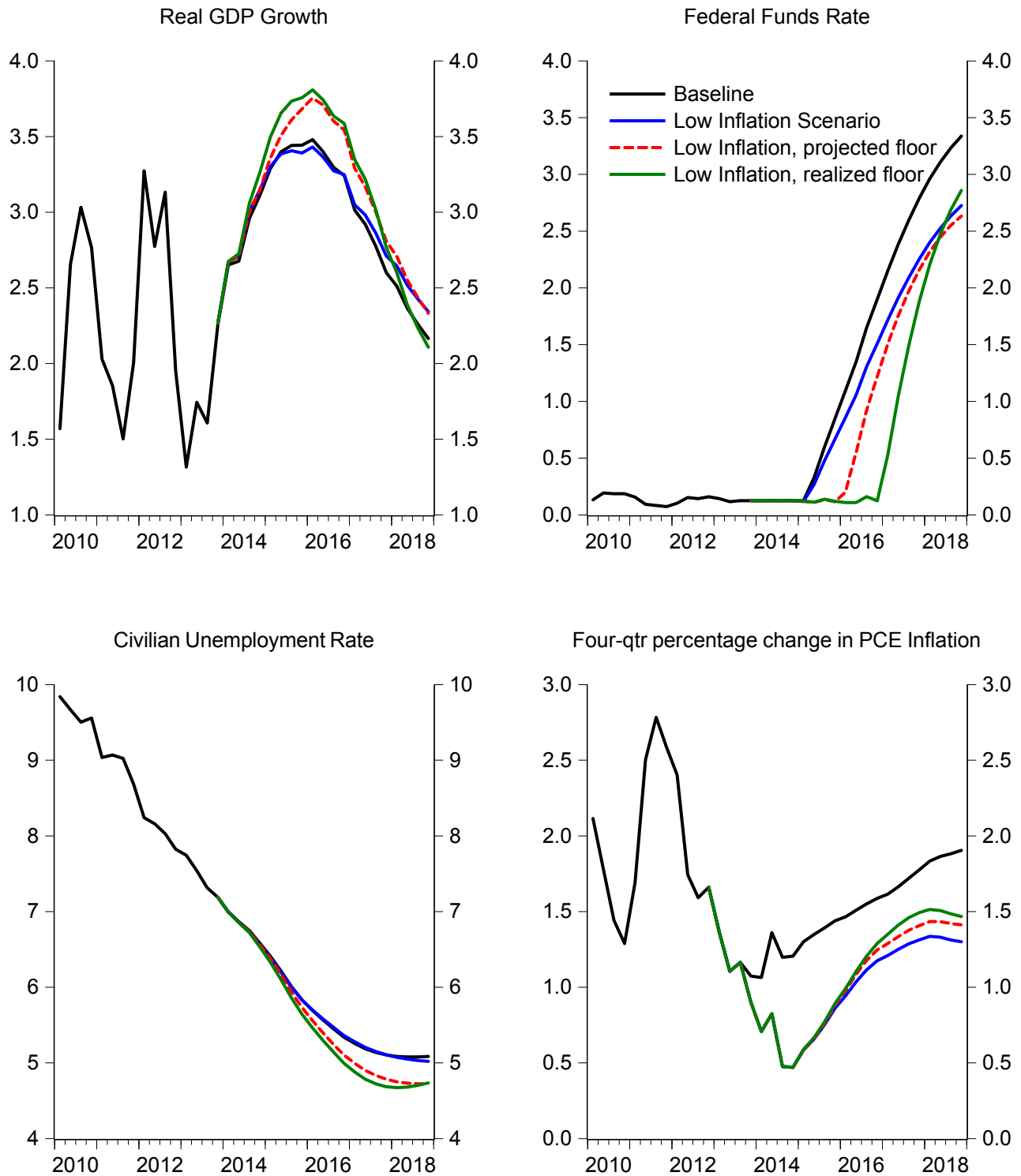


Figure 2: Implications of More Gradual Liftoff

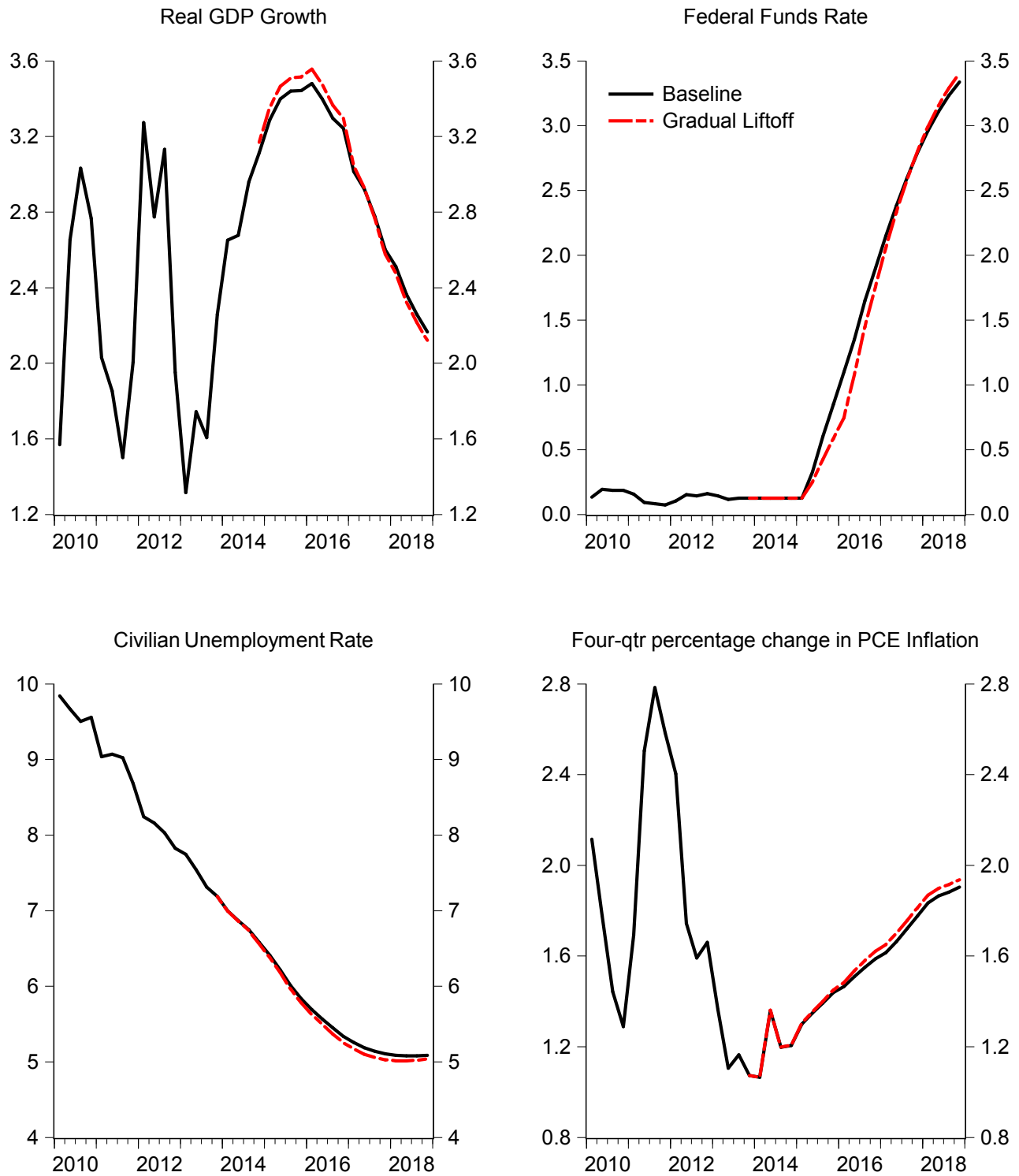
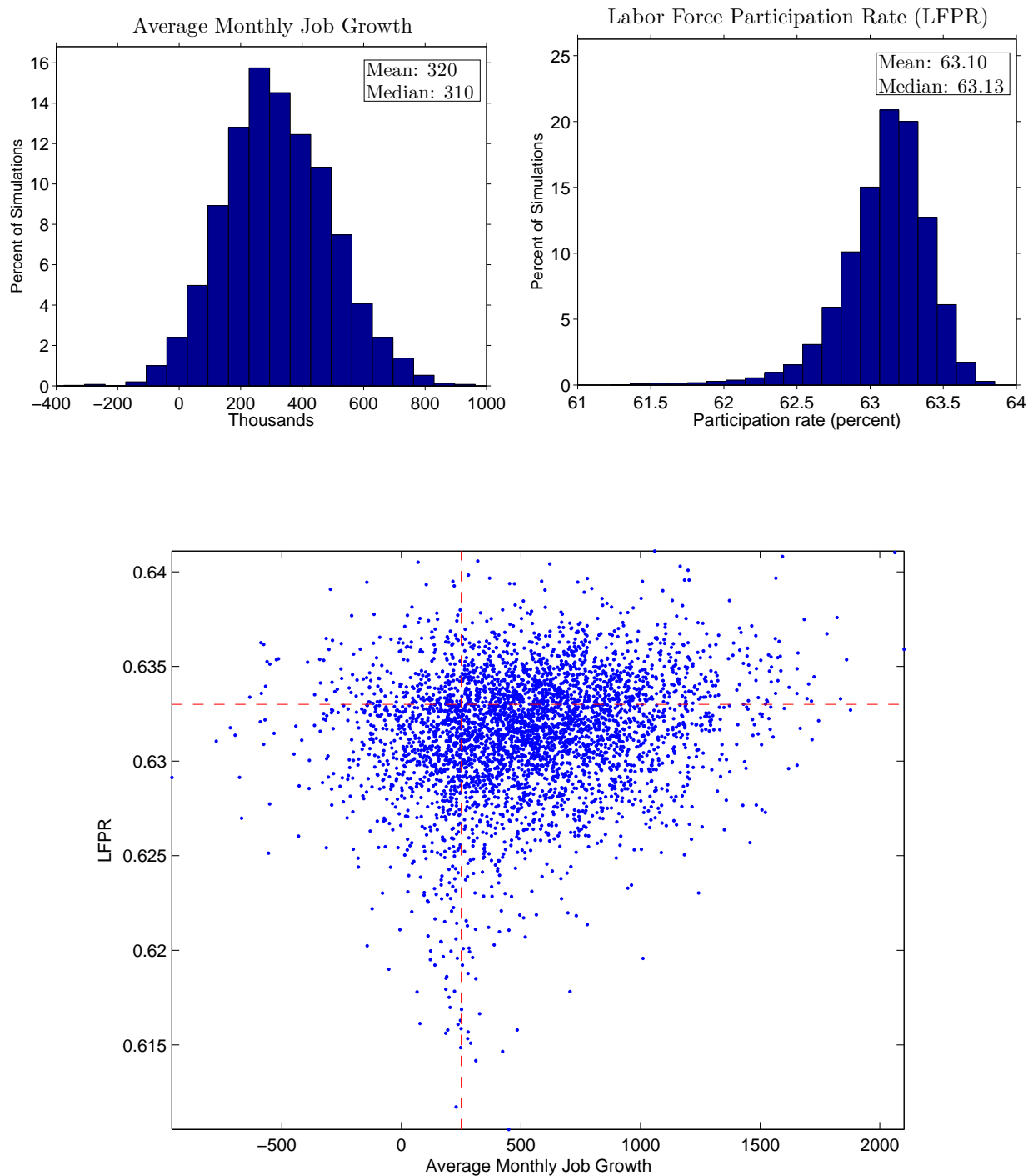


Figure 3: The Distribution of Labor Market Outcomes as of the Liftoff Date: Baseline



Notes: The threshold on inflation is set to 2.5 percent and the threshold on the unemployment rate is set to 6.5 percent in the simulations. In the lower panel, the dotted vertical red line highlights an average monthly job growth of 250 thousand and the horizontal red line shows an LFPR of 63.3 percent.

Table 1. Influence of Inflation Floor and More Gradual Liftoff On the Expected Timing of Threshold Crossing and Related Factors
Derived from Stochastic Simulations of the FRB/US Model¹

	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
Baseline	2014q4	2015q1	97.93	6.78	1.20	(0.65, 1.73)	6.40	(6.09, 6.63)
Inflation Floor:								
<i>realized core inflation</i>								
π floor = 1.50	2014q4	2015q2	97.93	6.93	1.20	(0.66, 1.72)	6.38	(6.07, 6.59)
π floor = 1.75	2014q4	2015q3	97.90	6.98	1.20	(0.66, 1.72)	6.38	(6.08, 6.60)
<i>projected inflation</i>								
π floor = 1.50	2014q4	2015q1	97.93	6.78	1.20	(0.65, 1.73)	6.40	(6.08, 6.63)
π floor = 1.75	2014q4	2015q2	97.88	6.80	1.20	(0.65, 1.72)	6.40	(6.08, 6.64)
More Gradual Liftoff	2014q4	2015q1	94.45	7.65	1.17	(0.64, 1.71)	6.80	(6.45, 7.14)

1. The threshold on inflation is set to 2.5 percent and the threshold on unemployment is set to 6.5 percent in all of these simulations.

2. Percentage of crossings caused by each threshold sums to more than 100 percent because both thresholds are sometimes crossed simultaneously.

Table 2. Macroeconomic Performance Under Inflation Floor and More Gradual Liftoff Policy Rule
Based on Stochastic Simulations of the FRB/US Model¹

	Actual PCE Inflation ²		Unemployment Rate ²		Policymaker Loss ³		Welfare Improvement Share ⁴
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Median	
Baseline	1.91	0.92	4.91	1.32	74.54	65.88	n.a.
Inflation Floor:							
<i>realized core inflation</i>							
π floor = 1.50, picx4	1.98	0.90	4.74	1.43	76.64	66.72	54.75
π floor = 1.75, picx4	2.04	0.89	4.60	1.51	78.65	67.64	57.03
<i>projected inflation</i>							
π floor = 1.50, zpic58	1.92	0.91	4.88	1.33	74.52	65.91	57.53
π floor = 1.75, zpic58	1.96	0.90	4.81	1.35	74.54	66.09	62.45
More Gradual Liftoff	1.88	0.91	4.95	1.30	73.45	64.77	53.80

1. The threshold on inflation is set to 2.5 percent and the threshold on unemployment is set to 6.5 percent in all of these simulations.
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 2013Q4 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.

Table 3: Joint Probability Distribution of Employment Increases and Labor Market Participation Rate at the Time of Liftoff
 Derived from Stochastic Simulations of the FRB/US Model
 (percent of total simulations)

Labor Market Indicators	Baseline (no floor)	$\pi = 1.5$ (realized core)	$\pi = 1.75$ (realized core)	$\pi = 1.5$ (proj. headline)	$\pi = 1.75$ (proj. headline)	More Gradual Liftoff
Employ gains>250k; LFPR>63.3	27	24	27	27	27	27
Employ gains<250k; LFPR<63.3	18	16	18	18	18	18
Employ gains>250k; LFPR<63.3	49	54	49	49	49	49
Employ gains<250k; LFPR>63.3	6	6	6	6	6	6