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Alternative Strategies: How Do They Work? How Might They Help?

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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

Several structural developments in the U.S. economy—including lower neutral interest rates and a flatter Phillips curve—have challenged the ability of the current monetary policy framework to deliver on the Federal Open Market Committee’s (FOMC) dual-mandate goals. This paper explores whether *makeup strategies*, in which policymakers seek to stabilize average inflation around the inflation target over some horizon, could strengthen the FOMC’s ability to fulfill its dual mandate. The quantitative analysis discussed here suggests that credible makeup strategies may provide some moderate stabilization gains. The practical implementation of these strategies, however, faces a number of challenges that would have to be surmounted for the full benefit of these strategies to be realized.

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I. Introduction

The Federal Open Market Committee’s (FOMC) current monetary policy framework can be summarized by the following features: The dual mandate of maximum employment and price stability represents the main *goal* of the framework, with an explicit numerical inflation objective and a corresponding numerical estimate related to the employment leg of the mandate. According to the Statement on Longer-Run Goals and Monetary Policy Strategy, the FOMC *strategy* is to pursue a balanced approach in addressing deviations of employment and inflation from their goals, with an explicit acknowledgment of the importance of the balance of risks, including risks to the financial system. This strategy has been largely interpreted as an implicit adherence to a “bygones be bygones” approach, in which policymakers react to their best estimate of current economic conditions and the medium-term outlook without explicitly responding to the history of inflation and employment. The FOMC’s *monetary policy tools* used to achieve the mandated goals include communications and monetary policy instruments that have already been employed by the Committee (conventional interest rate policy, forward guidance, and balance sheet policies).

A number of ongoing structural developments in the U.S. economy have tested the ability of the current monetary policy framework to deliver on the FOMC’s dual mandate. The neutral real interest rate has likely fallen, implying less “policy cushion”—less leeway to lower the federal funds rate in the event of a downturn—and thus increasing the likelihood of reaching the effective lower bound (ELB). In addition, inflation appears to have been less responsive to resource slack in recent years—a flatter Phillips curve—suggesting that policymakers will find it more difficult to move inflation toward the Committee’s 2 percent longer-run objective. Moreover, inflation has persistently fallen below 2 percent, potentially leading to some slippage of long-term inflation expectations relative to their levels before the Great Recession. These developments raise the question of whether the current framework will serve the Committee well in addressing future downturns.

This paper and the companion paper “How Robust Are the Alternative Strategies to Key Alternative Assumptions” explore whether adjustments to the current monetary policy strategy could strengthen the FOMC’s ability to fulfill its dual-mandate goals. The

analysis largely focuses on a class of makeup strategies in which policymakers seek to stabilize average inflation around the inflation target over some horizon.¹ In pursuing such strategies, the Committee would at times use its monetary policy tools—communications, the federal funds rate, forward guidance, and balance sheet policies—to deliberately target rates of inflation that deviate from 2 percent on one side so as to offset past inflation deviations from 2 percent on the other side. Thus, by adopting a makeup strategy, the FOMC would abandon the by-gones-be-by-gones approach.

The academic literature suggests that makeup strategies offer three potential benefits.² First, makeup strategies naturally imply a desire to commit to a “lower for longer” path for the policy rate in episodes when the ELB significantly impairs the conduct of monetary policy and may cause extended periods of below-target inflation. Commitments to a lower-for-longer path provide more accommodative financial conditions, boosting aggregate demand and reducing deviations of inflation from its target even while the ELB binds. Second, (credible) makeup strategies foster expectations of more stable inflation, on average, thus reducing the sensitivity of inflation to transient developments. Third, the systematic materialization of stable inflation rates under makeup strategies may better anchor longer-term inflation expectations, inducing a virtuous circle.

The effectiveness of a makeup strategy depends on both the details of the strategy and the structural features of the economic environment. In this paper, we first describe how makeup strategies work and study the implications of key institutional decisions such as the length of the makeup window (that is, how long a history of past deviations to consider) and the symmetry or asymmetry of the makeup (that is, the conditions under which to engage the makeup strategy). We then use simulations from several macroeconomic models to provide a quantitative assessment of specific makeup strategies that have been put forward in the economic literature.

¹ In addition to inflation, makeup strategies may also be specified to make up for past misses of other variables from medium- and long-run objectives, such as output, employment, or (notional) interest rates.

² See, for instance, Bernanke (1999); Reifschneider and Williams (2000); Svensson (2001); Eggertsson and Woodford (2003); Kiley and Roberts (2017); Hebden and Lopez-Salido (2018); Bernanke, Kiley, and Roberts (2019); and Mertens and Williams (2019). Notwithstanding the popularity of makeup strategies in academic debates, the historical record is thin of actual central bank experience with makeup strategies. A notable exception is the attempt of the Riksbank to target the price level during the Great Depression of the 1930s. See Berg and Jonung (1999) for an account of this episode.

The main findings of this paper can be summarized as follows. First, makeup strategies generally improve macroeconomic stability compared with a by-gones-be-by-gones approach. Second, the size of these gains is moderate across the models and strategies considered here, with longer makeup windows yielding somewhat larger gains. Third, the practical implementation of these strategies faces a number of challenges that would have to be surmounted for the full benefit of these strategies to be realized.

II. The Design of a Makeup Strategy: The Choice of Makeup Measure

We begin by laying out key features regarding the design of makeup strategies. To keep the exposition specific, we consider average inflation targeting (AIT) strategies that seek to undo past deviations of inflation from its 2 percent long-run goal over a window of fixed length.³ The design of a makeup strategy revolves around two central aspects:

1. *The length of the makeup window.* As time advances, inflation misses that occurred further in the past eventually drop out of the window and become by-gones. Strategies that make up deviations of inflation over very long windows can approximate price-level targeting (PLT) strategies.⁴ In the context of an inflation shortfall during an ELB episode, larger windows are associated with more pronounced lower-for-longer interest rate paths. Thus, the length of the makeup window controls the additional stimulus to aggregate demand and the speed with which inflation returns to and, possibly, overshoots its objective.

³ Other makeup strategies, such as price-level targeting (PLT) strategies or shadow rate strategies, are discussed as appropriate. PLT strategies aim to offset the cumulative deviation of inflation from the 2 percent objective since a fixed reference date. Following Reifschneider and Williams (2000), a shadow rate strategy expresses the makeup objective in terms of the forgone policy accommodation due to the ELB. Implicitly, shadow rate strategies aim to make up with respect to both inflation and employment.

⁴ Under PLT, the price-level gap measures the cumulative deviations of inflation from 2 percent since a given reference date, and hence the length of the makeup window expands over time. As highlighted by Nessén and Vestin (2005), an AIT strategy with a very long window into the past will evidently keep track of (most of) the inflation deviations that enter the price-level gap and hence indicate a similar degree of makeup as the price-level gap.

2. *The symmetric versus asymmetric nature of the makeup.* Under a symmetric AIT strategy, policymakers will stimulate the economy when average inflation has been below the 2 percent objective, and they will also constrain it when average inflation has been above 2 percent. If policymakers' appetite for slowing the economy today because past inflation has averaged above 2 percent differs from their appetite for stimulating the economy because past inflation has averaged below 2 percent, they may wish to consider asymmetric strategies.

While we define the asymmetry of the makeup strategies with regard to inflation deviations from its longer-run objective, the economic literature has also considered temporary makeup strategies that are triggered by the occurrence of ELB episodes.⁵ In demand-driven recessions with low inflation and a binding ELB, asymmetric and temporary strategies would deliver very similar outcomes. However, in different economic circumstances, asymmetric and temporary strategies may imply different prescriptions from an AIT strategy. For instance, during a period of prolonged low unemployment and below-target inflation, an AIT strategy would prescribe lower interest rates than a temporary AIT strategy (which would not be triggered).⁶

The Length of the Makeup Window

We illustrate how the length of the makeup window under AIT strategies affects economic outcomes in a mild demand-driven recession scenario with a binding ELB.⁷ We construct the scenario using the version of the FRB/US model in which financial market participants as well as wage and price setters fully appreciate the implications of the alternative monetary policy strategies for macroeconomic outcomes. In contrast, the agents responsible for consumption and investment decisions are modeled as forming

⁵ See, for instance, Evans (2012), Bernanke (2017), and Bernanke, Kiley, and Roberts (2019).

⁶ Another difference may lie in the ability of economic agents to learn about these strategies. Svensson (2020) argues that policymakers may be more successful in communicating to the public strategies that are always in operation than strategies that are pursued only under special circumstances.

⁷ Appendix B provides a complete description of our simulation methodology.

expectations using time-series models that are *not* updated to reflect changes in macroeconomic dynamics induced by the alternative rules.⁸

Throughout the analysis, we implement monetary policy strategies through simple rules that deliver prescriptions for the federal funds rate. In particular, we consider the inertial version of the Taylor (1999) rule as an approximation to the current monetary policy framework and three makeup rules with different window lengths.⁹ The first two (AIT) rules respond one-for-one to the cumulative inflation misses from 2 percent (starting in 2019:Q4) over a four-year and an eight-year rolling window, respectively. For reference, the third rule fully responds to all inflation misses accumulated starting in 2019:Q4, thus implementing a PLT strategy.¹⁰ We assume that policymakers abstain from using additional monetary policy tools, such as balance sheet policies, to facilitate the comparison across different strategies.

Figure 1 presents the simulation results for the mild recession scenario. Owing to a sequence of negative shocks that, starting in 2019:Q4, pushes down demand and inflation, the economy falls into recession. Under the inertial Taylor rule, the federal funds rate reaches the ELB by mid-2021 and remains at that level until late 2023. The unemployment rate rises 2 percentage points to above 5.5 percent by 2022, while inflation drops from 1.6 percent in 2019 to 1.2 percent in 2021.

The three makeup rules call for notably lower paths of the policy rate than the inertial Taylor rule and imply lower real interest rates at short and long horizons.¹¹ The ELB spell is longer under makeup rules with longer windows of past inflation misses.

⁸ These assumptions allow for announcements regarding monetary policy to rapidly affect asset prices, in line with empirical evidence that credible forward guidance is very quickly reflected in financial market prices, while not attributing unrealistically high degrees of sophistication to households.

⁹ Under the inertial Taylor (1999) rule, the current prescription for the federal funds rate is derived from the current values of core inflation and a measure of economic slack, and the lagged realized value of the federal funds rate.

¹⁰ Appendix A provides the details on implementing AIT and other makeup strategies through simple rules. The parameter values of these rules are generally taken from the literature and are not necessarily “optimal” from the perspective of standard welfare criteria for a given theoretical model. For instance, the value of the coefficient on the makeup measure controls the strength of the makeup strategy. A coefficient higher than 1, as assumed here, would improve the stabilizing effects of the strategy but may also result in higher volatility of the prescribed federal funds rate. Similarly, in estimated models where shocks that move inflation and economic activity in opposite directions play a prominent role, the performance of the economy can be quite sensitive to the value of the coefficient capturing the response to economic slack.

¹¹ Although the different agents in the FRB/US model do not hold the same expectations about all future variables, they are assumed to hold identical views about the real interest rates at all horizons.

Lower nominal rates and somewhat higher inflation expectations associated with longer makeup windows cause steeper declines in real short- and long-term interest rates (such as the real 10-year Treasury yield). Hence, strategies with longer makeup windows better contain the rise in the unemployment rate and the drop in inflation during the depth of the recession, thus returning inflation to 2 percent sooner than under the inertial Taylor rule. Under PLT and, to a much lesser extent, under AIT, inflation rises above 2 percent later in the simulation, while the unemployment rate falls well below its value in the long run.

The different performance of the three makeup rules stems from the different treatment of past inflation misses. The lower-right panel labeled “Rule-Specific Cumulative Inflation Gaps” reports the value of the cumulative inflation deviation from 2 percent, given the specific window associated with each makeup rule. The inflation gaps in 2019:Q4 are, by assumption, zero and start turning negative as inflation drops below 2 percent. Under the PLT rule, the makeup window and the associated inflation gap expand over time. By contrast, under the AIT rules, past inflation misses eventually fall outside the makeup window and become bygones, whether or not they have been offset. For instance, under the four-year AIT rule, the cumulative inflation gap starts closing as early as 2024, as the larger inflation misses accumulated at the beginning of the scenario become bygones. Given the unresponsiveness of inflation to activity in the FRB/US model, under AIT rules, inflation is slow to return to 2 percent, especially with short makeup windows. As a result, by the time policymakers could conceivably allow inflation to exceed 2 percent, the inflation gaps have largely closed, and the AIT rules call for hardly any inflation overshooting.

Strategies with longer makeup windows keep inflation closer to 2 percent through (the promise of) extended lower-for-longer policy rate paths, raising credibility issues. For instance, the PLT rule and, to a lesser extent, the eight-year AIT rule require future policymakers to keep the federal funds rate below its neutral level for almost 20 years to allow inflation to run above the Committee’s 2 percent objective and close the price gap. However, the public may be skeptical about whether policymakers would adhere to such a policy rate path in the future, especially as inflation approaches 2 percent and the benefits of the makeup strategy have been reaped. Hence, the choice of the makeup window needs to balance an additional important tradeoff between macroeconomic

stabilization and credibility. Shorter makeup windows may be more credible, but they return inflation less rapidly to 2 percent (which may raise doubts about policymakers' commitment to their longer-run inflation objective). Longer makeup windows may lead to better stabilization outcomes but require credible promises about the course of monetary policy in the distant future.

The Symmetric versus Asymmetric Nature of the Makeup

Policymakers do not need to respond symmetrically to persistent deviations of inflation above and below target. While the stimulating effects of promising lower policy rates after a sequence of inflation shortfalls will most likely be welcomed by market participants and the broader public, the restraining effects of promising elevated policy rates when average inflation is above 2 percent may be unpopular. In addition, given the potential downward bias of inflation due to the ELB, pursuing an asymmetric strategy that does not aim to offset past inflation in excess of 2 percent may help the Committee reduce this bias and better anchor long-term inflation expectations. Finally, a symmetric strategy with a long makeup window may constrain the desire to act promptly at the onset of a recession if inflation has averaged above 2 percent over the makeup window.

To illustrate some potential pitfalls of symmetric strategies, we revisit the mild recession scenario but assume that policymakers need to address a positive initial inflation gap accumulated over the previous eight years.¹² In figure 2, we compare the economic outcomes under a symmetric eight-year AIT rule plus a positive inflation gap with those associated with the same AIT rule plus no initial inflation gap (standing in for an asymmetric strategy). Under the symmetric AIT rule, policymakers *raise* the federal funds rate in the early phases of the recession in their attempt to make up for accumulated above-target inflation readings and delay lowering the federal funds rate to the ELB. Starting in 2027:Q4, the path of the federal funds rate closely resembles its counterpart under the AIT rule with no initial gap, as past inflation outcomes in excess of 2 percent have fully dropped out of the eight-year window.

¹² To generate the positive cumulative inflation gap under the AIT rule, we simply calculate the deviations of inflation from 2 percent in the past eight years and flip the sign of such deviations.

The lower degree of monetary accommodation under the AIT rule with a positive initial inflation gap implies worse macroeconomic outcomes. The peak in unemployment exceeds the peak in unemployment under the baseline Taylor rule. Inflation dynamics under the two makeup rules are very similar because, in the FRB/US model, the Phillips curve is extremely flat and small differences in policy rates have little effect on inflation. In models that feature greater sensitivity of inflation to interest rates, however, the differences in inflation outcomes are likely to be more pronounced. More generally, this scenario highlights that symmetric makeup strategies may exacerbate policy tradeoffs in recessions associated with high inflation.

III. **The Quantitative Gains Associated with Makeup Strategies**

The stabilization gains of a selected makeup strategy depend on a variety of institutional and economic features, including the ability of the central bank to influence inflation expectations, the credibility of the makeup strategy, the slope of the Phillips curve, and the responsiveness of aggregate demand to interest rates. In this section, we compare the performance of makeup strategies across three models—namely, the baseline FRB/US model; a variant of the FRB/US model; and the DGS-FHP model, a modified version of the dynamic general equilibrium model developed by Del Negro, Giannoni, and Schorfheide (2015).¹³ The latter two models feature greater, yet empirically plausible, sensitivity of the economy with respect to interest rates than the baseline FRB/US model.¹⁴ In addition, the DGS-FHD model attributes a larger portion of inflation fluctuations to shocks that move unemployment and inflation in opposite directions.

The Performance of Average Inflation Targeting Rules at the Effective Lower Bound across Models

Figure 3 shows the ranges of outcomes for the four-year AIT rule and the eight-year AIT rule across models, together with the outcomes shown previously in figure 1 for

¹³ Appendix C provides details on the DGS-FHD model.

¹⁴ Many of the macroeconomic models found in the academic literature feature much greater sensitivity of the economy than is commonly considered plausible by policymakers.

the baseline FRB/US model. We construct the recession scenario to yield identical outcomes under the inertial Taylor rule in all three models.

The two additional models considered here imply somewhat stronger effects of the AIT strategies on the unemployment rate than in the baseline FRB/US model. Under the eight-year AIT rule, the peak in the unemployment rate can be up to an additional 50 basis points lower. Later in the scenario, the unemployment rate can dip below 3 percent in these models, while it stays above 3.5 percent in the baseline FRB/US model. The range of inflation outcomes across models, by contrast, is much narrower, as the Phillips curve is very flat in all models. In the models considered here, the four-year AIT rule is not very successful in stabilizing inflation by more than the inertial Taylor rule. The eight-year AIT rule is somewhat more successful in stabilizing inflation, at least in some of the alternative models.

Macroeconomic Outcomes under Makeup Strategies

We conduct stochastic simulations under a range of likely economic situations using the FRB/US and the DGS-FHP models to quantify the stabilization gains of makeup strategies compared with a by-gones-be-by-gones approach. In these simulations, the model economies experience shocks to supply and demand from distributions estimated from the historical data. We broaden the set of makeup strategies to include symmetric and asymmetric versions of the eight-year AIT rule discussed in section II, temporary versions of the AIT and the PLT that become operant at the ELB, and the shadow rate rule proposed by Reifschneider and Williams, or RW.

Table 1 reports the losses computed using the standard equal-weights loss function for the five makeup rules relative to the losses for the inertial Taylor (1999) rule in the two models.¹⁵ Table 2 presents the underlying statistics used to construct these losses. These tables provide three main results. First, makeup strategies show uniformly lower losses compared with the inertial Taylor rule. Second, the gains vary quantitatively with the sensitivity of aggregate demand to interest rates and the importance of shocks that drive fluctuations in unemployment and inflation in opposite directions. In the FRB/US model, aggregate demand and inflation respond little to interest rates, and,

¹⁵ Appendix A.9 provides details on the equal-weights loss function.

consequently, all makeup rules deliver similarly modest effects. In addition, because variations in unemployment and inflation contribute equally to the loss under the inertial Taylor rule (as shown in the first row of table 2), rules that address directly deviations caused by the ELB perform marginally better (such as asymmetric AIT and, to a larger extent, temporary rules activated at the ELB as well as shadow rate rules). In the DGS-FHP model, where aggregate demand and inflation respond more to interest rates, some makeup rules deliver significant stabilization gains. In addition, because inflation variations contribute more to the loss under the inertial Taylor rule (table 2), rules that respond more aggressively to deviations in inflation from 2 percent deliver larger gains (such as the symmetric AIT rule). Lastly, asymmetric and temporary rules push the long-run inflation rate up (table 2), suggesting that these strategies have the potential to create an inflation buffer in environments where the ELB induces material deflationary bias.

Our analysis points to smaller stabilization gains from the adoption of makeup strategies compared with the gains in some academic studies.¹⁶ As discussed, a higher sensitivity of the economy to interest rates, a steeper Phillips curve, and a smaller role of shocks that drive inflation and unemployment in opposite directions (“supply shocks”) provide greater scope for monetary policy stabilization and thus larger gains from makeup strategies. Similarly, a lower neutral real interest rate and a larger implied incidence of the ELB allow for larger gains. These details, as well as the assumed responsiveness of the policy rule to inflation, resource slack, and the makeup measure, also affect the relative performance of different strategies in providing stabilization gains.

IV. Communication of Makeup Strategies: Some Practical Challenges

The adoption of a makeup strategy is likely to involve a number of adjustments in the Committee’s communications. Policymakers may want to provide details on the makeup measure, the evolution of the makeup measure over time, and how *changes* in the makeup measure affect the appropriate path of policy. Similarly, policymakers may decide to indicate the systematic relationship between the level of the makeup measure

¹⁶ See, for instance, Bernanke, Kiley, and Roberts (2019); Hebden and López-Salido (2018); and analysis based on a standard three-equation New Keynesian model.

and the future path of monetary policy while clarifying the relationship between the makeup strategy and the 2 percent inflation objective.

We next discuss some practical challenges that may emerge with these communications. In our view, a relevant communication tradeoff associated with makeup strategies is that greater transparency about the details of the strategy may increase the understanding and the support of the public, and thus the effectiveness of the strategy itself, at the cost of reducing policymakers' flexibility in the future.

Details of the Makeup Measure

One key decision associated with makeup strategies is whether to give a numerical value of the makeup window or to give a range of windows. For instance, under the latter, the Committee may state that, in assessing the need for additional monetary accommodation at the ELB, the FOMC looks at inflation averages between four and eight years. If, coming out of an ELB episode, inflation were to move up toward its 2 percent goal earlier than anticipated, policymakers could argue in favor of abandoning further makeup by pointing to the improvements in average inflation measures with shorter windows. More generally, emphasizing a range of inflation averages would allow the FOMC to retain some discretion, while articulating the need to tilt policy in response to low-frequency movements in inflation. Similarly, while policymakers may have a clear preference for pursuing an asymmetric makeup strategy, they may appreciate the flexibility of pointing to moving averages of inflation if inflation readings have been above 2 percent for some time.

Evolution of the Makeup Measure and Its Implications for Appropriate Monetary Policy

To ensure the effectiveness of a makeup strategy, policymakers may want to consider communicating to the public on a regular basis how changes in the makeup measure affect the appropriate path of policy. This communication may include providing concrete guidance on the sign and magnitude of the past inflation misses that drop out of the makeup measure in a given period or the near future. As discussed in section II, for instance, these facets of the strategy provide information on the expected

degree of inflation overshooting (if any). Similarly, the makeup measure could feature oscillations—due to fluctuations in energy prices, for example—which would require detailed communication to avoid the perception of an unwarranted change in the policy path.

Relationship between the Makeup Measure and Future Monetary Policy

If the gains of the makeup strategy suggested by macroeconomic models are to be realized, agents in the economy must be able to understand the implications of the expected path of the makeup measure for the conduct of monetary policy. In the context of our model simulations, this result is easily achieved by augmenting the policy rule from which policymakers are assumed to derive prescriptions for the federal funds rate to include a makeup measure. In reality, policymakers may find it more challenging to provide guidance to the public on how the current and future levels of the makeup measure translate into future policy actions. Some inspiration on how to communicate the policy implications of makeup strategies to the public can be taken from Svensson’s (2020) suggestion of forecast targeting. Under forecast targeting, the central bank can reveal its systematic policy response by adjusting a published expected policy rate path in response to incoming information in the direction consistent with fulfilling its mandate. For example, when new information shifts up the inflation forecast, policymakers may raise the policy rate path relative to the one published previously. Once economic agents understand this response and deem it credible, financial conditions may shift in the appropriate direction even before the central bank takes action.¹⁷

Relationship between the Makeup Strategy and the Dual Mandate

When augmenting the existing framework with a makeup component for inflation, policymakers may find it helpful to carefully distinguish between their strategy for inflation and their long-run inflation goal and to repeatedly remind the public of this distinction. For instance, while an AIT strategy *responds* to a rolling window of

¹⁷ The box “Monetary Policy Rules and Systematic Monetary Policy” in the February 2019 *Monetary Policy Report* describes how the FOMC currently conducts systematic monetary policy. That description bears remarkable resemblance to Svensson’s ideas about communicating the “reaction function” under forecast targeting. For more information, see Board of Governors (2019, pp. 36–39).

cumulative past deviations of inflation from its objective, pursuing an AIT strategy does not *ensure* that average inflation over that window or any other window will be equal to 2 percent. In addition, targeting a specific average inflation rate does not imply that both this average inflation rate and the current (short-term) inflation rate stand near 2 percent simultaneously. As a result, the public may perceive the strategy as a failure even if it works as designed.

Relatedly, the public may perceive tensions between the FOMC’s strategy and its goals if policymakers define their makeup strategy in terms of core inflation but continue to judge headline inflation to be “most consistent over the longer run with the Federal Reserve’s statutory mandate” in its Statement on Longer-Run Goals and Monetary Policy Strategy.¹⁸ For instance, when the selected moving average of core inflation is near 2 percent, current headline inflation may not be. Moreover, even if the long-run inflation objective were expressed in terms of core inflation to eliminate some of the tensions between strategy and goals, the Committee may find itself exposed to public questioning in times of large energy price increases that strongly move up headline inflation but have little or delayed influence on core inflation.¹⁹

Figure 4 shows in the top panel the evolution of the eight-year moving averages of headline and core inflation between 2000:Q1 and 2019:Q2. Due to the run-up in energy prices before the Great Recession, the eight-year moving average in headline inflation remained above 2 percent until early 2013. By contrast, the eight-year average of core inflation was below 2 percent throughout the entire period shown. As a result, a symmetric strategy focused on the eight-year moving average of headline inflation would have been notably tighter than actual policy during much of the Great Recession. An asymmetric strategy focused on the eight-year moving average of headline inflation

¹⁸ A similar tension already arises under the current framework. Policymakers have repeatedly stressed core PCE (personal consumption expenditures) inflation to be a better indicator of future headline PCE inflation than headline PCE inflation itself when relating their policy decisions to the inflation outlook. Periodic large shifts in the prices of food and energy relative to other goods lead to one-time jumps in headline inflation. If these shifts are persistent, the spike in headline inflation will disappear. If these shifts are transitory, there is also no implication for the net direction of inflation over time.

The quoted text is in paragraph 3 of the statement, which is available on the Board’s website at https://www.federalreserve.gov/monetarypolicy/files/FOMC_LongerRunGoals.pdf

¹⁹ In the summer of 2008, financial market commentators pointed to high headline inflation to argue against monetary easing.

would not have been notably tighter than actual policy, but this strategy would still not have facilitated communication with the public about any forward guidance. Makeup strategies based on core inflation would have avoided the problematic recommendations derived from a headline-based strategy.²⁰ As shown in the lower panel of exhibit 4, similar issues arise at shorter windows for average inflation.

V. **Conclusion**

Our quantitative analysis suggests that credible makeup strategies may provide moderate stabilization gains in the context of an economy characterized by higher incidence of the ELB and an extremely flat Philips curve. Our overview of the practical implementation of these strategies suggests a number of considerations relevant for realizing the full benefit of these strategies. Because these strategies work by leveraging both expectations and the transmission channels of monetary policy, their effectiveness depends on a range of structural features, some of which are explored in greater detail in the companion memo.

²⁰ However, with the eight-year average of core inflation below 2 percent throughout the entire period shown, the pursuit of a core-inflation-based AIT strategy would have called for lower values of the federal funds rate than the Committee deemed appropriate in the past.

Table 1: Relative Expected Loss Values under Alternative Rules in 2029:Q4

	FRB/US	DGS-FHP
Taylor rule	1.00	1.00
AIT (8 years)	.97	.76
A-AIT (8 years)	.95	.84
T-AIT (8 years)	.93	.97
T-PLT	.90	.83
RW	.92	.96

Note: Staff calculations using stochastic simulations of the FRB/US and DGS models around the June 2019 SEP (Summary of Economic Projections)-consistent baseline. Relative expected loss is defined as the expected loss under the alternative rule divided by the expected loss under the Taylor rule. AIT (8 years) is average inflation targeting with an 8-year makeup window. A-AIT is asymmetric AIT. T-AIT is temporary AIT. T-PLT is temporary price-level targeting. RW is the Reifschneider-Williams shadow rate rule.

Source: Authors' calculations.

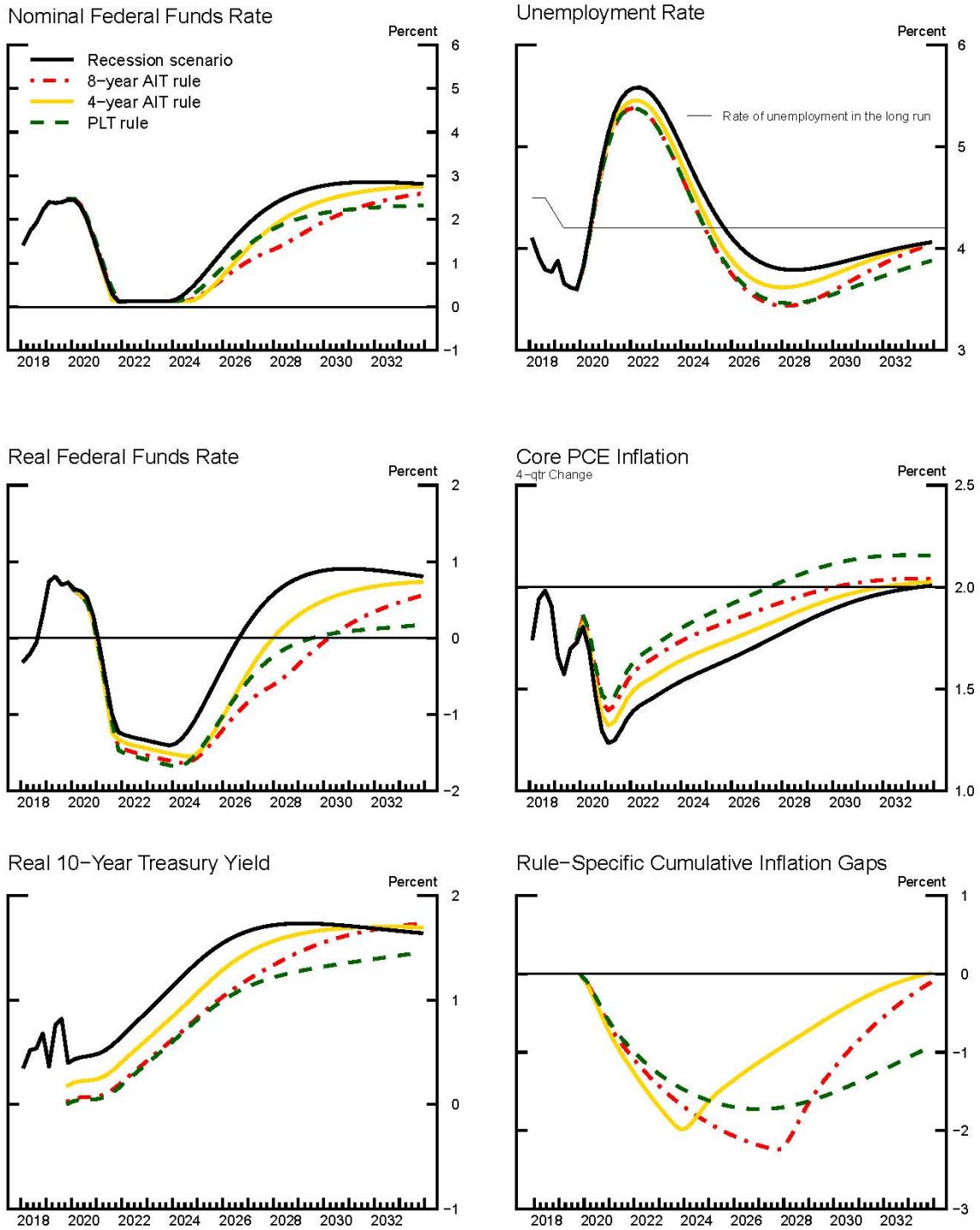
Table 2: Mean Outcomes and Standard Deviations under Alternative Rules in 2029:Q4

	FRB/US				DGS-FHP			
	Unemployment		Inflation		Unemployment		Inflation	
	Mean	Std	Mean	Std	Mean	Std	Mean	Std
Taylor rule	4.25	1.24	1.97	1.01	4.22	.80	1.96	1.70
AIT (8 years)	4.31	1.32	1.98	.85	4.17	.83	1.97	1.41
A-AIT (8 years)	4.13	1.24	2.17	.93	3.91	.55	2.18	1.59
T-AIT (8 years)	4.14	1.22	2.08	.93	4.02	.48	2.06	1.67
T-PLT	4.14	1.21	2.12	.91	4.20	.44	2.15	1.60
RW	4.16	1.20	2.05	.95	4.15	.74	1.97	1.69

Note: Staff calculations using stochastic simulations of the FRB/US and DGS models around the June 2019 SEP (Summary of Economic Projections)-consistent baseline. AIT (8 years) is average inflation targeting with an 8-year makeup window. A-AIT is asymmetric AIT. T-AIT is temporary AIT. T-PLT is temporary price-level targeting. RW is the Reifschneider-Williams shadow rate rule.

Source: Authors' calculations.

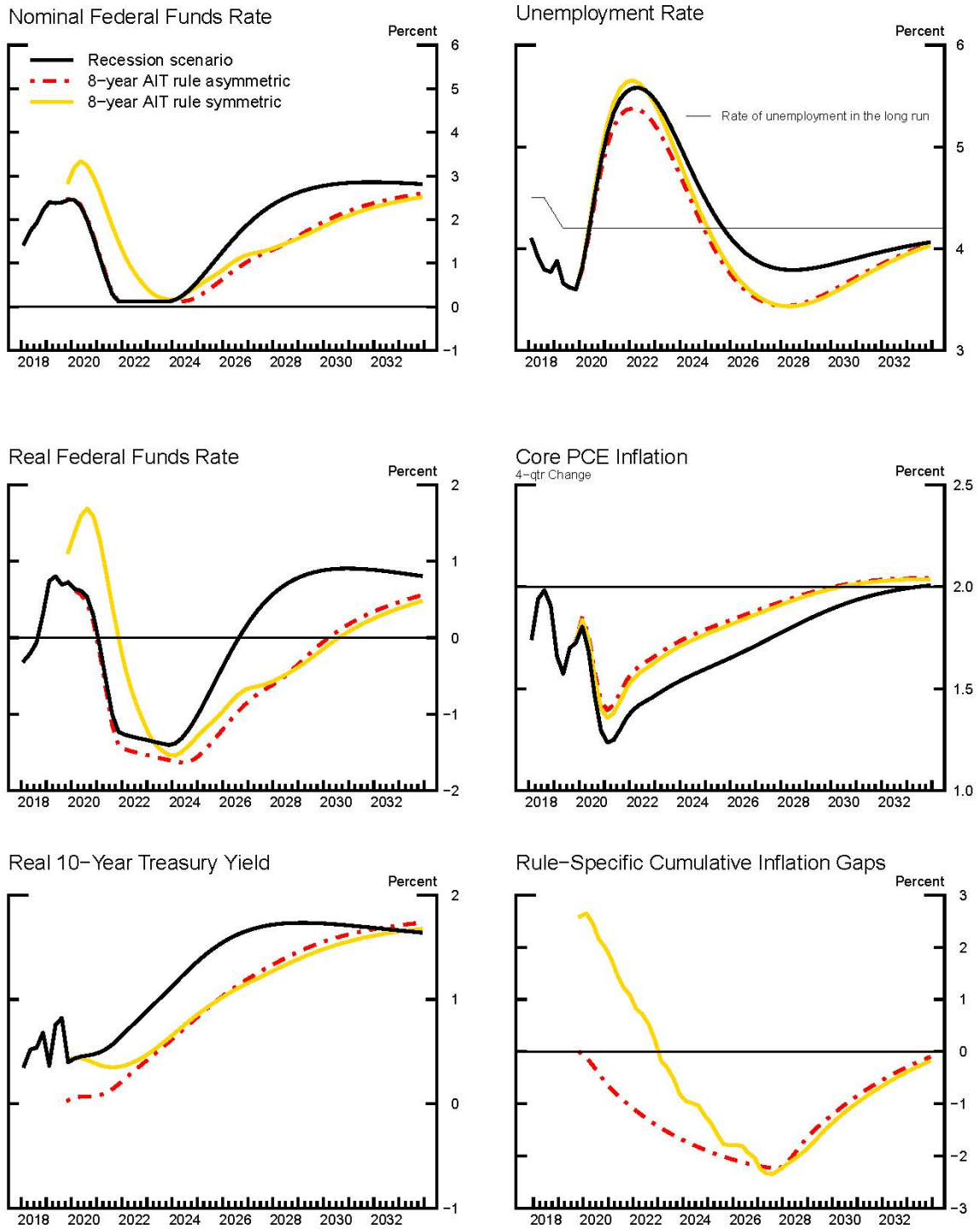
Figure 1. A Mild Recession Scenario



Note: AIT is average inflation targeting; PLT is price-level targeting; PCE is personal consumption expenditures.

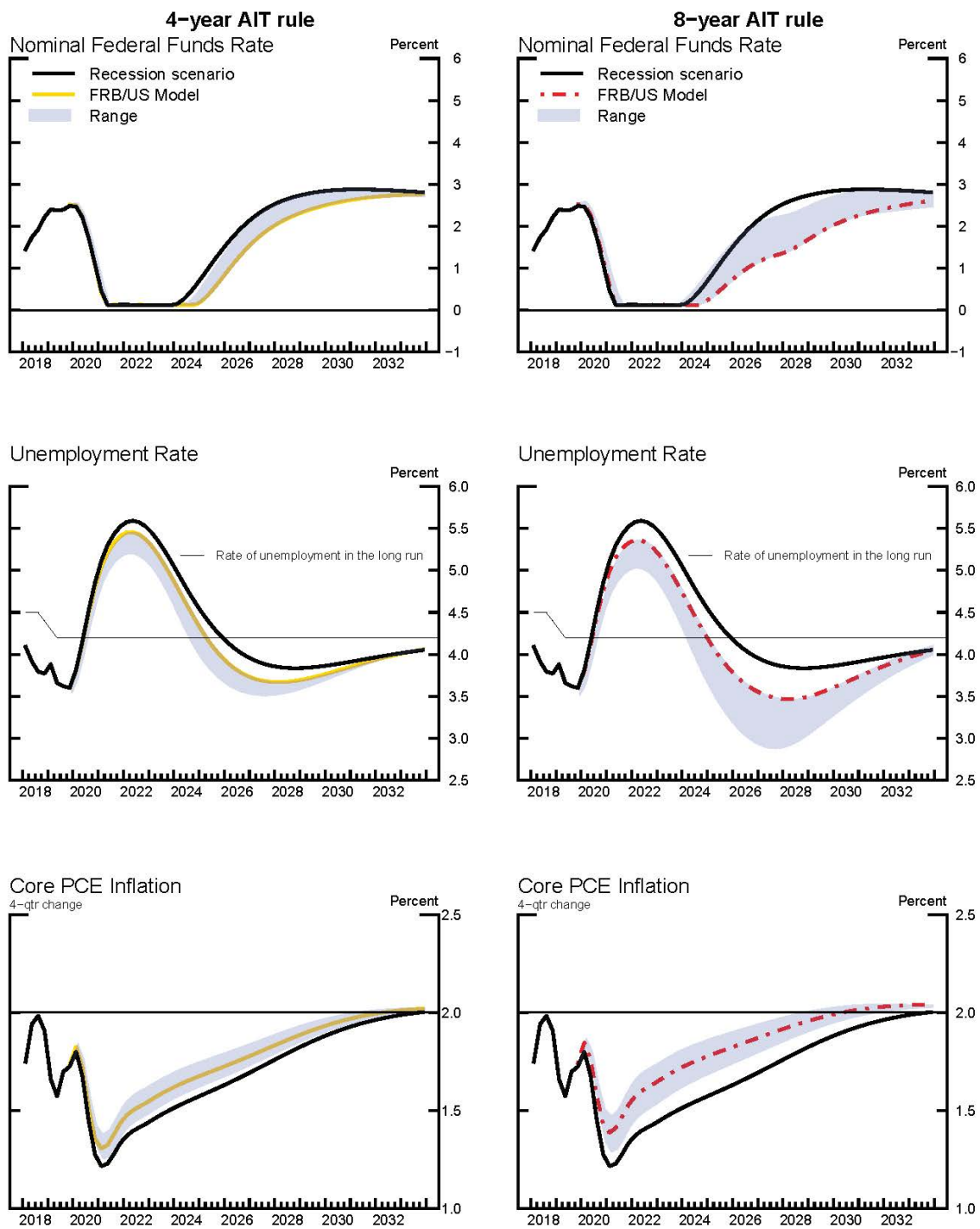
Source: Authors' calculations.

Figure 2. A Mild Recession Scenario with a Positive Inflation Gap



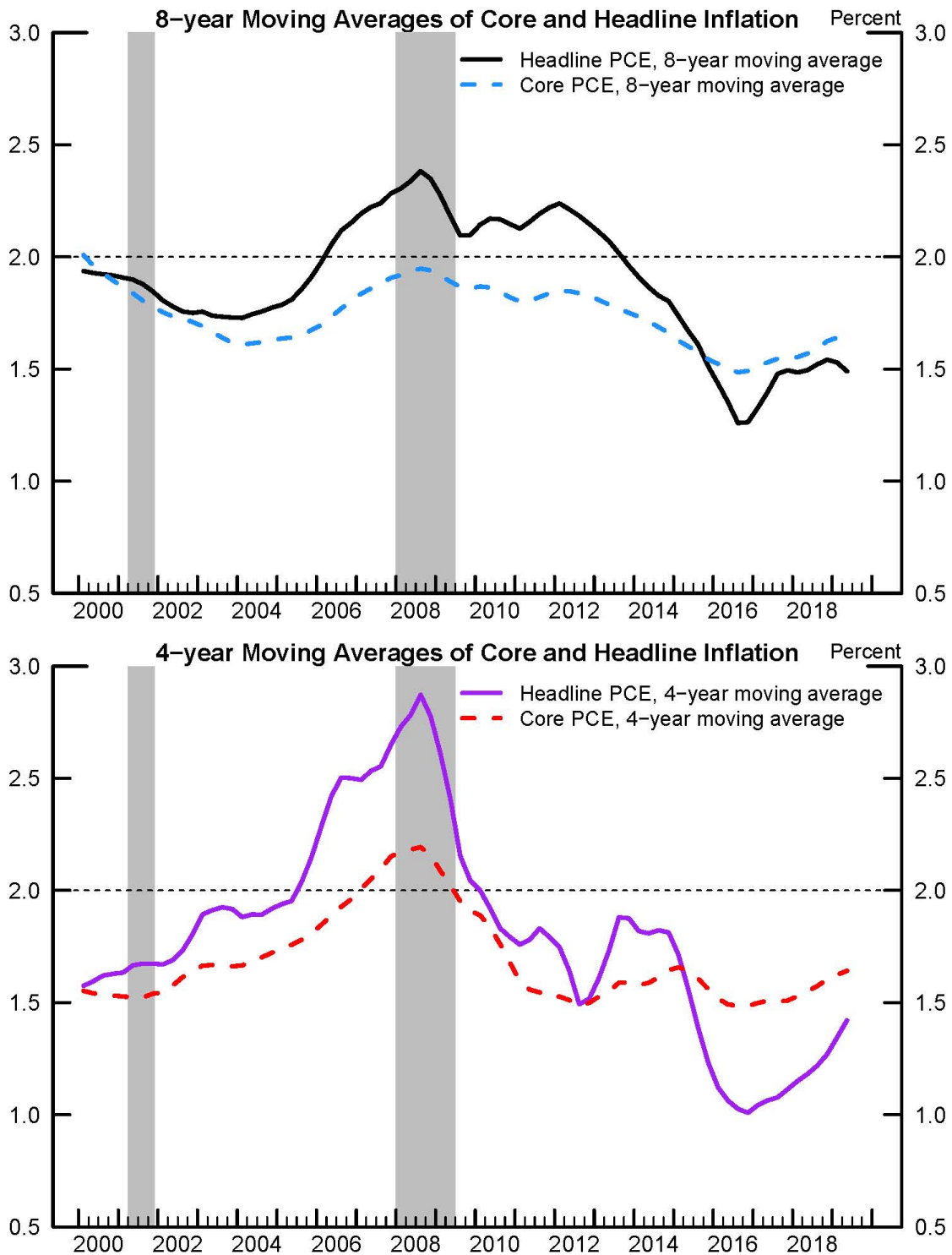
Note: AIT is average inflation targeting; PCE is personal consumption expenditures.
 Source: Authors' calculations.

Figure 3. The Performance of Average Inflation Targeting Rules across Models



Note: AIT is average inflation targeting; PCE is personal consumption expenditures.
 Source: Authors calculations.

Figure 4. Moving Averages of Headline and Core Inflation



Source: Federal Reserve Bank of St. Louis.

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

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Appendix A. Description of Alternative Rules

In the paper, we discussed the different monetary policy strategies in terms of their essential features. In this appendix, we describe the specific monetary policy rules that we used when evaluating the performance of the strategies in FRB/US and the DGS-FHP model. In all simulations, the ELB (R^{ELB}) is assumed to be equal to 0.125 percent.

A.1 Flexible Inflation Targeting: When monetary policy is unconstrained, the federal funds rate is set according to an inertial Taylor rule. When monetary policy is constrained, the federal funds rate equals the ELB. Formally, the flexible inflation-targeting rule sets the federal funds rate such that the federal funds rate (R_t) equals $\max(R^{ELB}, R_t^{Taylor})$, with R_t^{Taylor} defined as follows:

$$R_t^{Taylor} = 0.85R_{t-1} + 0.15(r^* + \pi_t + ygap_t + 0.5(\pi_t - \pi^{LR})),$$

where r^* is the longer-run level of the equilibrium real interest rate, $ygap_t$ is a measure of economic slack, π_t is the four-quarter change in the core PCE (personal consumption expenditures) price level, and π^{LR} is the 2 percent long-run objective. Note that the inertial term depends on the *realized* value of the federal funds rate (R_{t-1}) rather than the prescribed (possibly infeasible) R_{t-1}^{Taylor} . Henceforth, even though this rule corresponds to an expanded inertial Taylor rule, for ease of exposition we will refer to it as the inertial Taylor rule.

A.2 Average Inflation Targeting: When monetary policy is unconstrained, the federal funds rate is set according to a modified inertial Taylor rule. The modification consists of reacting to the gap between average quarterly inflation at an annual rate, $T\text{-year-}\bar{\pi}_t$, and the 2 percent long-run objective. When monetary policy is constrained, the federal funds rate equals the ELB. To summarize, the simple rules set the federal funds rate such that the federal funds rate (R_t) equals $\max(R^{ELB}, R_t^{AIT})$, where R_t^{AIT} is defined as follows:

$$R_t^{AIT} = 0.85R_{t-1} + 0.15(r^* + \pi_t + ygap_t + T(T\text{-year-}\bar{\pi}_t - \pi^{LR})),$$

with T denoting the length of the time window measured in years. Note that this strategy is equivalent to an inertial Taylor rule when T equals 1. When T equals 4, the rule corresponds to an AIT strategy with a four-year makeup window. When T equals 8, the rule corresponds to an AIT strategy with an eight-year makeup window. As the length of the window increases, the rule puts more weight on deviations of average inflation from the long-run objective.

A.3 Asymmetric Average Inflation Targeting: In this strategy, policymakers' appetite for slowing the economy today because past inflation has averaged above 2 percent differs from their appetite for stimulating the economy because past inflation has averaged below 2 percent. We capture this feature by assuming that when average inflation under the desired makeup window is below 2 percent, the policymaker follows the rule specified in A.2, and when average inflation under the desired makeup window is above 2 percent, the policymaker reverts back to the Taylor rule prescription. That is,

$$R_t = \begin{cases} \max(R^{ELB}, R_t^{AIT}) & \text{if } T\text{-year-}\bar{\pi}_t < 0 \\ \max(R^{ELB}, R_t^{Taylor}) & \text{if } T\text{-year-}\bar{\pi}_t \geq 0. \end{cases}$$

A.4 Temporary Average Inflation Targeting: When monetary policy is unconstrained, the federal funds rate is set according to the inertial Taylor rule described in A.1. When monetary policy is constrained or the inflation gap is negative, the policy rate is set as under an asymmetric inflation targeting strategy with the average inflation gap set equal to zero in the periods before the ELB binds.

A.5 Price-Level Targeting: When monetary policy is unconstrained, the federal funds rate is set according to a modified inertial Taylor rule. The modification consists of reacting to the gap between the log of the core PCE price level (p_t) and the log of the target price-level path (p_t^*). The latter is the price level that would prevail if inflation had been equal to an annual rate of 2 percent since a reference date (p_0^*). When monetary policy is constrained, the federal funds rate equals the ELB. The rule can be summarized by $R_t = \max(R^{ELB}, R_t^{PLT})$, where

$$R_t^{PLT} = 0.85R_{t-1} + 0.15(r^* + \pi_t + ygap_t + (p_t - p_t^*)).$$

A.6 Temporary PLT: When monetary policy is unconstrained, the federal funds rate is set according to a modified inertial Taylor rule. The modification aims at offsetting only those inflation misses that have occurred since the first period of an ELB episode (t_1). The misses keep accumulating until the cumulative shortfall of inflation is made up. The cumulative misses can be represented as a price-level gap (Z_t), where

$$Z_t = \begin{cases} 0, & \text{if } R_{t-1} \geq 0 \text{ and } Z_{t-1} \geq 0 \\ \beta_n Z_{t-1} + (\pi_t - \pi^{LR}), & \text{otherwise,} \end{cases}$$

where $\beta_n = 1$.

A.7 Shadow Rate: This strategy—proposed by Reifschneider and Williams (2000)—consists of reducing the policy rate prescription in a standard Taylor rule by the cumulative forgone accommodation (\tilde{Z}_t), until exhausted. Measuring the shortfall in accommodation requires specifying an unconstrained monetary policy rule. Formally, from the first quarter in which the ELB binds, \tilde{Z}_t evolves according to

$$\tilde{Z}_t = \tilde{Z}_{t-1} + R_t - R_t^{Taylor},$$

until \tilde{Z}_t rises above zero, at which point it becomes zero until the next ELB episode. The monetary policy rule is then

$$R_t = \max\{R_t^{Taylor} + \tilde{Z}_t, R^{ELB}\}.$$

A.8 Average Inflation Targeting over the Long Run: When monetary policy is unconstrained, the federal funds rate (R) is set according to a modified inertial Taylor rule. The modification amounts to reacting to the gap between current year-over-year inflation (π_t) and the 2 percent long-run objective (π^{LR}) plus an inflation buffer ($\delta > 0$). The size of the buffer must be chosen in order that inflation averages the 2 percent objective—that is, $E(\pi_t) = \pi^{LR}$. When monetary policy is constrained, the federal funds

rate equals the ELB. The following equation summarizes the rule:

$$R_t = \max\{0.85R_{t-1} + 0.15(r^* + \pi_t + ygap_t + 0.5(\pi_t - (\pi^{LR} + \delta))), 0\}.$$

A.9 Loss Function: The equal-weights loss function embeds the assumption that policymakers discount the weighted sum of squared inflation gaps, squared unemployment gaps, and squared changes in the federal funds rate with a quarterly discount factor:

$$L_t = (1/(T + 1)) \sum_{\tau=0}^T \beta^\tau \{ (\pi_{t+\tau}^{PCE} - \pi^{LR})^2 + (ugap_{t+\tau})^2 + (R_{t+\tau} - R_{t+\tau-1})^2 \}.$$

The discount factor is usually set to 0.99.

Appendix B. FRB/US Simulation Methodology

Unless otherwise noted, we perform our simulations using the linearized version of the FRB/US model under the following set of assumptions:

- The baseline economic projection is consistent with the median responses of FOMC participants in the June 2019 Summary of Economic Projections (SEP), retrieved from the public FRB/US data.
 - To construct this baseline projection, we interpolated annual SEP information to a quarterly frequency and assumed that, beyond 2021 (the final year reported in the June 2019 SEP), the economy transitions to the longer-run values in a smooth and monotonic way. We also posited economic relationships to project variables not covered in the SEP. For example, we assume an Okun's law relationship to recover an output gap from the deviation of the median SEP unemployment rate from the median SEP estimate of its longer-run value.
 - The projection is consistent with longer-run values of the unemployment rate and inflation of 4½ percent and 2 percent, respectively.
 - We impose an ELB of 12.5 basis points, a value equal to the midpoint of the lowest range for the federal fund rate implemented by the FOMC during the Global Financial Crisis.
- We specify the model equations as follows:
 - We assume that price setters, wage setters, and financial market participants form model-consistent expectations; all other agents project future variables using small systems of equations and historical data.
 - We assume that the term premiums in the model do not respond to resource slack.
 - Because we run stochastic simulations over many years, we assume that trend government spending is twice as responsive to the output gap as in the standard version of FRB/US. This alternative assumptions helps ensure that simulations produce stable solutions over long horizons.

- We perform stochastic simulations of the model to derive uncertainty bands around the staff projection.
 - We sample from the model’s equation residuals from the 1969–2016 period.
 - To ensure consistency with the frequency and severity of historical economic downturns, we sample recessions with the same probability as in the data, and, when a recession occurs, we draw the entire sequence of equation residuals associated with one of the historical recessions.
 - We scale down markup shocks to lower their variance by half, which helps limit occurrences of ELB episodes driven by falls in inflation unrelated to developments in real economic activity. This change is motivated by our judgment that historical innovations to inflation were more volatile than innovations to inflation going forward because the FOMC lacked an explicit inflation objective over most of the sample period.
 - In order to have reasonably small sampling uncertainty for tail event statistics, we perform stochastic simulations using 20,000 draws.

Appendix C: Del Negro, Giannoni, and Schorfheide Model Specification

This appendix describes the version of the DGS model (DGS-FHP) that we use in section III. The model structure and parameter settings are those corresponding to the estimates reported in the published paper.

In order to attenuate the implausibly large effects of forward guidance in this model (as in most models in this class), we modify the forward-looking optimality conditions for households and firms such that all expectations appearing in household optimality conditions are multiplied by an additional 0.95 compared with their standard coefficients, while the coefficient on lead inflation in the Phillips curve is multiplied by 0.9.²¹ These modifications of the model are roughly in the spirit of Woodford (2019).

Similar to what we do with the FRB/US model simulations, we scale the standard deviation of price Phillips curve shocks by 0.25 to bring the standard deviation of core inflation under the Taylor rule roughly in line with the historical average between 1975 and 2019.

²¹ A more detailed discussion of the FHP version of the model can be found in Nakata and others (2019).