

**Finance and Economics Discussion Series
Divisions of Research & Statistics and Monetary Affairs
Federal Reserve Board, Washington, D.C.**

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Mandate**

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2020-066

Please cite this paper as:

Ajello, Andrea, Isabel Cairó, Vasco Cúrdia, Thomas A. Lubik, and Albert Queralto (2020). "Monetary Policy Tradeoffs and the Federal Reserve's Dual Mandate," Finance and Economics Discussion Series 2020-066. Washington: Board of Governors of the Federal Reserve System, <https://doi.org/10.17016/FEDS.2020.066>.

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Monetary Policy Tradeoffs and the Federal Reserve’s Dual Mandate

Andrea Ajello, Isabel Cairó, Vasco Cúrdia, Thomas A. Lubik, and Albert Queralto

August 2020

The analysis in this paper was presented to the Federal Open Market Committee as background for its discussion of the Federal Reserve’s review of monetary policy strategy, tools, and communication practices. The Committee discussed issues related to the review at five consecutive meetings from July 2019 to January 2020. References to the FOMC’s current framework for monetary policy refer to the framework articulated in the Statement on Longer-Run Goals and Monetary Policy Strategy first issued in January 2012 and reaffirmed each January, most recently in January 2019.

Abstract

Some key structural features of the U.S. economy appear to have changed in the recent decades, making the conduct of monetary policy more challenging. In particular, there is high uncertainty about the levels of the natural rate of interest and unemployment as well as about the effect of economic activity on inflation. At the same time, a prolonged period of below-target inflation has raised concerns about the unanchoring of inflation expectations at levels below the Federal Open Market Committee’s inflation target. In addition, a low natural rate of interest increases the probability of hitting the effective lower bound during a downturn. This paper studies how these factors complicate the attainment of the objectives specified in the Federal Reserve’s dual mandate in the context of a DSGE (dynamic stochastic general equilibrium) model, taking into account risk-management considerations. We find that these challenges may warrant pursuing more accommodative policy than would be desirable otherwise. However, such accommodative policy could be associated with concerns about risks to financial markets.

JEL Classification: E32, E52, E58, E61.

Keywords: U.S. monetary policy, optimal policy, discretion.

Note: Authors’ affiliations are Board of Governors of the Federal Reserve System (Ajello, Cairó, Queralto), Federal Reserve Bank of San Francisco (Curdia), and Federal Reserve Bank of Richmond (Lubik), respectively. The authors benefited from the comments and suggestions of David Altig, Jeffrey C. Fuhrer, Marc Giannoni, Thomas Laubach, Giovanni Olivei, and Paula Tkac. The authors would like to thank Sarah Adler, Jay Faris, Owen Kay, Dawson Miller, Patrick Molligo, and Michael Tubbs for their expert research assistance. The analysis and conclusions set forth in this paper are those of the authors and do not indicate concurrence by other Federal Reserve System staff, the Federal Reserve Board, or the Federal Reserve Banks of Richmond and San Francisco.

Introduction and Summary

In recent decades, key features of the U.S. economy appear to have changed in ways that have made the conduct of monetary policy more challenging. The magnitudes and effects of these changes have been difficult to track in real time, and it is by no means certain that all of them have run their course. This paper characterizes those changes and the uncertainty surrounding them. It then discusses some of the challenges these changes and uncertainties pose for the conduct of monetary policy, taking into account risk-management considerations. In particular, we focus on the following aspects of the economy:

- a declining and uncertain natural rate of interest, r^*
- a declining and uncertain natural rate of unemployment, u^* (or, more generally, the degree of resource slack)
- a declining and uncertain effect of real activity on inflation—that is, the slope of the Phillips curve
- concerns about the unanchoring of inflation expectations at levels below the Committee’s inflation goal in the wake of a prolonged period of below-target inflation
- a heightened probability of hitting the effective lower bound (ELB) during a downturn, in large part due to the low level of r^*

We illustrate how these factors complicate the attainment of the objectives specified in the Federal Reserve’s dual mandate in the context of an estimated small-scale New Keynesian dynamic stochastic general equilibrium (DSGE) model. Our analysis aims to inform the debate regarding the ability of the current monetary policy framework (MPF), including the Statement on Longer-Run Goals and Monetary Policy Strategy, to satisfactorily achieve its objectives in this environment.

The uncertainty about these evolving features, coupled with important interactions among them, poses significant challenges to the Federal Open Market Committee (FOMC or “the Committee” hereafter) under the current MPF. Thus, appropriate policy

may differ in important ways from policy in the environment that prevailed before the changes. In particular, we reach the following conclusions:

1. Lower estimates of r^* imply lower nominal interest rates, all else being equal, and thus more limited conventional policy space. In addition, uncertainty about r^* , coupled with the ELB, produces an inherent asymmetry in the losses policymakers face as a result of errors in estimating r^* . In particular, the losses in assuming an r^* that is above the true value are greater than those in assuming an r^* that is lower than the true value because assuming an r^* that is too high results in more restrictive policy than is necessary, lowering inflation and potentially unanchoring inflation expectations. At this point, the constraint imposed by the ELB leads to greater losses: Unemployment is higher, inflation and expected inflation are lower, and the conventional policy space needed to address these error-induced outcomes is limited. However, choosing an r^* that is lower than the true value results in more expansionary policy. Given the flat Phillips curve, the costs in terms of inflation will be relatively small, although the costs in terms of higher unemployment in the future to bring back inflation will be higher. However, once unemployment is higher, the policy space is no longer constrained, so the losses are lower. This asymmetry might lead policymakers to err on the side of choosing a lower estimate of r^* or, equivalently, setting monetary policy as if they have embraced a lower r^* . Recognizing this asymmetry in risks is particularly important when a prolonged period of below-target inflation risks unanchoring inflation expectations, which could lower realized inflation and further reduce the available policy space.
2. Uncertainty about u^* is pervasive, making the determination of appropriate policy difficult. When, in addition, the Phillips curve is flat, inference about the current level of u^* is made even more difficult. For example, it will be difficult to determine if relatively stable inflation arises because the economy is near u^* , because the Phillips curve is flat, or both. Put differently, with a flat Phillips curve, a given set of inflation outcomes will be roughly consistent with a wider range of u^* levels, which makes it difficult to determine what the current u^* is and, thus, the appropriate policy setting.

3. In many models in which agents have rational expectations and have no doubts about the Fed’s commitment to its inflation goal, the interaction between a flat Phillips curve and low inflation does not pose a major challenge in reaching the inflation target. However, in a world in which expectations are adaptive—that is, expectations are importantly dependent on the recent history of actual inflation—the additional sluggishness that such expectations impart to the inflation process can make attainment of the 2 percent inflation goal quite difficult. To avoid getting into a self-reinforcing cycle in which lower inflation pulls down expectations, which pulls down inflation further (and so on), it may be prudent to adopt a more aggressive easing stance than is the case under rational expectations. Such an accommodative monetary policy stance would yield a lower unemployment rate and keep inflation from slipping too low, avoiding a downward expectations–inflation cycle.
4. When inflation—and inflation expectations—fall during a downturn, the constraint imposed by the ELB together with a flat Phillips curve suggests that a prolonged period of near-zero interest rates might be required to return inflation to its target. However, prolonged low interest rates risk the buildup of financial vulnerabilities. This consideration, unlike 1 and 3, would argue for caution in maintaining an accommodative monetary policy stance for too long. However, it is important to note how limited our understanding is of the role of low interest rates in causing financial instability and of the effectiveness of using higher nominal interest rates to reduce the probability of financial instability. The research literature suggests that, when policymakers are uncertain about the severity of a potential financial crisis and the effectiveness of monetary policy in reducing financial stability risks, it may be desirable to adopt a less accommodative policy stance.

The remainder of the paper is organized as follows. In section II, we briefly summarize the FOMC actions and economic outcomes since the Great Recession through 2019. In section III, we describe several ongoing changes in and uncertainty about the structure of the U.S. economy and study their implications for monetary policy tradeoffs. Section IV offers a review of the current literature on costs and benefits of adjusting the

monetary policy stance to lean against financial vulnerabilities. Finally, section V concludes.

I. FOMC Actions and Economic Outcomes since the Great Recession

Figure 1 shows the path of the federal funds rate (FFR), the five-year Treasury yield, the unemployment rate, and the four-quarter change in the headline PCE (personal consumption expenditures) price index over the course of the business cycle ending in 2019. The figure highlights how the unemployment rate increased sharply in the wake of the Great Recession (the shaded area) and stayed significantly above its natural rate for an extended period with limited downward pressure on inflation.¹ While the FFR reached the ELB early in the recession, unconventional policy brought down the level of longer-term yields, providing additional accommodation during the recovery. As the economy strengthened, the unemployment rate declined steadily and in 2018 reached levels well below most estimates of its natural rate. With an increasingly tight labor market, the Committee began reducing policy accommodation at the end of 2015. Inflation, however, has remained consistently below the FOMC's 2 percent target.

The Committee has arguably confronted a number of factors that have affected policy tradeoffs during the recovery and in the process of monetary policy normalization. For example, the apparent weakening of the relationship between inflation and resource utilization has acted as a constraint on the effect of monetary policy stimulus on inflation. In addition, a prolonged downward trend in u^* estimates as well as uncertainty around measures of economic slack and r^* has affected the perceived magnitudes of policy tradeoffs. Some of these challenges are due to long-running trends, while others have emerged in the wake of the Global Financial Crisis (GFC).² In either case, these challenges have affected the conduct of monetary policy. The analysis that follows

¹ Several authors have highlighted that recoveries from major financial crises are especially slow—for example, see Reinhart and Rogoff (2009) and IMF (2009).

² For example, the proximity to the ELB is partially due to long-run trends, but the financial crisis made it a more pressing reality.

discusses how some of these factors affect tradeoffs between the two objectives of the dual mandate with clear implications for monetary policy.

II. Structural Challenges and Monetary Policy Tradeoffs

In this section, we describe several ongoing changes in and uncertainty about the structure of the U.S. economy and study their implications for monetary policy tradeoffs. In particular, we focus on changes in and uncertainty about the level of u^* and r^* , on the stability of inflation expectations, on the effect of real activity on inflation (that is, the slope of the Phillips curve), and on recession risks in the proximity to the ELB.

We consider a quantitative model economy in which we capture a balanced-approach targeting rule by means of an optimal control exercise. Optimal control simulations assume that policymakers set the optimal path for the FFR to minimize a discounted weighted sum of squared inflation gaps, squared unemployment gaps, and squared changes in the FFR.³

As our laboratory, we use a small-scale New Keynesian DSGE model based on Cúrdia, Ferrero, Ng, and Tambalotti (2015), which is an extension of the core three-equation workhorse model for monetary policy analysis as popularized by Clarida, Galí, and Gertler (1999) and Woodford (2003).⁴ Throughout the paper, this model serves as the benchmark conceptual framework to discuss and analyze the questions at hand.

Figure 2 sets the stage for the analysis by comparing the nominal and real FFR, unemployment, and PCE price inflation outcomes from 2015 through 2019 (in black)

³ The simulations in this paper assume that policymakers act under discretion in a manner consistent with the scope outlined within the current Statement on Longer-Run Objectives and Monetary Policy Strategy. We leave the distinction between discretion and commitment for future research.

⁴ The model uses the structure described in Cúrdia, Ferrero, Ng, and Tambalotti (2015) and is augmented with a version of Okun's law to relate slack in output to labor markets. It is fitted to data on real GDP growth, core PCE inflation, the effective FFR, and unemployment, all from 1987:Q2 through 2019:Q1. We fit the model's u^* to the midpoint of the central tendency for the longer-run unemployment rate in the Summary of Economic Projections from 2012 onward and to the Congressional Budget Office short-run estimate before 2012. We also match model-implied FFR expectations to term-premium-adjusted, market-implied FFR expectations using the Christensen and Rudebusch (2012) model.

with the corresponding paths under optimal control (in blue), accounting for the role of uncertainty in model estimates (shaded area).⁵ In this model, the optimal path of the FFR after liftoff is slightly less accommodative than the historical data.⁶ Under the policymakers' preferences, the undershooting of unemployment below its natural rate is costly, and they would have been willing to trade off somewhat larger inflation misses for a path of unemployment closer to its estimated natural rate.

The case presented in figure 2 will function as a benchmark and is arguably subject to a number of limiting assumptions that may not fully capture the scope of the policy debate during the period under analysis. First, this analysis is *ex post* and does not account for real-time considerations. For example, expectations about the time needed to close the unemployment rate gap have been too pessimistic, which is one of the reasons for the differences between the observed path of the FFR and the *ex post* optimal control prescription. Second, in recent years the U.S. economy has faced a number of structural changes that may have influenced the conduct of monetary policy. For example, policymakers have acknowledged the presence of considerable uncertainty over estimates of resource utilization, the short- and longer-run level of r^* , and the sensitivity of price and wage inflation to labor market tightness. In the following subsections, we discuss several of these structural changes and use modified assumptions in our optimal control exercise to illustrate their implications for the tradeoffs associated with the dual mandate.

⁵ The blue shaded area represents the 90 percent intervals of optimal policy paths and outcomes that account for uncertainty around the model estimates (of parameters and states of the economy). We estimate the state of the economy and the shocks that affected its path through recent history by filtering the data through the model under the assumption that the FFR was set according to the estimated historical rule. We conduct optimal control simulations from 2016:Q1 up to the current quarter, conditional on the estimates of the state of the economy in 2016:Q1 and the shocks that hit the economy since then. We consider a standard loss function that places equal weights on squared inflation gaps (measured as the difference between four-quarter inflation and the Committee's 2 percent objective), squared unemployment gaps (measured as the difference between the unemployment rate and its natural rate), and squared changes in the FFR. Policymakers discount the future using a quarterly discount factor of 0.99.

⁶ The difference between the optimal path of the FFR and the historical data might be more pronounced in alternative models, such as FRB/US, that feature a lower interest rate elasticity of demand.

Lower and Uncertain Natural Rate of Interest

A number of studies have highlighted the downward historical trend and very low current estimates of r^* , with the possibility that it may remain at low levels for years to come.⁷ In our model, the short-run estimate of r^* is around negative 1 percent at the beginning of liftoff and around 1 percent by the end of 2018. Cúrdia (2015) shows that each new data vintage that became available over the recovery period that followed the GFC led to downward revisions to the estimates of the time-varying short- and medium-run r^* .

This evidence suggests that r^* appears to have been lower than what policymakers previously thought; hence, monetary policy was less accommodative than desired. Had policymakers been aware of the lower level of r^* , the FFR path might have been lower. By itself, a lower level of r^* does not substantially alter the tradeoffs of monetary policy unless the ELB is a binding constraint. When the ELB binds, conventional monetary policy is unable to provide enough stimulus, leading to weaker inflation and higher unemployment.⁸

To illustrate this point, we consider scenarios in which short-run r^* takes values that are, on average, lower and more volatile than in the baseline estimate, assuming that policymakers correctly estimate the alternative paths.⁹ Figure 3 plots the median outcomes for the same variables described in figure 2 for this scenario (in red) compared with the baseline case (in blue).¹⁰ In the presence of a lower r^* , optimal control yields a downward shift in the path of the FFR. The median effects on unemployment and inflation are relatively small because in 2016 the ELB was no longer binding, even under

⁷ See, for example, Laubach and Williams (2016) and Bauer and Rudebusch (2019).

⁸ In theory, if policymakers are credible and can commit to future policy actions, then they can promise continued accommodative policy that leads to higher expected inflation in the future. Higher expected inflation lowers the real interest rate, providing the stimulus that the nominal interest rate could not give because of the ELB (see Eggertsson and Woodford, 2003). In the absence of such commitment, policymakers are more limited in their ability to stimulate the economy—they cannot promise future above-target inflation.

⁹ The path of short-run r^* , starting in 2016:Q1, is drawn from a distribution that, on average, is shifted down 75 basis points and is three-fourths of a standard deviation more volatile than in our baseline case.

¹⁰ Note that the dispersion around the lower average path of r^* also leads to wider uncertainty bands (the red shaded area) in figure 3 relative to figure 2.

a lower average value for r^* . However, volatility in r^* is sufficiently large that in scenarios in which r^* is very low the FFR would be constrained by the ELB for some time, leading to higher unemployment and weaker inflation. As a result, compared with our baseline simulation shown in figure 2, the range of outcomes for the FFR is skewed to the downside throughout the simulation period. Correspondingly, the distribution of outcomes for unemployment is strongly skewed to the upside, especially in 2016 and 2017 when conventional policy space was still scarce. Similarly, inflation outcomes for 2016 in this scenario are skewed to the downside.

The previous simulation highlights the risks posed by low and volatile estimates of r^* in the presence of the ELB. An important factor in this discussion is that we have been treating r^* as known in all cases in figure 3 but, in reality, policymakers (and market participants) face considerable uncertainty about the true value of r^* . Given this uncertainty, risk-management considerations become essential.

On the one hand, if the true r^* were lower than policymakers' estimates, then policy would be excessively tight and inflation could become entrenched at low levels. With a relatively flat Phillips curve and the ELB constraining conventional policy space, it would be difficult to stabilize the economy in line with the dual-mandate objectives. On the other hand, if market participants believe that r^* is higher than policymakers' estimate, then the policy stance may be too loose, leading private forecasts of future inflation to climb. Especially if higher expectations of inflation feed through to inflation, policymakers may then choose to tighten policy, even if their estimate of r^* is low. However, a relatively flat Phillips curve suggests that it is unlikely that inflation would take off very quickly under such a scenario. In addition, policymakers can rely on extensive historical knowledge on stabilizing high inflation, compared with the more limited experience on how to deal with low inflation in a low interest rate environment.

Figure 4 illustrates these considerations in an environment in which policymakers misperceive the decline in r^* relative to figure 3.¹¹ In black we show the same fall in r^*

¹¹ In the simulations in figure 4 we assume that policymakers lean toward their estimate of r^* through a loss function that penalizes differences between the real interest rate and their estimate of the natural rate (with a small coefficient of 0.1). This additional term does not materially alter the path shown in figure 3.

as in figure 3. The blue line shows the behavior of the economy in a scenario in which policymakers fail to identify the decline in r^* and lean toward a level of r^* that is too high, leading to overly tight policy—as signaled by the higher path of the real FFR. In response to the tight policy, inflation is noticeably lower and unemployment is higher. This weaker outlook leads policymakers to adopt a lower nominal FFR despite the higher perceived r^* , and liftoff is delayed until the first half of 2017. The red line shows the alternative scenario in which policymakers instead overestimate the fall in the natural rate and thus overstimulate the economy, bringing inflation closer to target and unemployment further below its natural rate. Despite the initial looser monetary policy stance, as signaled by the path of the real FFR, policymakers increase the level of the FFR more aggressively as the economy firms up. This move allows for additional conventional monetary policy space to respond to future downside risks.

Due to the strong asymmetry in unemployment outcomes of conducting policy under the perception that r^* is too low rather than too high with respect to its true value, policymakers facing uncertainty about r^* may prefer to err on the side of overstimulating the economy.¹²

¹² For example, Evans and others (2015) argue that a delayed liftoff in 2015 was desirable in an uncertain economic environment when factoring in the possibility that the nominal interest rate could be constrained by the ELB.

Lower Natural Rate of Unemployment

The definition of maximum employment in the dual mandate is subject to interpretation. Usually, this mandated objective is interpreted as minimizing the deviations of unemployment from its natural rate. In this setting, u^* is defined as the rate of unemployment that would prevail if the economy were operating at full capacity with no resource utilization slack or overuse and no upward or downward pressures to inflation. However, there is uncertainty around how estimates of unemployment gaps and other measures of labor market slack correspond to resource utilization gaps, and this issue has implications for monetary policy.¹³

Estimates of u^* are themselves highly uncertain and subject to revision. In particular, the Summary of Economic Projections shows that expectations of the longer-run unemployment rate differ significantly among FOMC participants and have been revised downward over the past few years (see the top panel of figure 1 in Caldara and others, 2020). Research suggests that part of the decline in u^* reflects long-run trends related to demographics.¹⁴ However, the history of low inflation in recent years, despite what many perceive as a tight labor market, has prompted policymakers and private analysts to reduce their projections of u^* and also to be open to even lower estimates.

A flat Phillips curve environment might hinder the ability of policymakers to identify changes in u^* in real time. To illustrate this point, figure 5 considers the case in which the potential capacity of the economy is stronger and, consequently, u^* is

¹³ Policymakers expressed concern during the recovery that the unemployment rate might not be a sufficient statistic of labor market slack and instead suggested monitoring a broad range of labor market indicators (Bernanke, 2012; Bullard, 2014; Plosser, 2014; Yellen, 2014; Williams, 2017; and Kashkari, 2017). Erceg and Levin (2014) argue that the labor force participation rate (LFPR) should be taken into account, in addition to the unemployment rate, when setting monetary policy after a deep recession that leaves the LFPR well below its longer-run potential level. Reifschneider, Wascher, and Wilcox (2015) also show that the possibility that potential output will be affected by adverse demand shocks through hysteresis-like effects leads optimal monetary policy to be more activist in order to mitigate the possible damage to the current and future supply side of the economy. Rudebusch and Williams (2016) consider the difference between short- and long-term unemployment and how the distinction may lead to a wedge between the unemployment gap and the relevant measure of economic slack.

¹⁴ See, for example, Aaronson and others (2015) and Hornstein and Kudlyak (2019).

0.8 percentage point lower on average than in figure 2. Figure 5 compares the FFR path, the real FFR, and economic outcomes from 2015 to the present under optimal control for two alternative economies. In the benchmark economy (in blue), u^* evolves over time following the same estimate as in figure 2. In the alternative economy (in red), u^* follows the alternative lower path.¹⁵

With a lower level of u^* , there is less tightness in the labor market than in the baseline optimal control simulation. As a result, policymakers tighten policy more gradually. Despite the lower degree of labor market tightness, inflation outcomes are little changed due to the flat Phillips curve. These results highlight the challenges in identifying changes in u^* in an environment characterized by a weak response of inflation to resource slack.

Beyond our model simulations, the literature generally recommends caution in responding to measured unemployment gaps that may be imperfect measures of economic slack.¹⁶ For example, Orphanides and Williams (2005, 2007) show that when there are misperceptions about u^* and private agents are learning about it, policymakers should employ more inertia, a stronger response to inflation, and a smaller response to the (mis)perceived unemployment gap. Therefore, if the uncertainty is skewed toward a lower u^* —more slack in the economy—and inflation pressures are missing, policymakers should not push hard against the unemployment gap and should focus more on inflation.

Others, however, have challenged this conclusion and argued that policymakers might want to react to measures of resource slack even in the presence of mismeasurement and uncertainty about this variable. For example, Erceg and others (2018) find that a meaningful response to resource utilization is likely to be beneficial,

¹⁵ The alternative lower path of u^* is shown as a dashed line in figure 5.

¹⁶ Brainard (1967) discussed that, in the presence of uncertainty, policymakers should be more conservative while gathering more evidence.

even if the latter is mismeasured. This is particularly so in environments where resource utilization is thought to be tight to begin with and inflation is close to target.¹⁷

The Slope of the Phillips Curve and Inflation Expectations

While labor markets have tightened steadily in recent years, inflation has consistently underperformed relative to the FOMC's medium-term objective of 2 percent. Recent research points to the Great Recession and the subsequent economic expansion as evidence that the sensitivity of inflation to resource slack (the slope of the Phillips curve) has decreased in comparison to the U.S. historical experience.¹⁸ A flatter Phillips curve is often good news for policymakers, as it reduces the tradeoffs involved with stimulating the economy without compromising inflation. However, in a situation in which both inflation and resource slack are low, a flatter Phillips curve actually exacerbates the tradeoffs because closing the inflation gap would require an even larger miss on unemployment vis-à-vis its natural rate. In the recent period, a flatter Phillips curve would explain why inflation has remained so subdued while the labor market tightened.¹⁹

The analysis so far assumes that market participants' long-run inflation expectations are well anchored at the FOMC's target of 2 percent. However, there is the

¹⁷ Levin, Wieland, and Williams (2003) also argue for policy inertia and a strong response to a stable projection of underlying inflation, but they call as well for a strong response to the output gap when policymakers face uncertainty regarding key structural features of the economy. In this case, there is no learning about the unemployment gap as a measure of economic slack but rather uncertainty about the dynamics of inflation and the output gap. Therefore, responding to the output gap helps stabilize the economy because there is no misperception about what that gap is, only about its dynamics.

¹⁸ See Ball and Mazumder (2011); IMF (2013); Blanchard (2016); Del Negro, Giannoni, and Schorfheide (2015); and Kiley (2015) for a review of the evidence. A number of compelling explanations have emerged, linking the apparent breakdown of the tradeoff between economic activity and inflation pressure to structural features of the U.S. economy. In particular, studies have focused on changes in labor market structure (see Autor and others, 2017; Daly and Hobijn, 2014; and Leduc and Wilson, 2017), the role played by central bank independence and credibility on the anchoring of inflation expectations (see IMF, 2013; Blanchard, 2016), and deflationary pressures in the proximity of the ELB (Aruoba, Cuba-Borda, and Schorfheide, 2016). In the quantitative model that we use for numerical simulations, the posterior median estimate for the full sample (1987:Q2 through 2019:Q1) is 0.022, which compares with a 0.038 posterior median for the subsample ending in 2007:Q4.

¹⁹ Rather than signaling a flattening of the Phillips curve, low inflation outcomes could alternatively be a signal that policymakers' estimate of u^* is too elevated.

risk that a long spell of below-target inflation may trigger a fall in longer-run expected inflation.

This section examines the consequences for monetary policy of a partial unanchoring of longer-run inflation expectations in the context of a flat Phillips curve. To implement this scenario, we assume that market participants’ “perceived” inflation target differs from the central bank’s actual target and reacts, in part, to realized inflation over the past year. In addition, we assume that, starting in the current quarter, the public forms expectations of inflation adaptively: Expected inflation in the following quarter is a weighted average (with equal weights) of the model-consistent expectation and the public’s perceived inflation target.²⁰

Figure 6 shows in black the baseline case, in which we simulate the economy post-2019:Q1 without further shocks and under optimal control. Our baseline case shows that, in a world of rational expectations and a credible anchor, both inflation and unemployment reach their targets relatively quickly. In blue, we plot the resulting paths under optimal control with adaptive inflation expectations. Given the history of below-target inflation, long-run inflation expectations fall persistently below 2 percent.²¹ In response to lower inflation expectations, policymakers keep the FFR considerably lower than in the baseline. The additional accommodation keeps unemployment persistently below its natural rate, which helps bring inflation back to target—albeit very slowly. This pattern is typical of cost-push pressures that increase the tension between the two objectives. In this case, the pressures emerge from the partial unanchoring of inflation expectations. Policymakers respond by mitigating the unanchoring at the expense of driving unemployment further below its natural rate.

²⁰ Arias, Erceg, and Trabandt (2016) employ a similar approach to capture imperfectly anchored inflation expectations. We assume that market participants’ perceived inflation target has a weight of 0.95 on average inflation over the past four quarters, while the announced FOMC target has a weight of only 0.05.

²¹ By contrast, in the baseline simulation, five-year expected inflation never materially differs from 2 percent.

The policy prescription just outlined partly reflects the very flat estimated Phillips curve. To illustrate this point, the red line in figure 6 repeats the earlier exercise, but this time assuming the Phillips curve turns steeper at the start of the simulation.²² With inflation more responsive to slack, policymakers are able to mitigate substantially the unanchoring of inflation expectations. Unemployment remains below its natural rate but lies above the case with a flatter Phillips curve, as a more limited degree of labor market tightness is needed for inflation to return quickly to target. These results underscore how the flatness of the Phillips curve can pose a considerable challenge for policymakers, as it is responsible for an extremely slow return of inflation to target.

Recession Risk and the Effective Lower Bound

We have discussed how a persistently lower level of r^* may have influenced the path of policy normalization and outcomes vis-à-vis the dual mandate. Several studies have documented the continued decline in levels of r^* in the United States and abroad, raising the risk that policy is constrained by the ELB.²³ In this section, we consider the possibility of a future recession and analyze how it may interact with the ELB constraint.

In particular, we construct a scenario in which the level of productivity falls sharply in 2021, pushing the economy into recession. To illustrate the ELB risk, we assume that the FFR is below 3 percent just before the recession hits.²⁴ Figure 7 shows, in black, the resulting economic outcomes under optimal control. As policy provides accommodation to fight the recession, the FFR falls to the ELB and remains there for

²² We assume that the slope switches to 0.10, about four and a half times the estimated posterior median.

²³ See, for example, Laubach and Williams (2016); Holston, Laubach, and Williams (2017); Del Negro and others (2017); and Lewis and Vazquez-Grande (2017), among others.

²⁴ In this simulation, we let shocks hit the economy from mid-2019 through the end of 2020 and compute responses of the economy conditional on the estimated historical rule. In 2021:Q1, we shut down all shocks other than the productivity shock. A recession takes place as a result of two consecutive innovations to productivity with negative three-fourths of a standard deviation in the first and second quarters of 2021. We further assume that the shock to productivity persists over time following an AR(1) process with a persistent coefficient of 0.9. Optimal control starts in 2021:Q1. We build the scenario by generating 1,000 simulations subject to parameter, state, and shock uncertainty. We then use only those simulations with an FFR below 3 percent at the end of 2020.

some time, unemployment climbs, and inflation remains weak. These results illustrate how, in a recession scenario, the limited conventional policy space due to the ELB worsens economic outcomes.²⁵

A relevant consideration when the economy needs stimulus at the ELB is the slope of the Phillips curve. Figure 7 shows, in blue, the path of the economy when the Phillips curve becomes steeper at the start of the recession.²⁶ With a more responsive inflation rate and despite the fact that the FFR is still constrained by the ELB, the real FFR is lower, which mitigates the increase in the unemployment rate during the recession. Because a steeper Phillips curve alleviates the tension between the objectives of the dual mandate, policymakers can optimally trade off a reduction in unemployment with a temporary increase in inflation. As a result, policy normalization also happens earlier. Conversely, a flat Phillips further complicates policymakers' efforts to stabilize the economy in a recession scenario with a binding ELB.

III. Monetary Policy and Financial Stability: A Cautionary Tale

Our analysis has so far highlighted how structural changes in the U.S. economy and uncertainty around key policy variables may warrant the adoption of an accommodative policy stance to achieve the dual mandate and stave off risks deriving from the proximity to the ELB. Policymakers might be concerned, however, that in a low interest rate environment, loose financial conditions may foster excessive risk-taking and favor the buildup of financial vulnerabilities that could endanger future economic growth. This section offers a review of the current literature on costs and benefits of adjusting the monetary policy stance to lean against financial vulnerabilities.

Monetary policy decisions transmit through credit markets and can potentially affect credit and risk allocations in the economy and the buildup of financial

²⁵ The Committee could deploy other unconventional tools to mitigate the effects of the ELB. See Caldara and others (2020) for a discussion on forward guidance and balance sheet policies.

²⁶ We again assume that the slope switches to 0.10.

vulnerabilities.²⁷ The FOMC maintained an extraordinary degree of policy accommodation in the aftermath of the Great Recession, and the policy normalization process has been gradual by historical standards. In addition, some of the risks we highlighted earlier—such as the unanchoring of inflation expectations of figure 6 or the future recession scenario of figure 7—call for policies that keep interest rates very low far into the future.

Policies involving low rates for extended periods may contribute to a buildup of financial vulnerabilities. Low interest rates fuel credit and asset price growth and may encourage risk-taking by financial market participants—thus raising the risk of a future financial crisis in which the unemployment rate rises sharply. For this reason, a policymaker who explicitly takes into account the effect of financial instability on the frequency and severity of financial crises might consider a tighter policy stance than otherwise. Less accommodative policy in this framework has the added benefit of reducing the probability of a future crisis even if it leads to a rise in current unemployment and to a softer inflation outlook.

Though not without controversy, the post-crisis consensus stresses that tightening the monetary policy stance to mitigate risks of financial instability may produce costs in terms of a weakened economic outlook that outweigh the benefits of a reduction in the probability of future financial crises.²⁸ The same view argues that the first line of defense

²⁷ In determining the course of monetary policy, the Committee closely monitors how changes in financial conditions affect its ability to achieve the dual mandate. Financial conditions—describing the ease with which firms and households obtain financing—have predictive power for forecasting future economic activity and play a central role in analyses of the transmission of monetary policy to the real economy. Cúrdia and Woodford (2016) extend the New Keynesian model at the basis of our analysis to allow credit spreads to emerge and introduce a wedge between borrowers and savers as a gauge of financial conditions. They find that following a flexible targeting criterion in terms of inflation and the output gap, similar to the one found to be optimal for the model economy without financial frictions, performs reasonably well. They show that implementation of optimal policy requires accounting for the effect of financial conditions on economic dynamics, but the analysis suggests that there is little need to change the guiding principles of monetary policy in their relatively simple model. Our paper starts from this premise, and the current section focuses instead on the costs and benefits of using monetary policy to foster financial stability.

²⁸ Some researchers have argued that monetary policy should be used to “lean against the wind” of credit and asset price increases to reduce the likelihood of a financial crisis. See, for example, Carlstrom, Fuerst, and Paustian (2010); Woodford (2012); and Borio and Zhu (2012).

against financial stability risks should be supervisory, regulatory, and macroprudential tools.²⁹

Policymakers called to make monetary policy decisions in the presence of financial stability risk may face pervasive uncertainty about the efficacy of monetary policy tools in affecting predictors of financial instability. Their assessment would rely on comparing estimates of losses in output and inflation arising from policy tightening that responds to instability concerns against the potential benefit of lower financial vulnerabilities and probabilities of a future downturn.³⁰

The infrequent nature of financial crises in history makes the relationship between indicators of vulnerabilities and the probability of future financial crises hard to estimate. Similarly, recent studies have documented a large dispersion in the severity of crisis episodes across countries and time.³¹ Moreover, the structure of the economy and of the monetary policy transmission channels can change over time, and estimates on the effectiveness of monetary policy in preventing or reducing the effect of crises are limited and subject to substantial uncertainty.³²

Ajello Laubach, López-Salido, and Nakata (2019) study the optimal monetary policy response to financial stability risks and find that uncertainty can magnify the expected benefits of leaning against financial imbalances and consequently increase, rather than attenuate, the optimal degree of tightening in response to financial stability

²⁹ For example, Altinoglu and others (2019) find a large net benefit of using countercyclical macroprudential policy to mitigate vulnerabilities associated with credit and house price growth.

³⁰ Svensson (2014, 2017) follows Schularick and Taylor (2012) in assuming that high credit growth over the medium term is a reliable predictor of financial instability. He assesses that the effect of changes in the policy rate on credit growth is minimal and, hence, the benefit of running tighter policy in terms of reducing the probability of future crises is too small relative to the costs imposed by higher unemployment and subdued inflation.

³¹ See, for example, Reinhart and Rogoff (2009, 2014); Jordà, Schularick, and Taylor (2013); and Romer and Romer (2017).

³² For a recent empirical assessment of the effect of monetary policy on a wide range of indicators of financial vulnerability regularly monitored by the Federal Reserve Board and the Office of Financial Research, see Ajello (2020).

risk.³³ In particular, they highlight that policymakers who face uncertainty about the effectiveness of monetary policy in reducing financial vulnerabilities and about the severity of a potential crisis may wish to run a considerably tighter monetary policy stance than in the case without uncertainty.

IV. Conclusion

This paper has reviewed key challenges facing the Committee that have come to prominence as policy normalization progressed. These include the preeminence of ELB risk in a low-rate environment, the difficulties associated with ascertaining the true degree of economic slack, and the dangers of inflation expectations drifting below 2 percent in a world in which the Phillips curve is flat. These challenges may warrant pursuing more accommodative policy than would be desirable otherwise. Financial stability risks, however, provide a note of caution in the pursuit of accommodative policy.

The Statement on Longer-Run Goals and Monetary Policy Strategy adopted by the FOMC in 2012 and last reaffirmed in January 2019 appropriately highlights some of the key policy tradeoffs we identify. However, it could potentially go further in acknowledging the risk-management considerations involved when operating an economy in the vicinity of the ELB and in a low r^* environment. Furthermore, it could highlight the tensions between financial stability concerns and the need to address uncertainties that interact with the ELB. The adoption of such language in the statement could encourage more nuanced communications to ensure that policy achieves the intended results in the context of a balanced approach.

³³ They find this result in a simple New Keynesian model calibrated to the U.S. economy and similar in spirit to the one used in this paper. In the model, monetary policy affects financial conditions and aggregate credit growth; elevated credit growth can increase the probability of the economy entering a financial crisis and suffering from a severe downturn.

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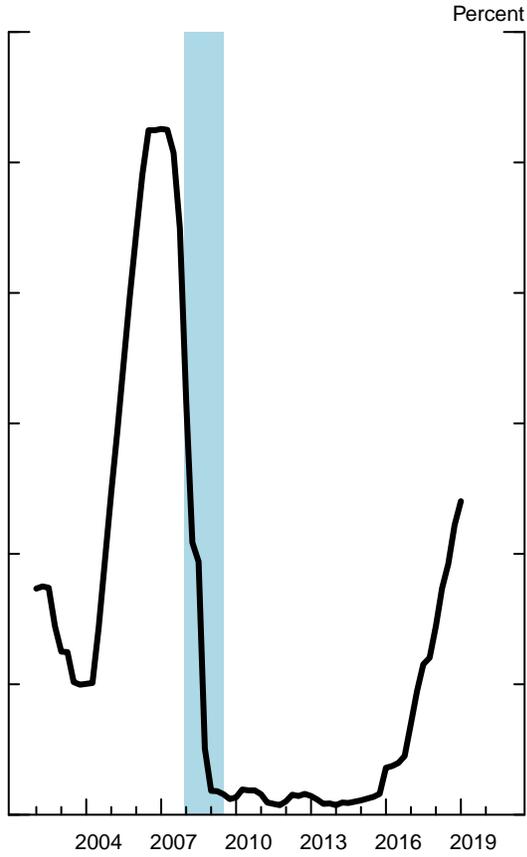
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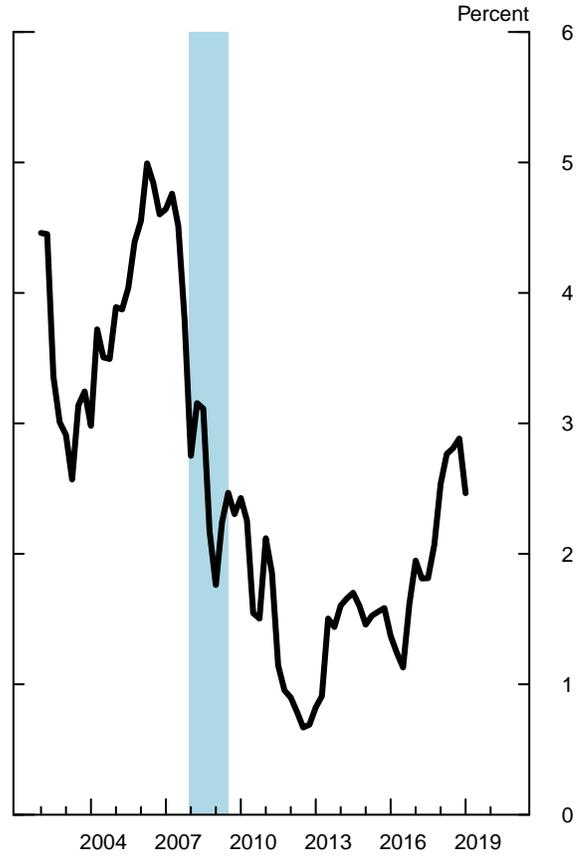
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Figure 1
U.S. Policy Rate and Economic Outcomes

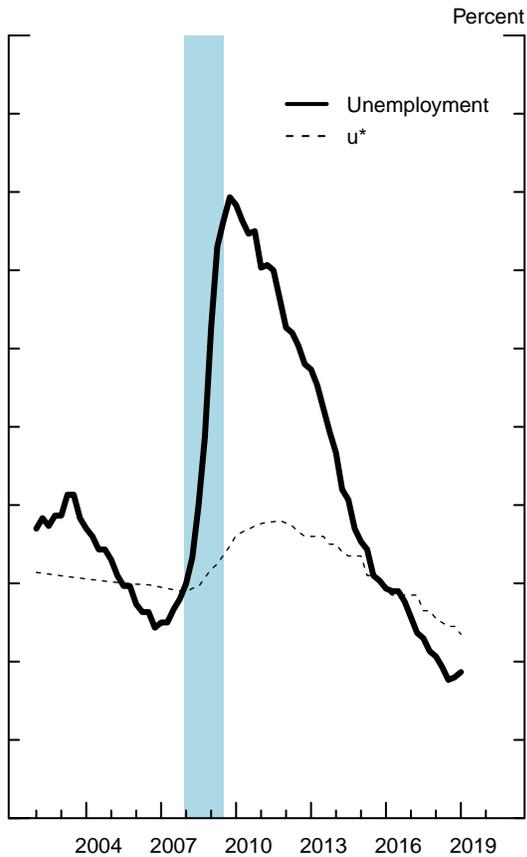
Nominal Federal Funds Rate



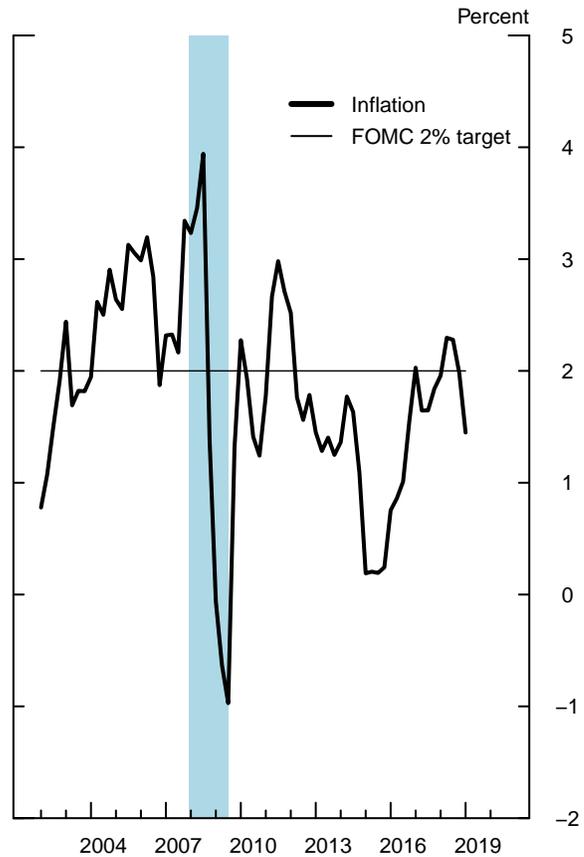
5-Year Treasury Yield



Unemployment Rate



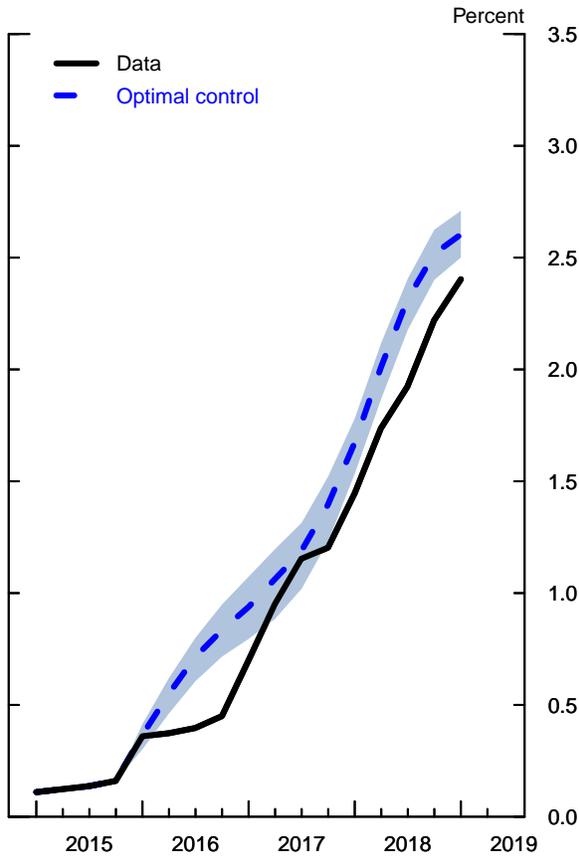
PCE Inflation



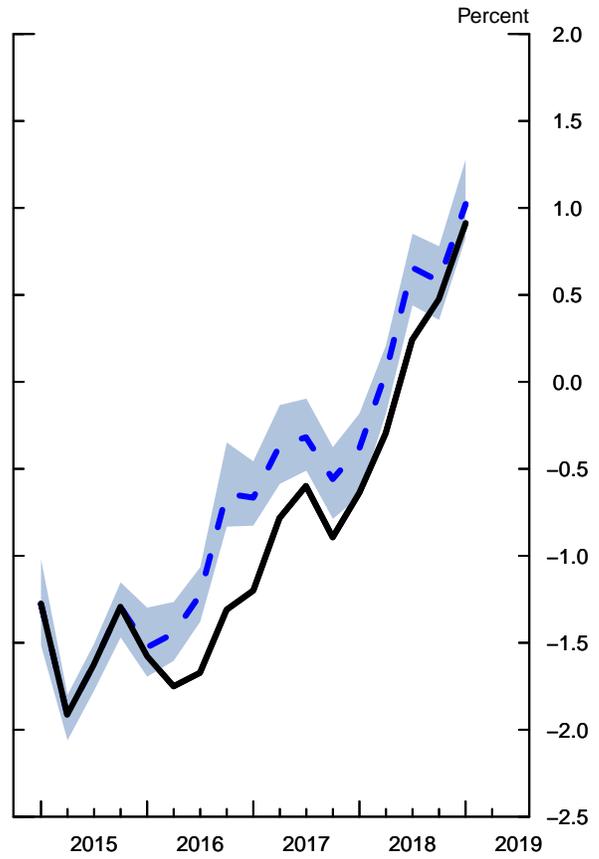
Note: The shaded areas indicate a period of business recession as defined by the National Bureau of Economic Research. PCE is personal consumption expenditures.

Figure 2
Optimal Control Simulations under Discretion: Benchmark Estimation

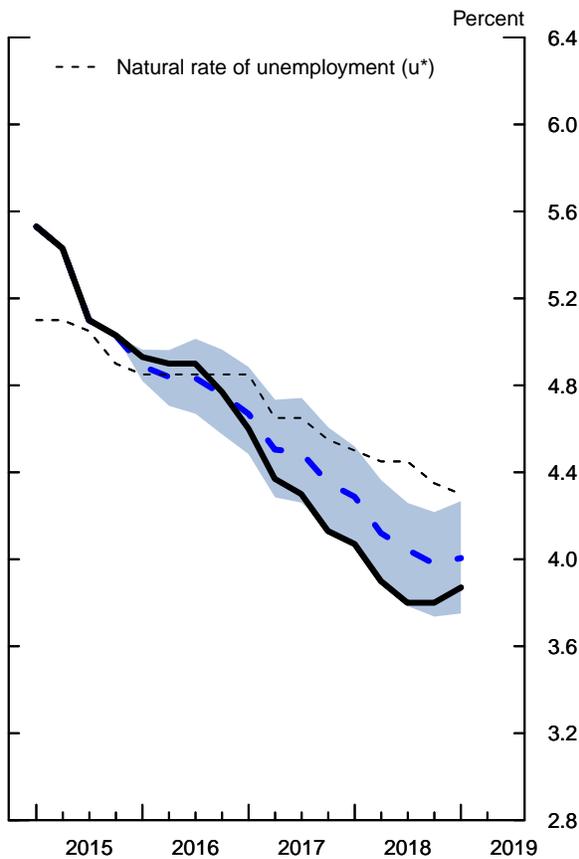
Nominal Federal Funds Rate



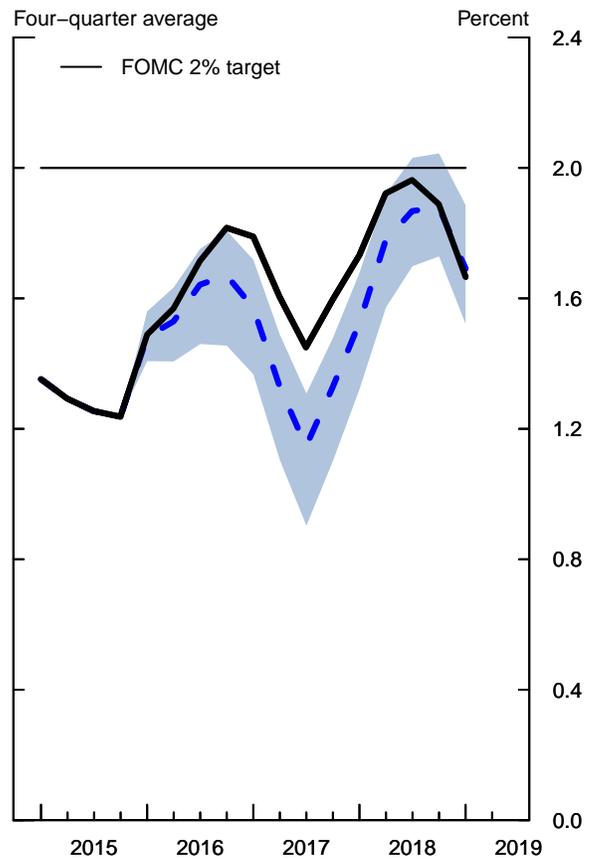
Real Federal Funds Rate



Unemployment Rate



Core PCE Inflation

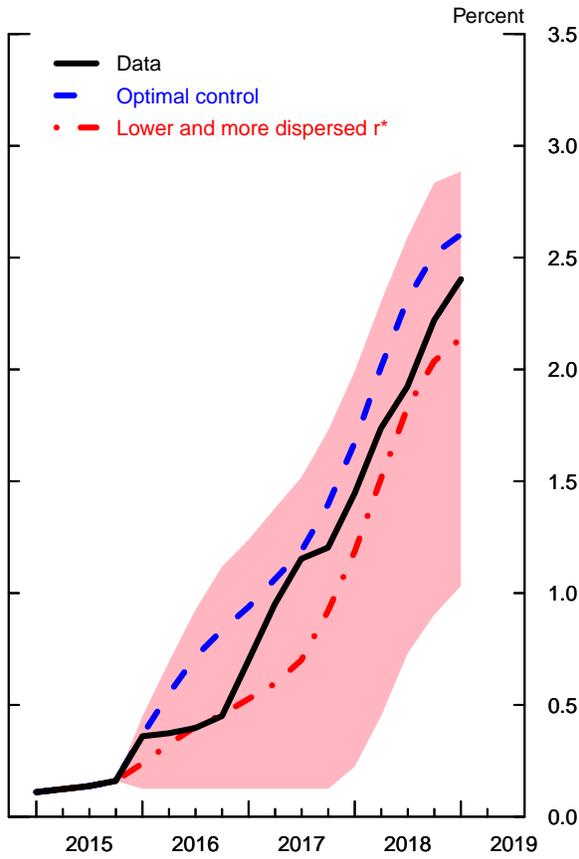


Note: PCE is personal consumption expenditures.

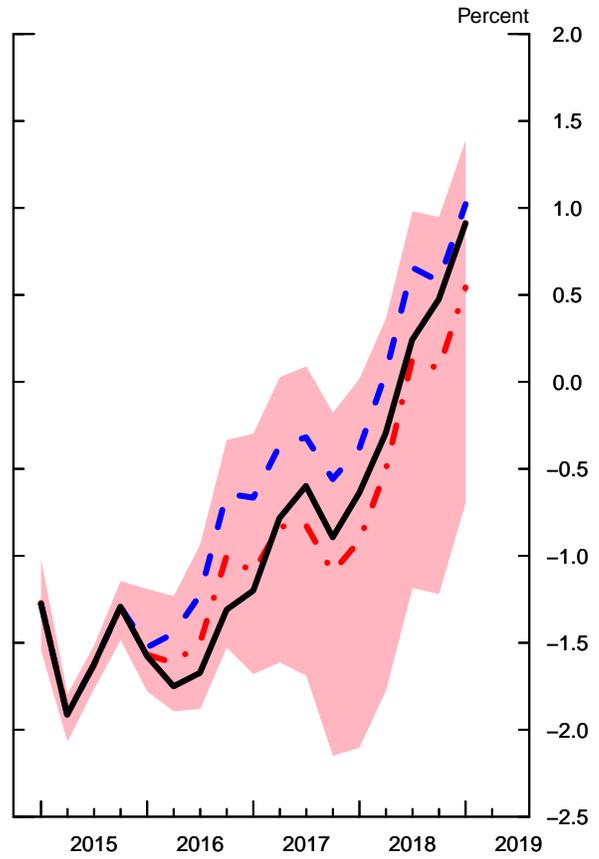
Source: Board of Governors of the Federal Reserve System (nominal federal funds rate and 5-year Treasury yield); U.S. Bureau of Labor Statistics (unemployment rate); U.S. Congressional Budget Office and U.S. Federal Open Market Committee (natural rate of unemployment); U.S. Bureau of Economic Analysis (PCE inflation); Survey of Professional Forecasters (10-year inflation expectations); Jens H.E. Christensen and Glenn D. Rudebusch, "Treasury Yield Premiums," complete model data available on the Federal Reserve Bank of San Francisco's website at <https://www.frbsf.org/economic-research/indicators-data/treasury-yield-premiums> (FFR expectations); authors' calculations.

Figure 3
Optimal Control Simulations under Discretion: Lower and More Dispersed r^*

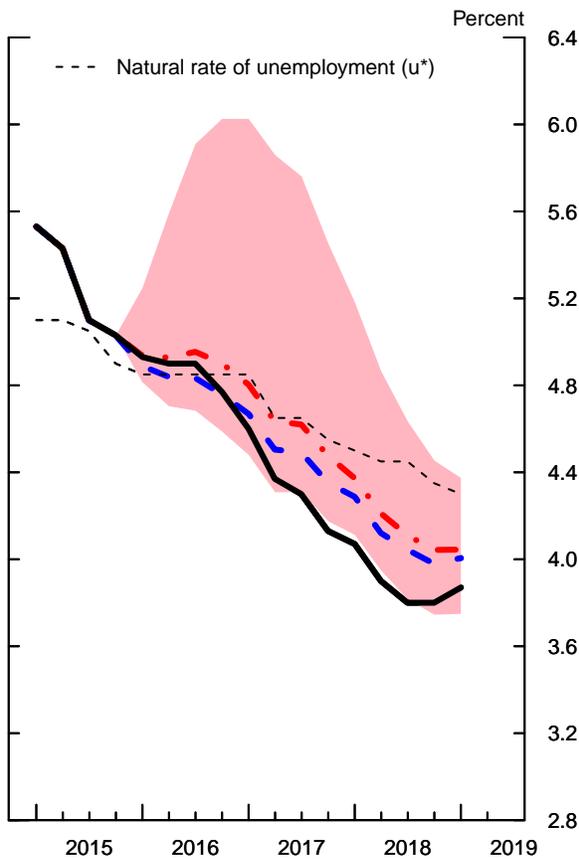
Nominal Federal Funds Rate



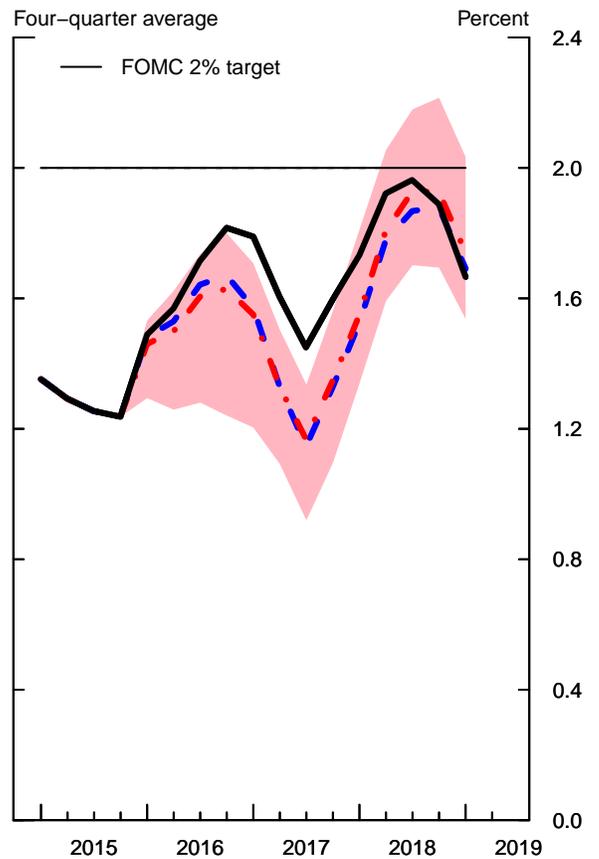
Real Federal Funds Rate



Unemployment Rate



Core PCE Inflation

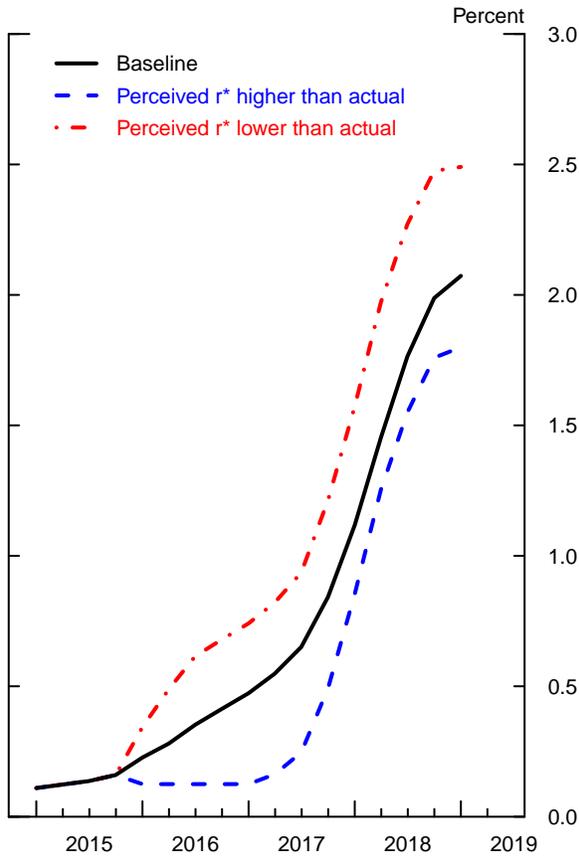


Note: PCE is personal consumption expenditures.

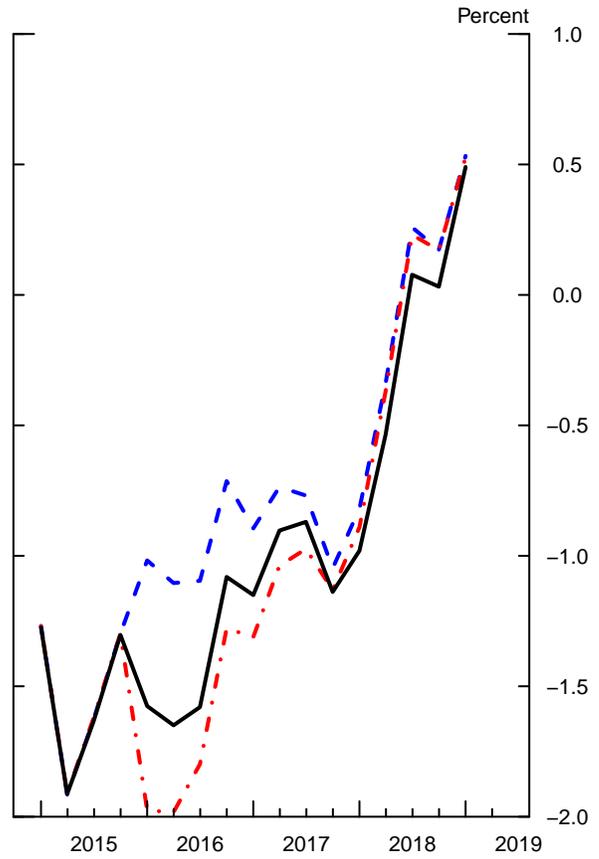
Source: Board of Governors of the Federal Reserve System (nominal federal funds rate and 5-year Treasury yield); U.S. Bureau of Labor Statistics (unemployment rate); U.S. Congressional Budget Office and U.S. Federal Open Market Committee (natural rate of unemployment); U.S. Bureau of Economic Analysis (PCE inflation); Survey of Professional Forecasters (10-year inflation expectations); Jens H.E. Christensen and Glenn D. Rudebusch, "Treasury Yield Premiums," complete model data available on the Federal Reserve Bank of San Francisco's website at <https://www.frbsf.org/economic-research/indicators-data/treasury-yield-premiums> (FFR expectations); authors' calculations.

Figure 4
Optimal Control Simulations under Discretion: Misperceived r^*

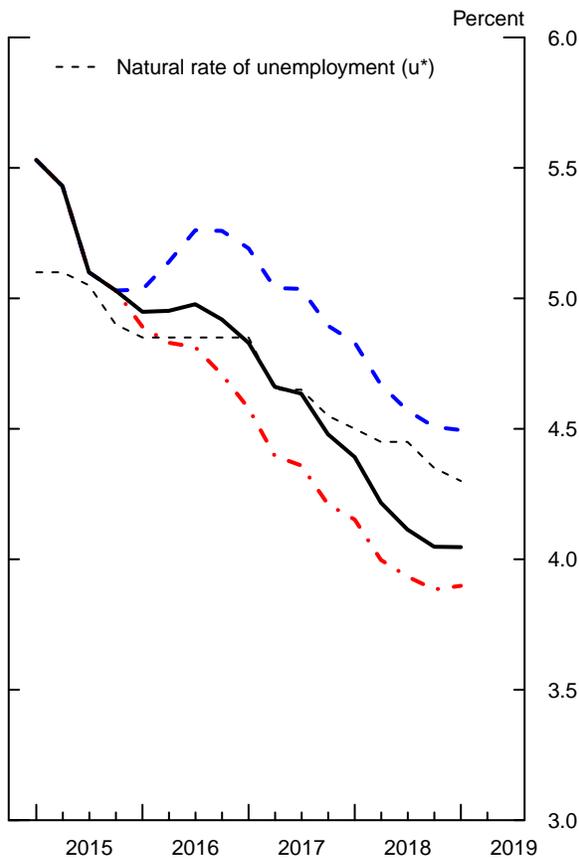
Nominal Federal Funds Rate



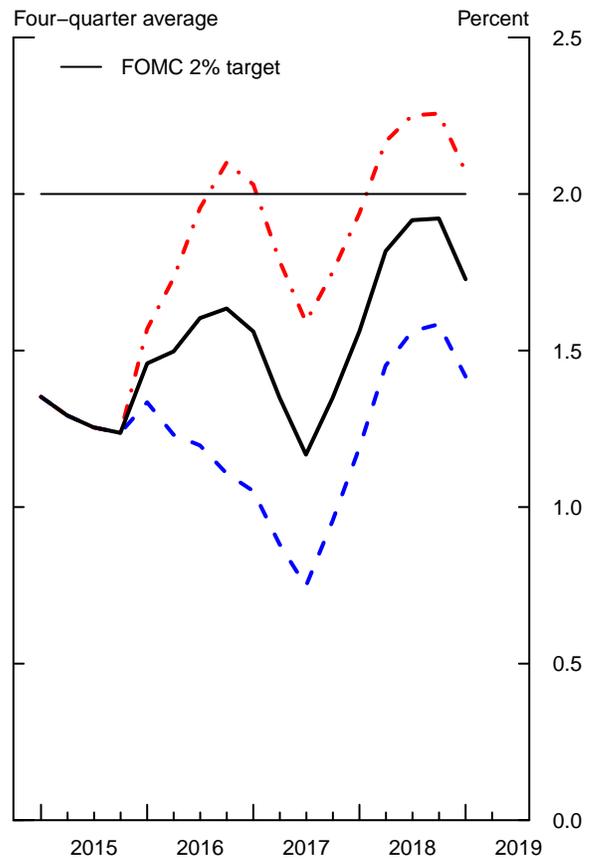
Real Federal Funds Rate



Unemployment Rate



Core PCE Inflation

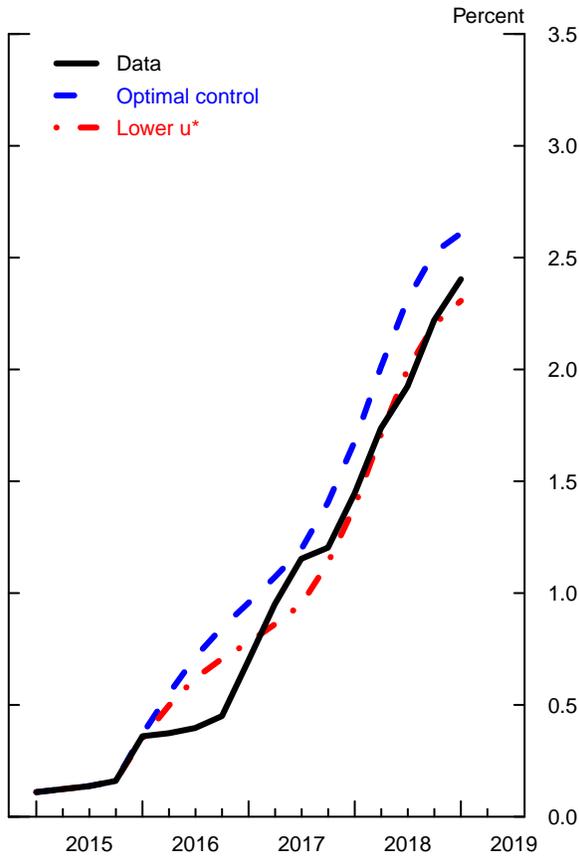


Note: PCE is personal consumption expenditures.

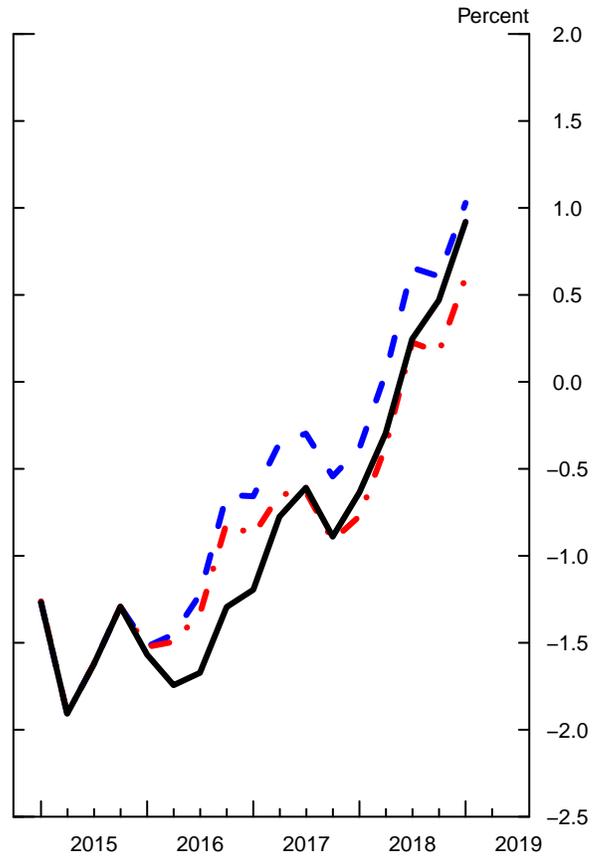
Source: Board of Governors of the Federal Reserve System (nominal federal funds rate and 5-year Treasury yield); U.S. Bureau of Labor Statistics (unemployment rate); U.S. Congressional Budget Office and U.S. Federal Open Market Committee (natural rate of unemployment); U.S. Bureau of Economic Analysis (PCE inflation); Survey of Professional Forecasters (10-year inflation expectations); Jens H.E. Christensen and Glenn D. Rudebusch, "Treasury Yield Premiums," complete model data available on the Federal Reserve Bank of San Francisco's website at <https://www.frbsf.org/economic-research/indicators-data/treasury-yield-premiums> (FFR expectations); authors' calculations.

Figure 5
Optimal Control Simulations under Discretion: Lower u^*

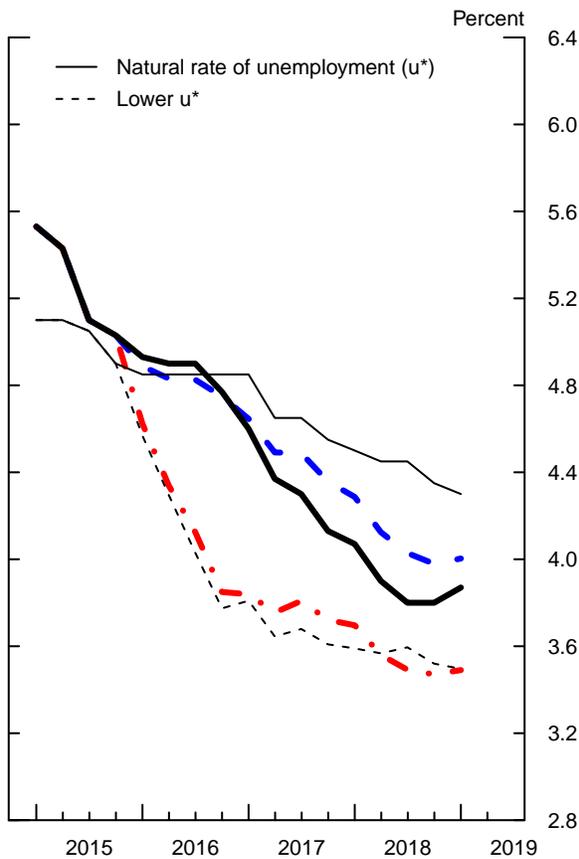
Nominal Federal Funds Rate



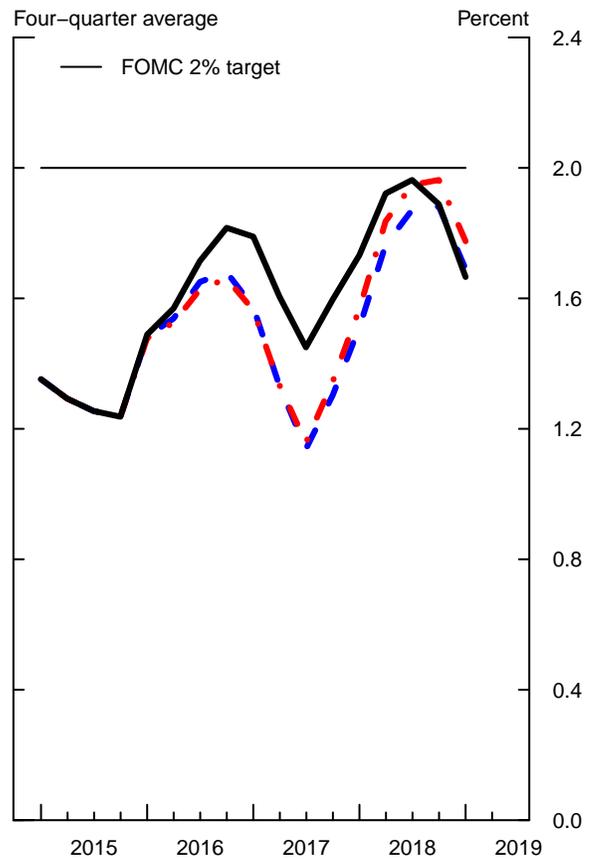
Real Federal Funds Rate



Unemployment Rate



Core PCE Inflation

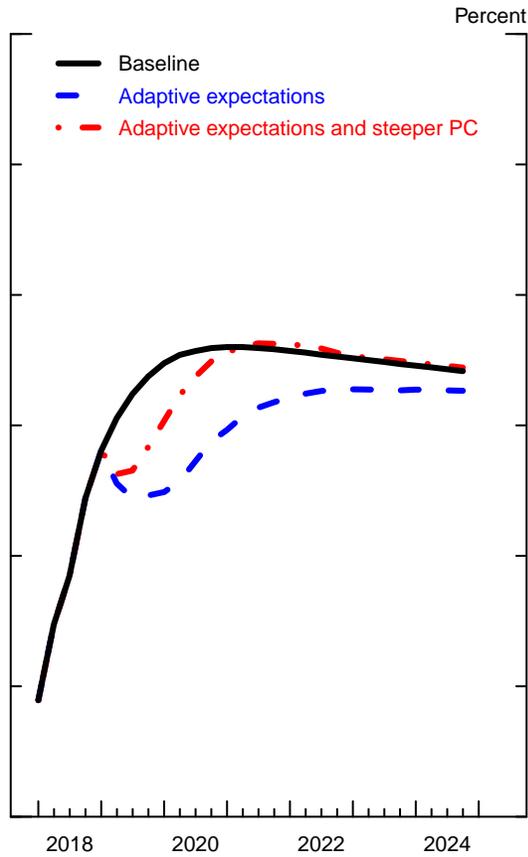


Note: PCE is personal consumption expenditures.

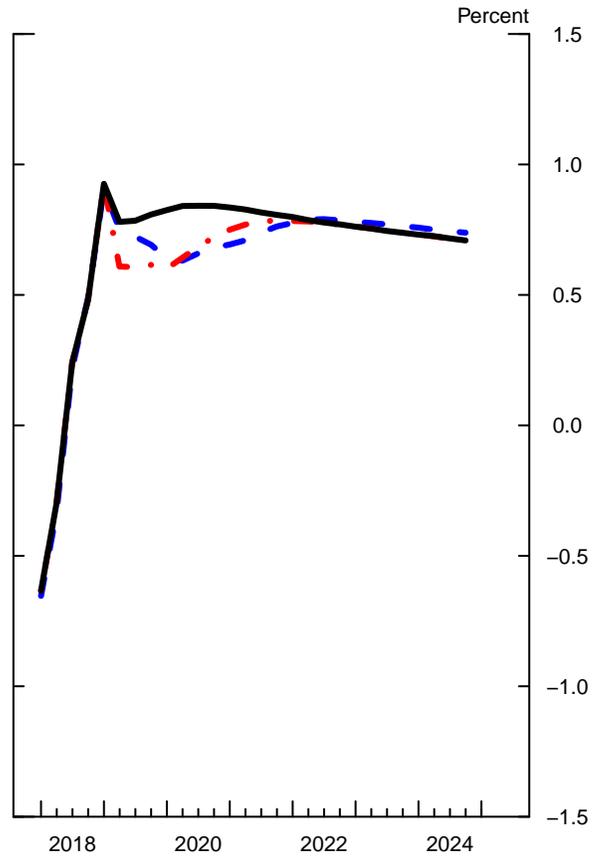
Source: Board of Governors of the Federal Reserve System (nominal federal funds rate and 5-year Treasury yield); U.S. Bureau of Labor Statistics (unemployment rate); U.S. Congressional Budget Office and U.S. Federal Open Market Committee (natural rate of unemployment); U.S. Bureau of Economic Analysis (PCE inflation); Survey of Professional Forecasters (10-year inflation expectations); Jens H.E. Christensen and Glenn D. Rudebusch, "Treasury Yield Premiums," complete model data available on the Federal Reserve Bank of San Francisco's website at <https://www.frbsf.org/economic-research/indicators-data/treasury-yield-premiums> (FFR expectations); authors' calculations.

Figure 6
Optimal Control Simulations under Discretion: Adaptive Inflation Expectations

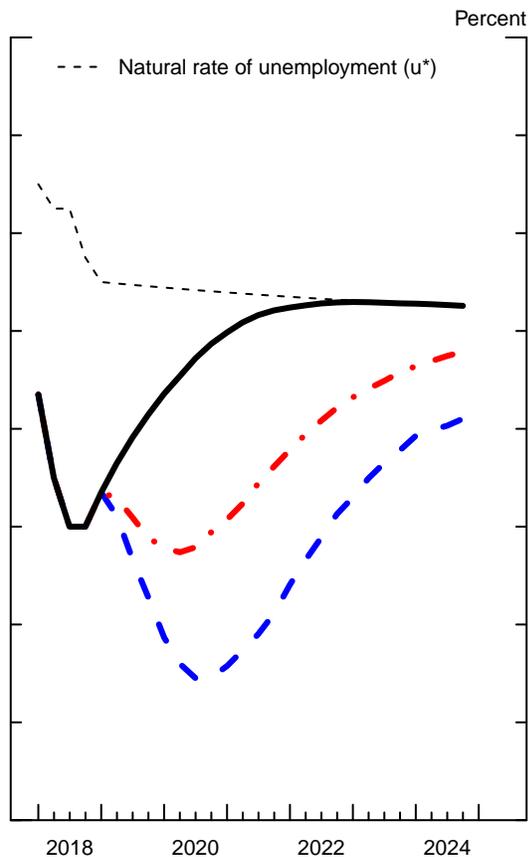
Nominal Federal Funds Rate



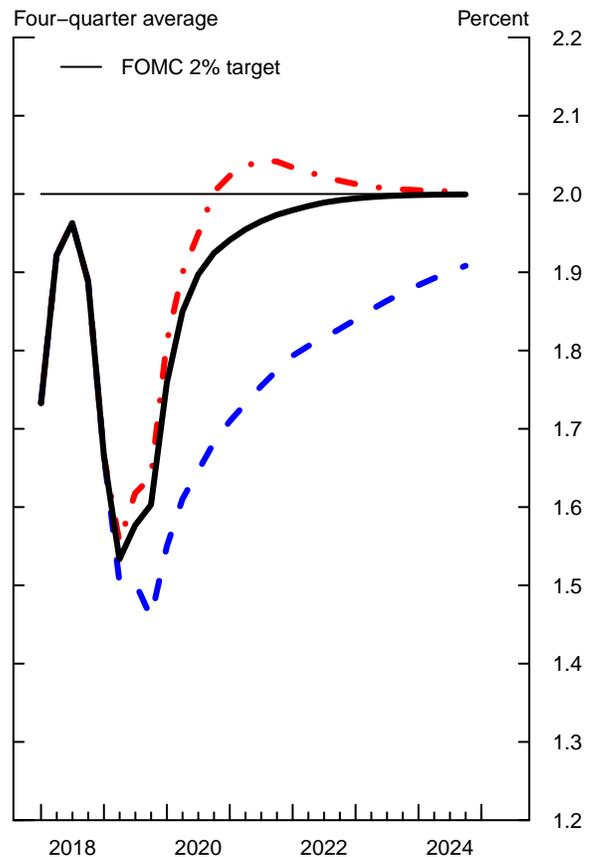
Real Federal Funds Rate



Unemployment Rate



Core PCE Inflation

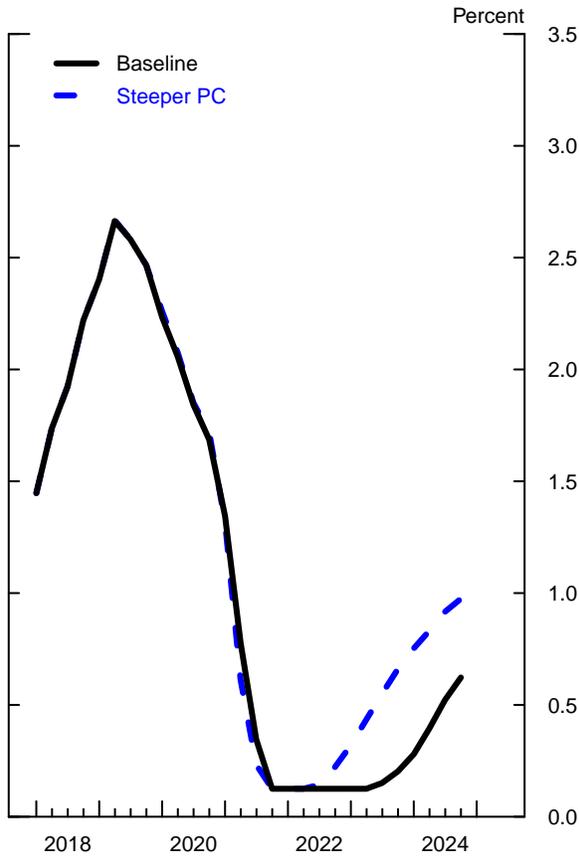


Note: PCE is personal consumption expenditures; PC is Phillips curve.

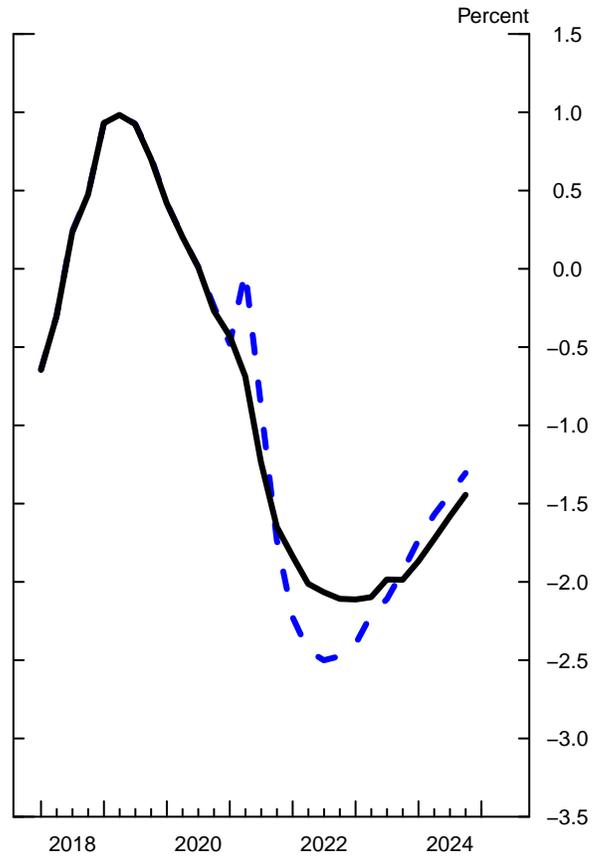
Source: Board of Governors of the Federal Reserve System (nominal federal funds rate and 5-year Treasury yield); U.S. Bureau of Labor Statistics (unemployment rate); U.S. Congressional Budget Office and U.S. Federal Open Market Committee (natural rate of unemployment); U.S. Bureau of Economic Analysis (PCE inflation); Survey of Professional Forecasters (10-year inflation expectations); Jens H.E. Christensen and Glenn D. Rudebusch, "Treasury Yield Premiums," complete model data available on the Federal Reserve Bank of San Francisco's website at <https://www.frbsf.org/economic-research/indicators-data/treasury-yield-premiums> (FFR expectations); authors' calculations.

Figure 7
Optimal Control Simulations under Discretion: Recession Scenario

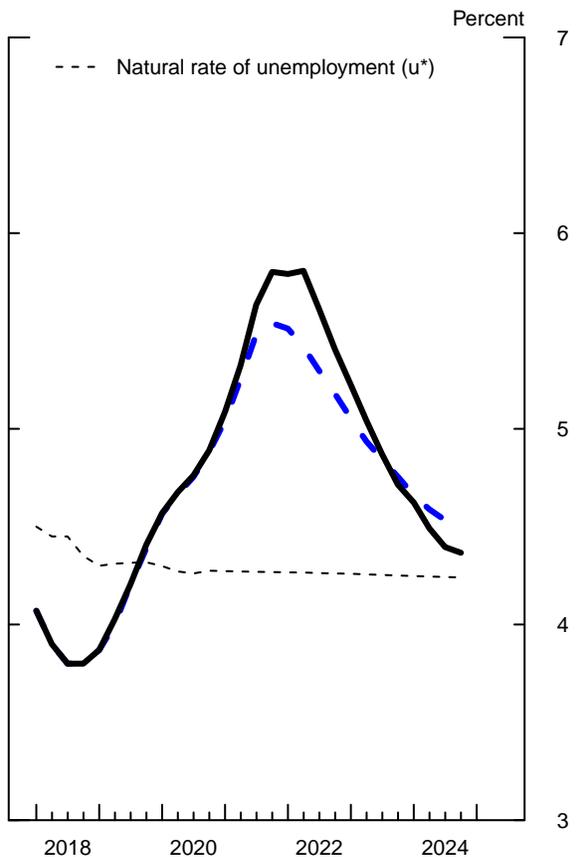
Nominal Federal Funds Rate



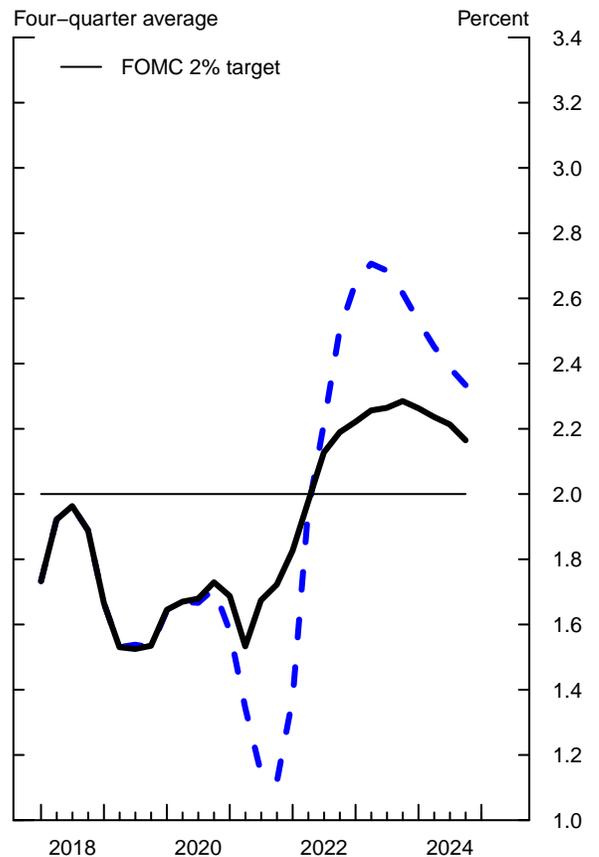
Real Federal Funds Rate



Unemployment Rate



Core PCE Inflation



Note: PCE is personal consumption expenditures; PC is Phillips curve.

Source: Board of Governors of the Federal Reserve System (nominal federal funds rate and 5-year Treasury yield); U.S. Bureau of Labor Statistics (unemployment rate); U.S. Congressional Budget Office and U.S. Federal Open Market Committee (natural rate of unemployment); U.S. Bureau of Economic Analysis (PCE inflation); Survey of Professional Forecasters (10-year inflation expectations); Jens H.E. Christensen and Glenn D. Rudebusch, "Treasury Yield Premiums," complete model data available on the Federal Reserve Bank of San Francisco's website at <https://www.frbsf.org/economic-research/indicators-data/treasury-yield-premiums> (FFR expectations); authors' calculations.