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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 2025 review of its monetary policy strategy, tools, and communications.

Abstract: This paper considers robust monetary policy strategies both in situations of low demand and low inflation and when economic developments pose a tradeoff between inflation and output stabilization. We proceed in two parts. First, our quantitative analysis suggests that asymmetric average inflation targeting can provide modest benefits over other inflation-targeting strategies when the risks associated with the effective lower bound remain significant. Second, motivated by the recent experience of persistent supply shocks and rapid increases in inflation, we describe the main qualitative features of optimal policy in circumstances when the objectives of stabilizing inflation and economic activity conflict. We find that monetary policy may allow inflation to depart from the target in response to certain supply shocks or in cases when sectoral dynamics are relevant, but that it should be ready to respond forcefully and expeditiously to large inflationary shocks or if inflation expectations are at risk of becoming unanchored.

JEL Classification: E31, E52, E58.

Keywords: Alternative monetary policy strategies, monetary policy communication, effective lower bound, supply shocks, sectoral dynamics, inflation surges.

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1. Introduction and overview

Starting in the 1990s, an increasing number of central banks around the world adopted inflation-targeting strategies. Under these strategies, central banks set an explicit inflation target to help deliver low and stable inflation. Under "flexible" inflation targeting, central banks balance medium-run inflation stabilization against other objectives, including stabilizing economic activity or employment. The Federal Reserve adopted flexible inflation targeting in 2012, with the announcement of a 2 percent longer-run inflation objective in its first Statement on Longer-Run Goals and Monetary Policy Strategy.

Prior to the Global Financial Crisis, inflation targeting had generally performed well, although it was well understood that the effective lower bound (ELB) on nominal interest rates posed challenges to these strategies as conventionally pursued.[1] The difficulty of providing sufficient accommodation when the policy rate is constrained by the ELB was readily apparent during the protracted recovery from the Great Recession. In response, many central banks employed unconventional policy instruments, such as balance sheet policies and forward guidance to provide additional policy accommodation.

In the U.S., the decade following the Great Recession was characterized by below-target inflation, low nominal interest rates, concern about future binding ELB episodes, and the risk that longer-term inflation expectations might drift downwards. In light of these experiences and in line with the practices of other major central banks, the Federal Reserve conducted the first review of its monetary policy framework in 2019-20 to assess whether changes in its monetary policy strategy could improve outcomes when the federal funds rate is at risk of being constrained by the ELB. A key outcome of that review was the adoption of a new element in its 2020 Statement on Longer-Run Goals and Monetary Policy Strategy: In order to achieve 2 percent inflation on average over time, the Federal Open Market Committee (FOMC) would "likely aim to achieve inflation moderately above 2 percent for some time" in situations where inflation had been running persistently below 2 percent. This strategy shares some similarities with an asymmetric variant of flexible average inflation targeting, a class of strategies under which the central bank aims to stabilize average inflation over some time period under certain conditions. As widely discussed in the literature, strategies in this class help to move inflation towards target on average, better anchor inflation expectations, and improve economic outcomes when the policy rate is at the ELB.

The experience since 2020 presented different challenges to monetary policy than had been the primary focus during the previous framework review. As described further in the companion papers by Hajdini and others (2025) and Lipińska and others (2025), widespread

[1] See Bernanke and others (1999) for an early treatment of the benefits of inflation targeting. More recently, Borio and Chavaz (2025) and Mishkin and Kiley (2025) emphasize how inflation targeting became even more prevalent after the financial crisis. See Krugman (1998) and Reifschneider and Williams (2000) on challenges posed by the ELB.

shortages, supply-chain disruptions, and reductions in labor supply contributed to depressed economic activity and increased inflationary pressures during that period. The recent higher incidence of supply shocks, a more important role for sectoral dynamics, and the possibility of rapid increases in inflation underscore that the objectives of stabilizing inflation and economic activity can be in conflict and that monetary policy must balance them.

This paper considers robust monetary policy strategies both in situations of low demand and inflation, and when developments pose a tradeoff between inflation and output stabilization objectives. In the first part of the paper, we analyze the main costs and benefits of asymmetric flexible average inflation targeting compared with other inflation targeting strategies through simulations using the FRB/US model, focusing on the performance of these strategies at the ELB. In the second part, motivated by the experience since 2020, we review the tradeoffs that supply shocks, sectoral dynamics, and sudden inflation surges may pose for monetary policy. In addition, we describe the main qualitative features of optimal policy in such circumstances, as well as the possible implications for the relative benefits of flexible average inflation targeting.

For the purposes of this paper, we mainly focus on two inflation targeting strategies: (1) flexible inflation targeting (FIT) where monetary policy follows the prescriptions of a standard inertial Taylor rule at all times, and (2) asymmetric flexible average inflation targeting (FAIT), under which policy seeks to stabilize average inflation when that average has fallen persistently below 2 percent, and reverts to FIT at all other times. Where appropriate, we also consider modified versions of FIT in which the central bank uses forward guidance when the ELB binds and versions of both FIT and FAIT that adopt a "shortfalls" approach to economic slack.

The two main parts of this paper and the key conclusions are as follows:

Evaluating Inflation Targeting Strategies

- FAIT can improve economic outcomes relative to FIT when inflation runs persistently below target because it prescribes a lower expected federal funds rate path relative to FIT for some time. During recessions when the ELB binds, the decline in the inflation rate under FAIT is smaller than under FIT, and inflation converges back to the target faster. By design, following a period of low inflation, FAIT calls for inflation to run somewhat above target for some time; in our simulations, overshooting tends to be relatively modest.
- Some of the shortcomings of FIT at the ELB can be addressed with modifications that provide additional accommodation when the ELB binds. A leading example is the specification of thresholds as a form of forward guidance that delays exit from the ELB for an extended period beyond what would be called for in the absence of the thresholds. In our simulations, modifications to FIT must keep the funds rate at the ELB for a considerable period in order to deliver benefits comparable with FAIT. As with FAIT, FIT strategies modified in this way often imply inflation overshooting the target modestly.
- Fully realizing the benefits of either FAIT or modifications of FIT requires that the public views the strategies as credible and adequately understands their implications. Achieving

these prerequisites may be challenging in practice. Incomplete descriptions of these strategies may have the advantage of retaining flexibility, maintaining credibility, and simplifying communications. However, incomplete descriptions may also be less effective at shaping public expectations, reducing the effectiveness of the policies.

Some Principles of Optimal Monetary Policy in Response to Inflationary Shocks

- Provided inflation expectations remain well anchored, optimal monetary policy allows inflation to depart from the target in response to certain supply shocks or in cases when sectoral dynamics are relevant, for instance, when large shocks originate in specific sectors or when the disparate effect of aggregate shocks across sectors is significant. In such cases, fully and promptly stabilizing inflation may come at a substantial cost for economic activity.
- Large inflationary shocks may also cause the public to become highly sensitive to inflation dynamics, raising the risk that sudden inflation surges may develop. These nonlinear inflation dynamics may lead to a persistent upward spiral between inflation and inflation expectations if not countered by a strong and expeditious policy response.

2. Evaluating inflation targeting strategies

In this section, we explore the macroeconomic costs and benefits of flexible versions of two strategies: flexible inflation targeting (FIT) and flexible average inflation targeting (FAIT). In the case of FAIT, we consider an asymmetric variant, which seeks to stabilize average inflation only when that average has been running below target, as might occur when the effective lower bound (ELB) is binding.[2] In all other cases, FAIT reverts to FIT. For robustness, we also interact both FIT and FAIT with the shortfalls approach to the maximum employment objective.

2.1 FIT versus FAIT: A quantitative evaluation

While FAIT has been part of the FOMC's strategy since 2020, the historical record since then has not been particularly informative about the relative performance of FIT versus FAIT because the economy has been far from the ELB for most of this time and inflation has generally been above target. Accordingly, we focus on evaluating the relative performance of FIT and FAIT quantitatively in the FRB/US model. We represent these strategies in the form of simple monetary policy rules, calibrated to be broadly representative of the policy prescriptions that might be expected from these two strategies. These rules have been specified for illustrative purposes only and our results should be interpreted as indicative of general tendencies in outcomes, while the quantitative differences may vary depending on the exact rule specifications.

Concretely, as described in table 1 and in more detail in appendix A.1.1, we represent FIT by a standard inertial Taylor rule, according to which, when not constrained by the ELB, the federal funds rate is set as a function of its level over the past quarter, the output gap, and four-

[2] FAIT belongs to the class of "make-up strategies" that have been shown to be effective when the ELB constrains policy. Broadly speaking, make-up strategies commit monetary policy to follow deficits in certain variables (such as inflation below target) with surpluses in those variables later (such as inflation overshooting the target). Prominent examples of such strategies in the literature are price-level targeting, average inflation targeting, and, in the context of the ELB, the forward guidance strategy described in Reifschneider and Williams (2000). The literature showing the advantages of make-up rules in modern macroeconomic models dates back at least to the early 1980s, such as Bean (1983) on nominal income targeting. More recently, theoretical explorations of optimal policy at the ELB very generally lead to history-dependent rules. These rules function, in some ways, like make-up rules. For example, as shown in Eggertsson and Woodford (2003), the optimal monetary policy response to a binding ELB is a form of price-level targeting, in which the permanent increase in the price level is related to the severity of the ELB constraint. Make-up strategies, like FAIT, that do not allow the price level to rise permanently above its trend only approximate the optimal policy. See the discussion in Levin and others (2010) for a quantitative comparison of these policies versus the optimal policy.

A number of recent papers have evaluated the performance of these strategies, among them, Kiley and Roberts (2017), Hebden and López-Salido (2018), Bernanke, Kiley, and Roberts (2019), Reifschneider and Wilcox (2019), Amano and others (2020), Arias and others (2020), Budianto, Nakata, and Schmidt (2020), Coenen, Montes-Galdón, and Schmidt (2021), Erceg, Jakab, and Lindé (2021), Gerke and others (2021) and Coulter, Duncan, and Martinez-Garcia (2022). These studies typically find, as we do, that make-up strategies can improve on FIT, especially at the ELB, although the magnitude of the improvement, and the best performing make-up strategy, varies across papers.

quarter core personal consumption expenditures (PCE) price inflation.[3] As mentioned previously, standard Taylor rules are known to perform poorly at the ELB, so we will also consider modifications of FIT that use thresholds to delay exit from the ELB beyond what would be implied by the Taylor rule.

Table 1: Specifications of Monetary Policy Rules for FIT and FAIT

FIT: $R_t^{FIT} = 0.85R_{t-1} + 0.15(r^{LR} + \pi^{LR} + 2.5(\pi_t - \pi^{LR}) + ygap_t)$

FAIT: $R_t^{FAIT} = \begin{cases} R_t^{FIT} & \text{if } \bar{\pi}_t \geq \pi^{LR} \\ R_t^{FIT} + 0.15 * 8(\bar{\pi}_t - \pi^{LR}) & \text{if } \bar{\pi}_t < \pi^{LR} \end{cases}$

Notes: R_t is the annualized net federal funds rate, $\bar{\pi}_t$ is 32-quarter average inflation, $ygap_t$ is the output gap, π_t is the 4-quarter percent change in core PCE prices, π^{LR} is the inflation target, and r^{LR} is the long-run real funds rate.

A number of policy rules can be regarded as forms of FAIT, differing in the conditions under which policy starts and ceases to target average inflation.[4] In this paper, the FAIT rule targets average inflation whenever average inflation is below 2 percent and is identical to the calibrated Taylor rule used to represent FIT when average inflation is at or above 2 percent. Formally, we select a rule to represent FAIT that is identical to the standard Taylor rule but adds a term (in red in table 1) that reacts to the eight-year trailing average inflation rate, when this average runs below target.[5]

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[3] We focus on rules with a symmetric output gap response, but, below, also consider rules that respond only to shortfalls in activity.

Allowing for inertia in the FIT rule blurs the conceptual distinction between FIT and make-up strategies. Just like certain make-up strategies, very inertial FIT rules react persistently to past inflation. For example, a FIT rule with a high degree of inertia could deliver outcomes very close to those obtained under a price-level target. In this paper, we choose a degree of inertia that is roughly in line with historical FOMC behavior. With this degree of inertia, a meaningful quantitative difference between FIT and make-up strategies still exists.

[4] Among alternative rules that could also be viewed as falling under FAIT are the proposed rule in Bernanke (2017), under which policy targets average inflation until such time as the rule departs from the ELB, and the temporary price-level and average-inflation targeting rules described in Hebden and López-Salido (2018) and Chung and others (2019), in which policy starts to target average inflation when the ELB binds and continues to target average inflation until the average is 2 percent. The Bernanke rule has been evaluated by Hebden and López-Salido (2018), who find that the rule performs well compared with FIT rules, and by Erceg, Jakab, and Lindé (2021), who find that the rule provides only relatively modest additional stimulus in an estimated model of the euro area. While we focus on FAIT rules that respond dynamically to the average inflation gap, as shown in Mertens and Williams (2019), the downward bias due to the ELB could also be corrected by adopting a FIT rule that aims to stabilize inflation at a constant level above the inflation target when the policy rate is not at the ELB.

[5] The length of the AIT horizon significantly affects the outcomes generated by the rule. In theoretical models where the public has complete understanding of the rule and its consequences, the optimal horizon is

We evaluate the performance of FIT and FAIT using stochastic simulations of the FRB/US model.[6] The simulations assume model-consistent expectations on the part of asset-market participants and wage- and price-setters, that is, the expectations of these agents are identical with the modal forecast of the model, in the absence of shocks. Figure 1 plots the median of the distribution of outcomes, conditional on shocks that would drive the economy into a recession and the federal funds rate to the ELB.[7] In these simulations, recessions severe enough to drive the funds rate to the ELB are largely driven by adverse shocks to demand. In the median recession, under FIT (the red solid line), the unemployment rate rises from roughly 4 percent in the year before the recession to around 6½ percent at the peak, while inflation drops to 1.3 percent at its trough and remains around 1½ percent for several years thereafter. Under FAIT (the blue dashed line), the median unemployment and inflation outcomes are appreciably better, with both variables closer to target.

FAIT achieves a faster convergence of inflation to target because of the additional accommodation it provides when average inflation is below target. While FAIT departs from the ELB at roughly the same time as FIT, it is substantially more accommodative after liftoff. This additional accommodation is clearly apparent in the lower trajectory for the expected 10-year average real funds rate compared with FIT. Because the eight-year average inflation rate returns to two percent very gradually, policy prescriptions under FAIT are persistently more accommodative than under FIT. Higher expected inflation than under FIT further depresses real rates. Wage- and price-setters, anticipating the higher level of demand (and hence inflation), raise nominal wages and prices earlier, even when the federal funds rate is constrained by the ELB and demand is weak.

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typically very long. In models featuring imperfect understanding (Amano and others, (2020), Budianto, Nakata, and Schmidt (2020)), the horizon is typically shorter due to effects similar to those we discuss below in section 2.2. In the FRB/US model, because both output and inflation are quite inertial, a relatively long horizon is necessary to generate meaningful differences from FIT.

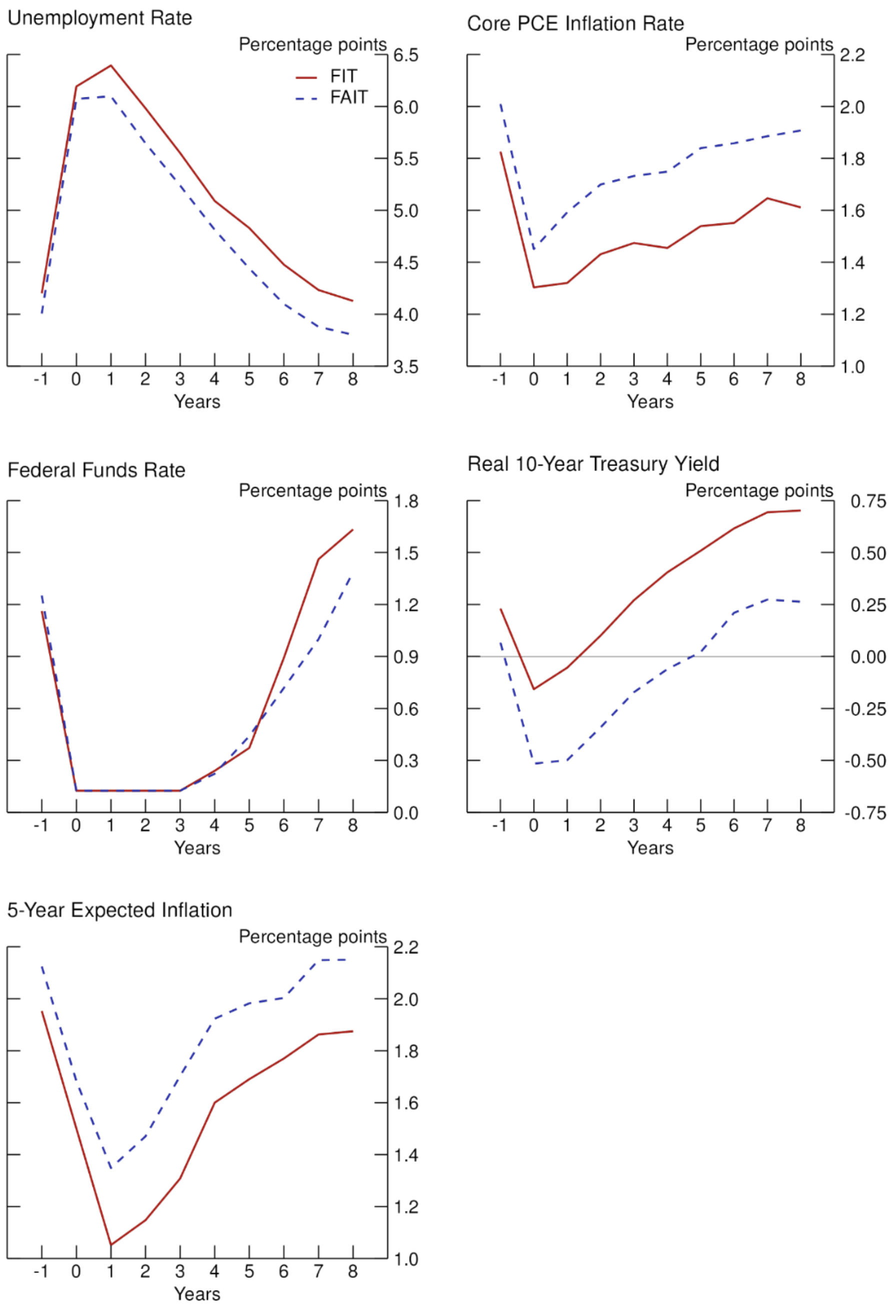
[6] The shocks for this exercise are drawn from FRB/US model residuals from 1969q1 to 2024q4, excluding the pandemic (2020q1 to 2021q2). The baseline trajectories for these simulations are taken from the public FRB/US dataset, starting in 2030q1 (near the steady-state, in which the long-run real funds rate is 1 percent).

Unless otherwise noted, the rules are simulated in the absence of forward guidance strategies at the ELB; that is, after hitting the ELB, the federal funds rate is raised in the quarter when the rule prescription is above the ELB. Appendix A.1 describes further technical details behind the simulations, as well as simulations of recessions under VAR and fully model-consistent expectations comparable to those described in this section.

We abstract from active balance-sheet policies, which could be incorporated into either strategy.

[7] For the purposes of this figure, a recession is defined as in González-Astudillo and Vilán (2019): an event in which the unemployment rate rises in four consecutive quarters along with at least two—not necessarily consecutive—quarters of negative gross domestic product (GDP) growth. The median recession in our simulations does not imply a binding ELB and we therefore focus here on events that also cause the ELB to bind. All rules are simulated using the same randomly drawn shock paths. Median outcomes are conditional on entering a recession along with a binding ELB under FIT in the fortieth quarter of the simulation; this period is labelled as period 0 in the figures.

Figure 1: Median outcomes at the ELB in a recession, alternative policy rules



Notes: Authors' estimates. Median outcomes conditional on entering a recession along with a binding ELB under FIT in the fortieth quarter of the simulation; this period is labelled as period 0 in the figures. All rules are simulated using the same randomly drawn shock paths.

By design, following a period of low inflation, FAIT calls for inflation to run somewhat above target for some time. In these simulations, monetary policy affects inflation only with a considerable lag. As a result, the expected overshooting occurs many years after the ELB binds and is not visible in figure 1.[8] Moreover, by the time the overshooting occurs, the eight-year average inflation rate is only slightly above the target. Consequently, the overshooting tends to be relatively modest. As shown in figure 1, under FAIT, the median expected five-year-ahead average inflation rate rises a bit above 2 percent six years after the trough of the recession.[9] If policy lags were shorter, the overshoot of inflation would occur sooner.

Both an extensive research literature and the record of central bank practice after the Great Recession suggest many different modifications to the standard Taylor rule approach that might improve the performance of FIT at the ELB.[10] A prominent example of such a modification is the specification of threshold conditions on economic outcomes that must be met before lifting rates off the ELB, delaying exit beyond what would naturally be called for by the Taylor rule and thus providing a "lower for longer" policy when the ELB binds. Results in the literature indicate that the use of thresholds may be able to effectively address the weaknesses of FIT at the ELB, if exit from the ELB is delayed sufficiently beyond what would be called for by FIT alone.[11] Specifically, the literature suggests that thresholds may have to delay lift-off until either economic activity is above potential or inflation is above target in order to provide sufficient additional accommodation.[12] With such thresholds, the additional accommodation is provided by a longer period of time at the ELB rather than the lower policy path after liftoff that

[8] The onset of overshooting is also delayed by a technical issue with the perfect foresight methodology used to simulate the model. Under the assumption of perfect foresight, households and firms do not take into account the downward bias on inflation as a result of the ELB and hence do not anticipate real interest rates low enough to compensate for the bias. Consequently, the median inflation path does not overshoot as quickly as it would under fully rational expectations. Related issues arise below in our discussion of threshold-based forward guidance, as further elaborated in footnote 12.

[9] The long delay before inflation overshoots under FAIT, as well as its modest magnitude, in FRB/US simulations has been previously noted and discussed by Reifschneider and Wilcox (2019) and Arias and others (2020). Both features stem from the very gradual recovery of inflation in the model.

[10] In addition to using forward guidance to ameliorate the shortcomings of FIT, suitably chosen balance-sheet policies could also diminish the gap between FIT and FAIT.

[11] See Boneva, Harrison, and Waldron (2018) and Chung and others (2019).

[12] Appendix A.1.4 reports outcomes under an inflation threshold, which delivers roughly as much accommodation as FAIT and achieves similar outcomes for inflation. However, as further discussed in that appendix, inflation can be volatile, and, since inflation in these simulations is only a few tenths of 1 percent below the threshold, the probability of a short-lived shock causing inflation to breach the threshold is appreciable. In the simulation methodology used in generating the FRB/US simulations, agents do not account for the possible effects of these shocks when forming expectations and, as a result, significantly over-estimate the duration of the ELB episode under an inflation threshold. Boneva, Harrison, and Waldron (2018), who take account of this effect, find that an unemployment rate threshold (without an inflation escape clause) works better than an inflation threshold when demand shocks dominate the distribution of risks, but that an inflation threshold can work better in the presence of volatile supply shocks.

is prescribed by FAIT.[13] Thresholds that permit exit from the ELB earlier often fail to improve meaningfully over FIT.[14]

In typical models in the literature, the abnormally sharp drop in economic activity and, hence, inflation at the ELB causes average inflation under FIT to run below the inflation target. The magnitude of the downward bias in the average inflation rate depends on several factors, including the strength of monetary policy effects on inflation and the distribution of shocks. In addition, the probability of hitting the ELB—and hence the magnitude of the downward bias in inflation—depends importantly on the long-run level of the federal funds rate, with a higher level reducing the probability of a binding ELB. Quantitative evaluations of the downward bias in inflation differ significantly along these dimensions. For example, for an inflation target of 2 percent and a long-run real equilibrium federal funds rate of 1 percent, prominent estimates in the literature of the average inflation rate lie between 1 and 2 percent.[15] In the simulations reported in Appendix A.1.3, FAIT strategies effectively address this downward bias, even in environments where the downward bias is large under FIT.[16]

2.2 FIT versus FAIT: Robustness

Interactions with the "shortfalls" approach. The relative costs and benefits of the two strategies, FIT and FAIT, also depend on the degree to which policy responds asymmetrically to economic activity. As discussed in Bundick, Cairó and Petrosky-Nadeau (2025), a rule that does not respond to positive output gaps or to unemployment below the unemployment rate consistent with maximum employment (a "shortfalls" approach) could result in a higher average inflation rate than a similar rule that has a symmetric response. A shortfalls approach may therefore

[13] For more discussion of the tradeoffs between providing accommodation through a longer period of time at the ELB versus a slower pace of tightening after liftoff, see Erceg, Kiley, and Tetlow (2014).

[14] For example, as discussed in more detail in appendix A.1.4, in these FRB/US simulations, an unemployment rate threshold set at the natural rate of unemployment increases the expected duration of the ELB episode only an extra year or so at the trough of the recession in the median case, compared with the unmodified FIT rule, and hence it provides only very modest additional stimulus.

[15] Kiley and Roberts (2017) and Bernanke and others (2019) report average inflation around 1 percent under these conditions. A survey of model results presented as part of the European Central Bank's price stability framework review in 2021 finds that, in most models, inflation averages above 1½ percent, with a median result about mid-way between 1½ and 2 percent. Appendix A.1.3 provides further discussion of the determinants of the average inflation rate in FRB/US simulations.

[16] In theory, the probability that the funds rate is at the ELB could be either higher or lower under FAIT than under FIT, depending mainly on how strong the effects of monetary policy on inflation and output are. Because inflation is higher, on average, under FAIT than under FIT, it is possible that the funds rate could be at the ELB less frequently under FAIT than under FIT, as suggested by some results in the literature—see, for example, Mertens and Williams (2019). As shown in the FRB/US simulations in appendix A.1.3, under the assumption of model-consistent expectations for financial market participants and wage and price setters, the fraction of quarters at the ELB is slightly higher under FAIT than FIT. By contrast, assuming fully model-consistent expectations and a low degree of fiscal stabilization—and thus a more adverse effect of being constrained by the ELB—implies that the fraction of quarters at the ELB is much higher under FIT than FAIT.

partly substitute for FAIT as a strategy for supporting average inflation against downside risks. Furthermore, such an asymmetric approach may imply a more gradual tightening path after exiting the ELB, helping to provide additional accommodation when the ELB is binding. As shown in Figure 2, when FIT is combined with a shortfalls approach, inflation outcomes during a recession are closer to those seen under FAIT. When FAIT is combined with a shortfalls approach, inflation now overshoots 2 percent within seven years of the start of the episode, much earlier than under a FAIT rule that responds symmetrically to the output gap.

The importance of public understanding and credibility. The full benefits of FAIT materialize only if the public understands the strategy adequately and views it as credible.

First, the benefits of FAIT shown in the simulations require that, at the ELB, the public correctly anticipates that monetary policy will remain more accommodative than FIT for a number of years into the future.[17] FAIT is a more complex policy than FIT, and although describing the desired policy in a particular scenario is straightforward, communicating how the policy would work out under a variety of scenarios that may materialize over the implementation horizon is more challenging. For example, a policy that has a substantial backward-looking element, such as a long averaging horizon, would have to be qualified to allow policymakers to respond appropriately to rapid developments, such as a surge in inflation or other unforeseen events. Policymakers may wish to specify such exit conditions from FAIT. Incomplete descriptions of the policy strategy may have the advantage of retaining flexibility and simplifying communications with the public.[18] However, incomplete descriptions may also be less effective at shaping public expectations, reducing the effectiveness of the policy. Nonlinearities in inflation dynamics—discussed in more detail in the next section—could complicate this communication further, as accommodation may have to be withdrawn more rapidly than previously anticipated.

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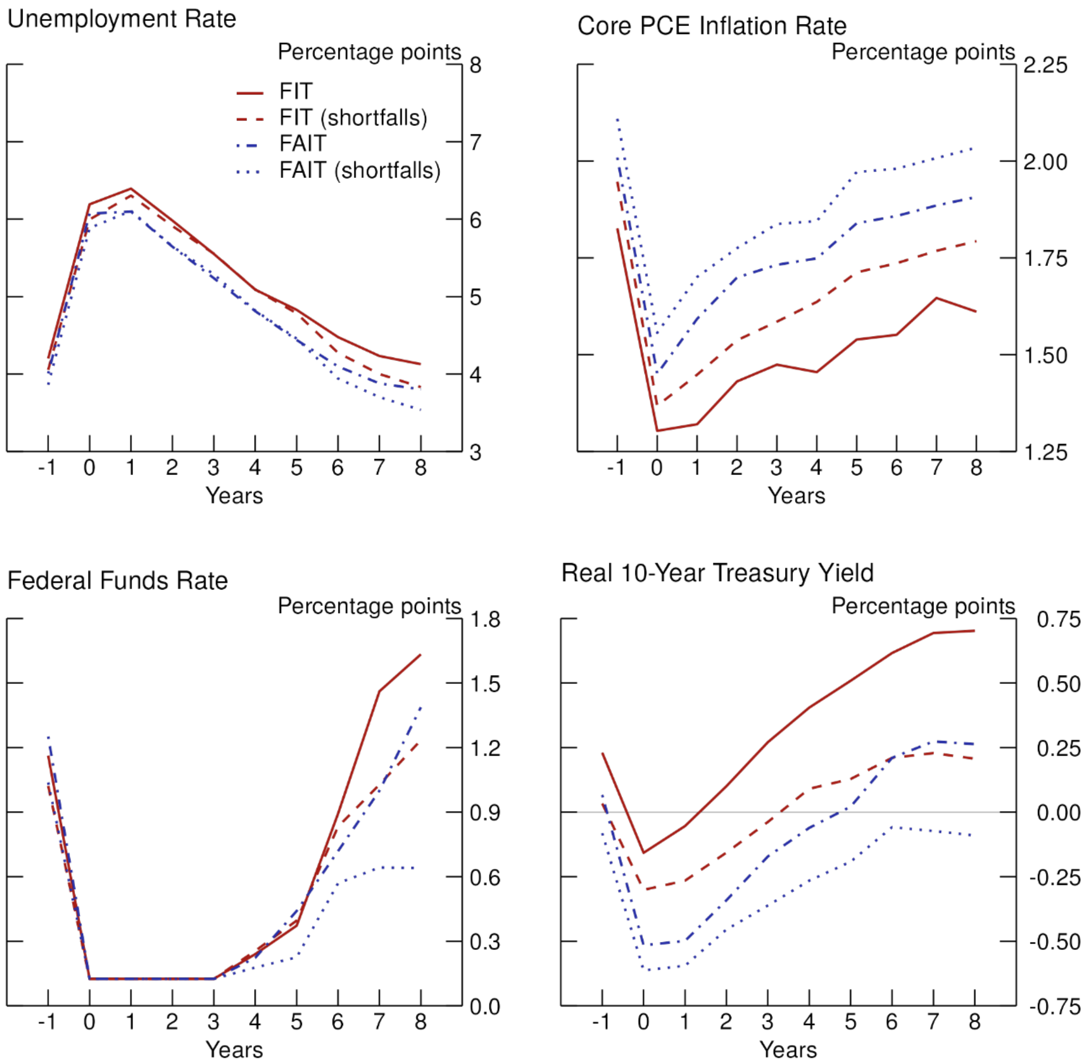
[17] Formally, the simulations assume that financial market participants form model-consistent expectations, which are then reflected in asset prices.

[18] See Bernanke (2003) for a discussion of the merits of what he terms "constrained discretion," in which "the central bank is free to do its best to stabilize output and employment in the face of short-run disturbances", (paragraph 11) subject to maintaining a strong commitment "to keeping inflation low and stable" (paragraph 6).

Figure 2: Median outcomes at the ELB in a recession, alternative shortfall rules



Notes: Authors' estimates. Median conditional on being in a recession along with a binding ELB under FIT in the fortieth quarter of the simulation.

Second, outcomes under the two strategies also depend on the extent to which monetary policy strategies can shape expectations of future activity and inflation. For example, simulations reported in appendix A.1.5 suggest that, if the public's expectations of inflation are sufficiently backward looking, FAIT does not succeed in raising inflation expectations when demand is low.[19] Therefore, inflation is only a little higher under FAIT compared with FIT.

[19] To get a sense of how the benefits and costs of the two strategies depend on how the public may form expectations, we re-run the simulations assuming that the public correctly anticipates the path of the federal funds rate but does not fully understand the implications for inflation—instead relying on a simple (backward looking)

Nonetheless, if longer-term inflation expectations are linked to average realized inflation, FAIT may still help stabilize longer-term inflation expectations by stabilizing average inflation.

Finally, reaping the benefits of FAIT requires that the rule is perceived to be credible. Under FAIT, following a period of low inflation, inflation will often overshoot the target, potentially over a prolonged period, and this overshooting must occur without impairing the public's confidence in a continued strong commitment to price stability. On account of the tension between the commitment to allow overshooting and the mandate to achieve price stability, the public may not be certain that past promises will be honored once the benefits are realized, possibly diminishing the effectiveness of the strategy. Incomplete communication about the policy reaction function, along with escape clauses, could reduce the burden of commitment, but, as previously mentioned, could also temper the effectiveness of FAIT at guiding expectations.[20]

These considerations apply with similar force to threshold-based forward guidance under FIT. For example, credibility concerns and communication challenges similar to those with FAIT would also arise for a threshold strategy under which the minimum inflation threshold for exiting the ELB was chosen at or above the target.

Summing up.

In this section, we focused on alternative monetary policy strategies that may be appropriate under the mix of risks that were prominent before the pandemic—in particular, the challenges posed by the ELB and persistently below-target inflation. These risks may continue to be relevant. However, the post-pandemic experience has highlighted some additional risks—such as a heightened prevalence of supply shocks, sectoral developments, and nonlinearities in inflation dynamics. In the years ahead, these risks may remain salient. We next turn to an examination of these recently prominent risks and their possible implications for monetary policy strategies.

3. Some principles of optimal monetary policy in response to inflationary shocks

As described in the companion papers by Hajdini and others (2025) and Lipińska and others (2025), widespread shortages, supply-chain disruptions and reductions in labor supply likely contributed to depressed economic activity and increased inflationary pressures during and after the pandemic. This experience has brought renewed attention to the risks and challenges posed by supply shocks and sectoral dynamics, by which we mean both shocks that originate in

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statistical forecasting model that does not change across the different policy rules. As shown by appendix figure A.1.5.1, inflation remains well below 2 percent for the first five years after the recession under both rules, implying a significant loss in effectiveness for FAIT.

[20] See Jia and Wu (2023).

specific sectors and the disparate effect of aggregate shocks across sectors. When faced with developments of this kind, monetary policy cannot generally stabilize both output and inflation. As also discussed by Hajdini and others (2025), the post-pandemic rise in inflation was much larger than would have been predicted based on the patterns in the pre-pandemic data. The risk of rapid increases in inflation (inflation surges) further complicates the task of monetary policy.

In the following sub-sections, we discuss each of the risks enumerated above and illustrate the appropriate monetary policy response in stylized models. The discussion is complemented by an appendix describing simulations of models that have been used in the literature. The models and the simulations presented in the appendix are intentionally simplified versions of more complex settings. These simplified settings abstract from uncertainty about the shocks and transmission mechanisms, and thus, this section does not consider implications for risk-management. Even so, the discussion presents general principles likely to be applicable in more complex scenarios.

In addition, we briefly discuss possible implications of these shocks for the costs and benefits of FIT and FAIT. In particular, the frequency and size of the inflationary shocks mentioned above can affect the distribution of aggregate inflation as well as the likelihood and duration of ELB episodes—all relevant to the relative merits of FIT versus FAIT. While the probability of hitting the ELB may remain appreciable going forward, if the distribution of inflationary shocks were such that either the probability of hitting the ELB or its severity is noticeably lower, the expected benefit of FAIT may be smaller than it would have been had the distribution of shocks remained as it was.

3.1 Aggregate supply shocks

Aggregate supply shocks—which move inflation and economic activity in opposite directions—have been especially notable in recent years. For example, the post-pandemic environment featured both significant movements in labor supply, and higher labor productivity growth, on average, than in the previous decade. In this section, we discuss some of the considerations that shape the appropriate policy response to supply shocks. Broadly speaking, provided inflation expectations remain well anchored, the central bank may wish to "look through" a *temporary* deviation of inflation from its longer-run goal rather than adjust policy in ways that reduce that deviation but magnify the adverse short-run effect on output and employment.[21]

The term "supply shocks" is broad and encompasses different types of disturbances. In general, it is useful to distinguish between two classes of aggregate supply shocks:

[21] For example, in the context of a New Keynesian model, Bodenstein, Erceg, and Guerrieri (2008) note that the optimal policy should not be overly aggressive at stabilizing inflation in response to *transitory* energy supply shocks. Similarly, if short-lived supply disruptions may potentially result in permanent damage to the productive capacity of the economy, the optimal policy should focus on stabilizing real activity rather than inflation; see Galí (2022).

- Supply shocks in the first class do not affect the productive capacity of the economy (that is, potential output and its determinants, such as the natural rate of unemployment). These shocks are referred to as "cost-push" shocks.[22] Given the link between inflation and economic activity, offsetting an inflationary cost-push shock comes at the cost of a contraction in aggregate demand and a negative output gap. Consequently, optimal monetary policy might allow some inflation, as long as inflation expectations remain well anchored.[23] When the link between economic activity and inflation is weak, reducing inflation would require large declines in output.[24] In such circumstances, optimal policy may lean against the shock only modestly. In this case, the funds rate may rise a little more than inflation, raising real interest rates slightly to maintain a somewhat contractionary monetary policy stance.[25]
- A second class of supply shocks encompasses those that affect potential output, such as productivity shocks.[26] Following these shocks, the central bank can in principle intervene to align aggregate demand with aggregate supply, thereby largely closing the output gap and stabilizing inflation.[27] In appendix A.2.2, we use a simulation from a stylized macroeconomic model to illustrate the optimal monetary policy response to a positive and persistent increase in the level of aggregate productivity. We show that, for this shock, there is no conflict between stabilizing inflation and the output gap under optimal policy.

3.2 Sectoral dynamics

The previous section described some broad principles for monetary policy following aggregate shocks. However, some shocks may originate at the sectoral level. In addition, some aggregate shocks may particularly affect certain sectors of the economy (for example, through sector-specific capacity constraints). Recent examples include the post-pandemic supply-chain disruptions and the shift in the composition of demand from services to goods described in Hajdini and others (2025). When sectoral dynamics are important, aggregate inflation is not tightly linked to overall aggregate demand (the output gap), but can be affected by other factors,

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[22] Examples of cost-push shocks in simple models are somewhat artificial. We discuss below realistic examples of shocks that have cost-push properties in the context of richer models.

[23] The optimal policy response to cost-push shocks has been the subject of an extensive discussion in the literature. Galí (2008) for example, lays out the optimal policy response to cost-push shocks in the canonical three-equation New Keynesian model.

[24] Recent surveys of the evidence on this relation—the Phillips curve—include Furlanetto and Lepetit (2024) and Tetlow (2024).

[25] The optimal policy response described here differs from the case in which the funds rate does not respond to a shock. Not responding may be warranted when the effects of monetary policy are felt well after the effects of a shock have fully dissipated, provided that longer-term inflation expectations remain well anchored.

[26] Shocks to productivity have been a significant feature of this decade and may continue to be important going forward, with advances in artificial intelligence technology as a leading example. Qualitatively similar outcomes would result from other shocks to potential output and its determinants, such as an increase in population stemming from immigration.

[27] In practice, a policymaker uncertain about how much potential output has shifted may be reluctant to induce large movements in activity. In that case, policy might stabilize inflation only to a limited extent.

such as imbalances between supply and demand across sectors. As a result, monetary policy will generally not be able to stabilize both aggregate inflation and the output gap.[28]

In models that focus on sectoral dynamics, a common finding is that a heavy emphasis on stabilizing aggregate inflation can result in undesirable declines in aggregate output and misallocation across sectors, while prioritizing output gap stabilization would be close to optimal.[29] When weighing the degree to which monetary policy should intervene, the literature emphasizes that policymakers should especially seek to lean against inflation when it arises in sectors with stickier prices, as inflation in those sectors can cause persistent movements in aggregate inflation. By contrast, optimal policy should tolerate more inflation arising in sectors with more flexible prices.[30] In appendices A.2.3 and A.2.4, using a stylized macroeconomic model, we illustrate that optimal monetary policy may allow some inflation when sectoral dynamics are consequential, provided that inflation expectations remain well anchored.

The literature also highlights the relevance for optimal monetary policy of the input-output network—the fact that outputs of some sectors are inputs to other sectors. Some shocks may affect the price of certain inputs more than others and may therefore affect the costs of some sectors more than others. The result, again, is that monetary policy cannot fully stabilize both inflation and output. While quantitative results on optimal policy in network models are relatively few and recent, some results suggest that, as in the earlier literature on optimal policy in multi-sector models, a heavy focus on output gap stabilization is close to optimal.[31] Taking supply chains into account, the literature emphasizes the advantages of focusing on mitigating

[28] These issues are not new. For example, the contribution of shifts in the composition of demand to the inflation of the late 1950s was extensively discussed by economists at the time (Schulze, 1959, among others) and oil price shocks were key drivers of inflation in the 1970s. Consequently, there is a rich body of literature that studies monetary policy in response to sectoral shocks.

Interest in sectoral shocks had been growing before the pandemic—see Baqaee and Farhi (2020)—and the pandemic experience has further increased interest in such shocks in the literature; see the discussion in Hajdini and others (2025). Guerrieri and others (2021) study optimal monetary policy following a shock that shifts demand from one sector to another and argues that, when labor is mobile across sectors, accommodative monetary policy, by stimulating wages in the growing sector, helps reallocate activity towards it.

[29] In the context of New Keynesian models, an important reference is Erceg, Henderson and Levin (2006).

[30] See Aoki (2001), who studies optimal monetary policy in a multi-sector model following a shock that affects relative prices across sectors and argues that optimal policy should aim to stabilize inflation in sticky-price sectors. This prescription is akin to a policy that focuses on core inflation as a guide to implement policy (while still targeting headline inflation). See also the detailed discussion of this case, as well as the case of sticky wages, in Erceg, Levin and Henderson (2000) and in Woodford (2003).

[31] A recent example in this literature is La'O and Tahbaz-Salehi (2022). These authors characterize optimal monetary policy in an environment in which price stickiness arises because of information frictions and use simulations of a calibrated model to find that stabilizing a consumer price index leads to quantitatively relevant welfare losses relative to the optimal policy. In addition, Rubbo (2023) uses a multisector model with a realistic input-output network to argue that optimal monetary policy should not target a consumer price index, but rather a "divine coincidence index" that weights sectors according to their share of sales in the input-output network as well as their degree of price stickiness.

fluctuations in the prices of important suppliers. Price movements in sectors that are important suppliers set off a process of adjustment as each sector reacts to changes in its suppliers' prices. Because this process is uncoordinated and likely to involve significant inefficiency, research suggests that monetary policy should especially lean against persistent inflation in sectors that are important to the supply chains of the rest of the economy.[32]

3.3 Nonlinearities

The pandemic experience has highlighted that the relationship between inflationary pressures and the strength of the economy may be weak in normal times but strengthen sharply in certain circumstances.[33] For example, shocks to demand that affect sectors that are at or close to full capacity may trigger a sudden surge in inflation.[34] In addition, elevated inflation may induce a situation in which price-setting becomes highly sensitive to current macroeconomic conditions, perhaps because firms concurrently adjust their prices.[35] Furthermore, a large increase in realized inflation may raise the public's attention to inflation dynamics, causing inflation developments to become very salient for the public.[36] These nonlinear inflation dynamics may lead to a persistent upward spiral between inflation and inflation expectations, if not countered by a strong policy response and a credible commitment to return inflation to target.

In Appendix A.3, we illustrate the optimal policy response in the presence of nonlinearities in several macroeconomic models featuring empirically plausible nonlinear inflation dynamics.[37] The simulations presented there illustrate an important point made in the literature: in the presence of nonlinearities, policymakers should react with more force to large inflationary shocks than would be optimal in normal times, in order to forestall spikes in inflation.[38]

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[32] Examples of such sectors include electronics and machinery sectors. These sectors have correspondingly substantial weights in the divine coincidence index of Rubbo (2023), cited in footnote 31.

[33] See the discussion in Hajdini and others (2025). Furlanetto and Lepetit (2024) provide a summary of the state of knowledge on Phillips curve nonlinearities.

[34] See for example Comin, Johnson and Jones (2023).

[35] Blanco and others (2024) provide a model in which nonlinear inflation dynamics arise because firms can choose to readjust their prices more frequently following a persistent inflationary shock. Thus, periods of high aggregate inflation would induce firms to adjust prices more frequently, which, in turn, amplifies the initial inflation response to the negative supply shock.

[36] Several recent papers (Bracha and Tang (2024), Pfäuti (2025), Weber and others (2025)) emphasize that the public's attention to inflation increases as inflation increases, which raises the possibility that inflation expectations may become more sensitive to realized inflation when inflation is high.

[37] These simulations are based on the model of Blanco and others (2024). We examine the robustness of our results in a version of the FRB/US model that incorporates nonlinear inflation dynamics. This analysis confirms that policymakers should react more strongly to inflation deviations in the presence of nonlinearities.

[38] Karadi and others (2024) examine a menu cost model in which the sensitivity of inflation to economic activity rises after large shocks due to an endogenous increase in the frequency of price changes and conclude that

3.4 Implications for FIT versus FAIT

The previous five years featured a large role for supply shocks and sectoral dynamics and highlighted the significant risk of inflation surges. The degree to which these events continue to be important has some bearing on the relative benefits of FIT and FAIT.

If the future balance of risks is more like the past five years, with a higher incidence of inflationary shocks, the probability that inflation will be persistently low enough to trigger FAIT may decline, if either the ELB binds less often or, when it does bind, the severity of the episode is reduced. In addition, the possibility of a higher long-run natural rate of interest may also diminish the expected benefits of FAIT.

The simulation results shown in appendix 1.3 suggest that the probability of hitting the ELB remains appreciable as long as the long-run natural rate of interest remains comparatively low. The risks in the years ahead may thus be marked by low inflation and more closely resemble the pre-pandemic period. In this case, FAIT, or similar make-up strategies (for instance, the modified FIT strategy discussed above), can offer benefits compared with FIT in ELB episodes and provide a degree of insurance against such risks.[39] These benefits need to be weighed against the credibility concerns and communication challenges outlined previously.

4. Conclusion: Effective monetary policy in the post-pandemic world

The period between the Great Recession and the COVID-19 pandemic highlighted the risk that inflation might run persistently below target, with attendant risks to the stability of longer-term inflation expectations. The experience since the onset of the pandemic has brought back into focus the risks of persistent supply shocks and sectoral dynamics, as well as sudden inflation surges. These risks may well continue to be relevant in the future.

In this paper, we have explored the costs and benefits of FIT versus FAIT, focusing on outcomes during recessions with a binding ELB, and reviewed some principles of optimal monetary policy in response to supply shocks, sectoral dynamics and the risk of inflation surges.

Regarding the costs and benefits of FIT versus FAIT, in circumstances when the risks associated with the ELB remain significant, alternative strategies that support well-anchored inflation expectations, such as FAIT, might be warranted. FAIT can provide moderate support when inflation is persistently below target. FIT may be able to achieve broadly similar outcomes, if modified with the use of thresholds delaying ELB departure. Importantly, realizing

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optimal monetary policy should lean more forcefully against large cost-push shocks than small cost-push shocks. Beaudry, Carter, and Lahiri (2023) find that it is optimal for a central bank to adopt a hawkish anti-inflationary stance in response to shocks if inflation expectations are at risk of de-anchoring. Harding and others (2025) study optimal monetary policy in a model with a nonlinear Phillips curve and find that optimal policy takes a more aggressive approach to curbing inflationary pressures associated with larger shocks.

[39] As shown in tables A.1.3.1 and A.1.3.3, the fraction of time spent at the ELB in FRB/US stochastic simulations ranges from around 15 percent to around 30 percent of all quarters. See Nakata (2017) for a discussion of the effect on risk premiums from the likelihood that policy may be constrained by the ELB in the future.

the benefits under either approach requires that the public perceives the strategies to be credible and understands their implications adequately.

Supply shocks and sectoral dynamics may pose a tradeoff between inflation and maximum employment for monetary policy. The weak link between inflation and economic activity in normal times implies that offsetting inflationary supply shocks could require substantial declines in economic activity. Such declines might be justified if the supply shock persistently depresses potential output. In the case of a shock that affects sectors of the economy differently, monetary policy might tolerate some aggregate inflation, especially if it occurs mostly in flexible-price sectors, but should avoid inflation in sectors with sticky prices, or sectors that have a high importance in the supply chains of other sectors. In the event of large shocks, policymakers should be vigilant about the risk that elevated inflation may cause inflation dynamics to become very sensitive to economic conditions, possibly triggering an inflation surge, and should forcefully intervene to avoid such transitions.

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Appendixes

A.1 Supplementary material on FIT versus FAIT: Average inflation, thresholds rules, and VAR expectations

A.1.1 Rules specifications

FIT: $R_t = 0.85R_{t-1} + 0.15(r^{LR} + \pi^{LR} + 2.5(\pi_t - \pi^{LR}) + ygap_t) - 0.85 * (UR_t - UR_{t-2}) * \mathbb{1}(UR_t - UR_{t-2} > 0.25)$

FAIT: $R_t = 0.85R_{t-1} + 0.15(r^{LR} + \pi^{LR} + 2.5(\pi_t - \pi^{LR}) + ygap_t + 8(\bar{\pi}_t - \pi^{LR}) * \mathbb{1}(\bar{\pi}_t - \pi^{LR} < 0)(r^{LR} + \pi^{LR} + 2.5(\pi_t - \pi^{LR}) + ygap_t + 8(\bar{\pi}_t - \pi^{LR}) * \mathbb{1}(\bar{\pi}_t - \pi^{LR} < 0)) - 0.85 * (UR_t - UR_{t-2}) * \mathbb{1}(UR_t - UR_{t-2} > 0.25)$

where $\bar{\pi}_t$ is 32-quarter average inflation and $\mathbb{1}(\phi)$ is the indicator function equaling 1 when ϕ is true and zero otherwise. Relative to the simplified description in the main text, the additional terms reacting the two-quarter change in the unemployment rate are designed to mimic the rapid decline in the funds rate typical in a recession.

In addition to these rules, we also report outcomes under rules that react only to shortfalls in economic activity.

FIT (shortfalls): $R_t = 0.85R_{t-1} + 0.15(r^{LR} + \pi^{LR} + 2.5(\pi_t - \pi^{LR}) + ygap_t * \mathbb{1}(ygap_t < 0)\ ) - 0.85 * (UR_t - UR_{t-2}) * \mathbb{1}(UR_t - UR_{t-2} > 0.25)$

FAIT (shortfalls): $R_t = 0.85R_{t-1} + 0.15(r^{LR} + \pi^{LR} + 2.5(\pi_t - \pi^{LR}) + ygap_t * \mathbb{1}(ygap_t < 0)\ + 8(\bar{\pi}_t - \pi^{LR}) * \mathbb{1}(\bar{\pi}_t - \pi^{LR} < 0)(r^{LR} + \pi^{LR} + 2.5(\pi_t - \pi^{LR}) + ygap_t * \mathbb{1}(ygap_t < 0)\ + 8(\bar{\pi}_t - \pi^{LR}) * \mathbb{1}(\bar{\pi}_t - \pi^{LR} < 0)) - 0.85 * (UR_t - UR_{t-2}) * \mathbb{1}(UR_t - UR_{t-2} > 0.25)$

Finally, we consider rules that respond to the change in the output gap rather than the level of the gap. Optimized rules typically contain a large weight on the change, compared with the level of the gap, and, importantly for the current setting, can moderate the upward inflation bias as a result of FAIT in conjunction with a shortfalls-based approach to the output gap. Accordingly, for our simulations, these simulations only react to the change in the output gap when the level of the gap is negative.

FIT (change): $R_t = 0.85R_{t-1} + 0.15\big(r^{LR} + \pi^{LR} + 2.5(\pi_t - \pi^{LR}) + (ygap_t - ygap_{t-1}) * \mathbb{1}(ygap_t < 0)\big) - 0.85 * (UR_t - UR_{t-2}) * \mathbb{1}(UR_t - UR_{t-2} > 0.25)$

FAIT (change): $R_t = 0.85R_{t-1} +$

$$0.15\begin{pmatrix} r^{LR} + \pi^{LR} + 2.5(\pi_t - \pi^{LR}) + (gap_t - gap_{t-1}) * \mathbb{1}(gap_t < 0) \\ +8(\bar{\pi}_t - \pi^{LR}) * \mathbb{1}(\bar{\pi}_t - \pi^{LR} < 0) \end{pmatrix}$$

$$-0.85 * (UR_t - UR_{t-2}) * \mathbb{1}(UR_t - UR_{t-2} > 0.25)$$

A.1.2 Simulation methodology

Simulations are conducted using a linearized version of the FRB/US model under the assumption of model-consistent expectations on the part of asset-market participants and wage- and price-setters. The baseline is taken from the public FRB/US dataset, starting in 2030, when the economy is essentially at its long-run steady-state, in which the federal funds rate stands at 3 percent. Shocks are drawn according to the block bootstrap procedure outlined by González-Astudillo and Vilán (2019), using residuals between 1969:Q1 and 2024:Q4, with the exclusion of the exceptionally large residuals associated with the pandemic (2020:Q1-2021:Q2). Simulations run for 20 years and the distributions are taken over 20,000 draws, which are held the same for all the rules simulated.

Long-term inflation expectations (PTR) are endogenous to actual inflation.

$$PTR_t = 0.9\, PTR_{t-1} + 0.05\, \pi_t + 0.05\, \pi^{LR}.$$

A.1.3 Average inflation in FRB/US

As discussed in section 2.1, estimates of the downward bias in average inflation due to the ELB cover a wide range, even across studies using the FRB/US model. Results in Kiley and Roberts (2017) and appendix II of Chung and others (2019) highlight two important sources of divergence in the context of the FRB/US model. In many New Keynesian models, sufficiently large adverse shocks can cause the economy to enter a regime in which activity contracts explosively.[40] In the FRB/US model, this threshold is significantly more likely to be reached under the assumption that all agents in the model form expectations in a model-consistent way. Consequently, the effects of hitting the ELB are, on average, much worse under full model-consistent expectations than under mixed assumptions for expectations formation. Relatedly, previous studies with the FRB/US model have moderated the explosive regime by assuming some degree of active fiscal stabilization. Because the economy deteriorates exponentially in the explosive regime, the details of the assumed fiscal stabilization are important, as slightly weaker fiscal support can translate into large differences in outcomes.

These points are illustrated in table A.1.3.1, which reports features of the distribution of outcomes in stochastic simulations with the FRB/US model, under different assumptions about expectations formation and fiscal stabilization. In these exercises, the degree of fiscal stabilization is modeled by a parameter that determines the responsiveness of the desired surplus-GDP (gross domestic product) ratio target as a function of the output gap. Setting this parameter so that a 1 percent increase in the output gap raises the target surplus-GDP ratio by 1 percent (*gfsrt* = 0.01) is sufficient to avoid hitting the explosive regime, even for very long horizon

[40] See appendix II of Chung and others (2019) and Eggertsson and Giannoni (2021).

stochastic simulations (20 to 30 years). Reducing this parameter to 0.005 is enough to cause a non-negligible fraction of draws to enter into the explosive region within relatively short time horizons (10 years or so).

The main takeaway from the table is that, with a significant degree of active fiscal stabilization, the average inflation bias under FIT is relatively modest, with average inflation around 1.8 percent in the worst case (fully model-consistent expectations). However, without this degree of fiscal stabilization, the inflation bias under FIT can be more severe. Under fully model-consistent expectations (MCE) and reduced fiscal support, average inflation is only 1.5 percent. Further reductions in the degree of fiscal support could produce even lower average inflation rates, depending on how often the explosively deteriorating regime is encountered and how long it is permitted to continue.

Table A.1.3.1: Distributions of outcomes under alternative assumptions about expectations formation and fiscal support

			Inflation			Unemployment Rate			ELB Statistics	
			mean	5%	95%	mean	5%	95%	P(entry ELB)	Fraction of Qtrs at ELB
gfsrt = 0.01										
	MCAP+WP									
		FIT	1.91	0.53	3.17	4.37	2.30	7.58	0.14	0.23
		FAIT	2.07	0.96	3.21	4.19	2.12	7.18	0.14	0.25
		FIT (UR threshold)	1.94	0.59	3.18	4.33	2.31	7.47	0.14	0.25
	MCAP									
		FIT	1.94	0.87	2.82	4.35	2.18	7.64	0.14	0.23
		FAIT	2.04	1.11	2.85	4.14	1.90	7.24	0.14	0.26
		FIT (UR threshold)	1.95	0.90	2.82	4.31	2.18	7.54	0.14	0.25
	MCE									
		FIT	1.83	-0.08	3.28	4.64	1.8	9.76	0.14	0.27
		FAIT	2.07	0.79	3.31	4.29	1.61	8.44	0.14	0.27
gfsrt = 0.005										
	MCE									
		FIT	1.50	-2.14	3.34	5.36	1.22	15.32	0.14	0.28
		FAIT	1.98	0.24	3.39	4.55	0.96	10.61	0.14	0.28

Notes: Authors' estimates.

Table A.1.3.2: Distribution of inflation (π) under FIT and FAIT

		$0.5 \leq \pi$	$0.5 < \pi \leq 1.0$	$1.0 < \pi \leq 1.5$	$1.5 < \pi \leq 2.5$	$2.5 < \pi \leq 3.0$	$3.0 < \pi$
MCAP+WP	FIT	0.05	0.07	0.16	0.50	0.15	0.08
	FIT (UR threshold)	0.04	0.07	0.15	0.51	0.15	0.08
	FAIT	0.02	0.04	0.13	0.57	0.17	0.08
MCE	FIT	0.09	0.07	0.14	0.45	0.15	0.10
	FAIT	0.03	0.04	0.12	0.53	0.18	0.10

Notes: Authors' estimates.

As noted in the main text, adopting a shortfalls approach to the maximum employment objective will imply asymmetrically low probability mass on low inflation outcomes, compared with a symmetric rule. The resulting bias will depend on many of the same factors as the ELB bias reported in table A.1.3.1. To provide an illustration of the magnitude of the bias, we present results under several different shortfalls rules in table A.1.3.3, under the assumption of model-consistent asset pricing and wage- and price-setting.

Table A.1.3.3: Distribution of outcomes under alternative shortfall policy rules

	Inflation			Unemployment Rate			ELB Statistics	
	mean	5%	95%	mean	5%	95%	P(entry ELB)	Fraction of Qtrs at ELB
MCAP+WP								
FIT (shortfalls)	2.09	0.69	3.43	4.01	1.01	7.58	0.14	0.26
FAIT (shortfalls)	2.21	1.01	3.44	3.89	0.94	7.25	0.14	0.29
FIT (shortfalls,change)	1.97	0.56	3.33	4.18	0.91	8.03	0.15	0.15
FAIT (shortfalls, change)	2.13	0.98	3.35	3.99	0.86	7.60	0.15	0.21

Notes: Authors' estimates; model-consistent wage and price setting; baseline assumptions regarding fiscal support.

A.1.4 Threshold rules

This section presents results on the performance of FIT with threshold conditions. We consider two thresholds: first, a threshold that delays lift-off until either the unemployment rate has reached its natural rate ("UR thresh") or four-quarter PCE price inflation is above 2¼ percent and, second, a threshold that delays lift-off until the four-quarter change in core PCE prices has reached 2 percent ("infl. thresh"). Figure A.1.4.1 presents median outcomes under the same recessionary conditions as described in the main text.

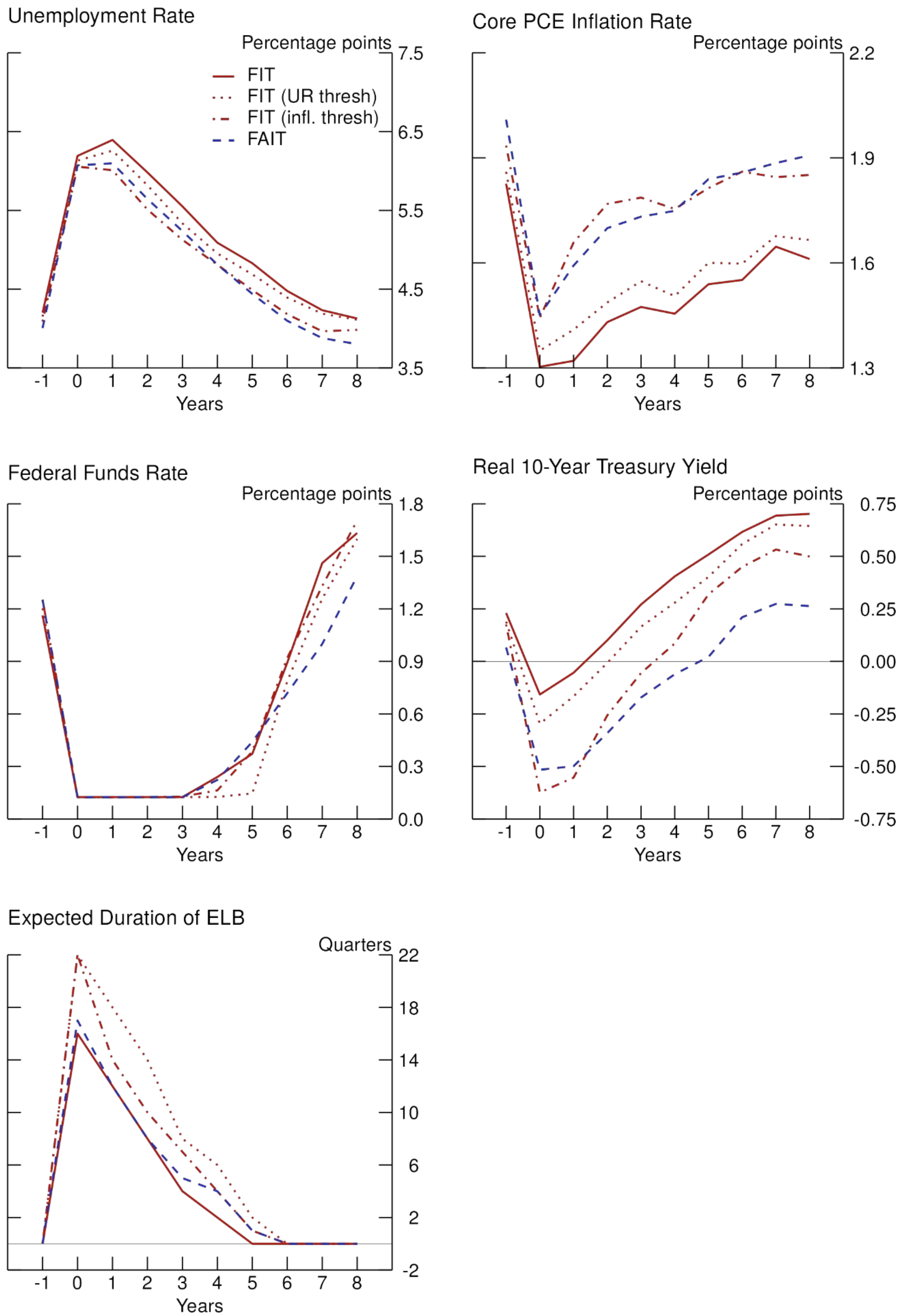
Outcomes under the unemployment rate threshold are very similar to those under the Taylor rule, largely because the expected duration of the ELB under the unemployment threshold is only about six quarters more than under FIT. Perhaps surprisingly, the expected duration of the ELB episode under FAIT is only a little bit longer than under FIT; most of the additional accommodation implied by FAIT comes from the lower path of the funds rate *after* exiting the ELB.

Outcomes under the inflation threshold are quite similar to FAIT, but come with a significant caveat. These simulations are conducted assuming that the model-consistent expectations can be modeled as modal forecasts—that is, in the absence of shocks (a so-called perfect foresight assumption). As is apparent, however, modeling expectations in this way leads to an "expected" duration of the ELB that is systematically larger than the actual outcomes of the stochastic simulations—a violation of the rational expectations hypothesis.[41] In the case of FIT,

[41] Similar considerations also explain why the median level of the funds rate rises above the ELB within four years after hitting it, at a time when the median inflation is still well below two percent. These outcomes are compatible because temporary inflation shocks can cause the ELB to cease binding, even though the inflation rate then returns to its previous (low) level. By year four, most recession draws have experienced at least one of these temporary shocks, as a result of which the ELB has ceased to bind, while inflation remains persistently below two percent.

FIT (UR thresh) and FAIT, the discrepancy is not especially consequential, but the discrepancy is large in the case of the inflation threshold (an expected duration of around five and a half years versus an actual duration of around three years). The large discrepancy in this case is a result of two factors: a long modal duration, which allows the effects of stochastic shocks to cumulate, and the presence of large inflationary shocks in the shock distribution, which implies a significant probability that shocks will cause the threshold to be breached. In light of this discrepancy, it is likely that obtaining a quantitatively reliable evaluation of the inflation threshold case will require a more sophisticated solution methodology, as in Boneva, Harrison, and Waldron (2018).

Figure A.1.4.1: Median outcomes under alternative threshold policy rules at the ELB in a recession



Notes: Authors' estimates.

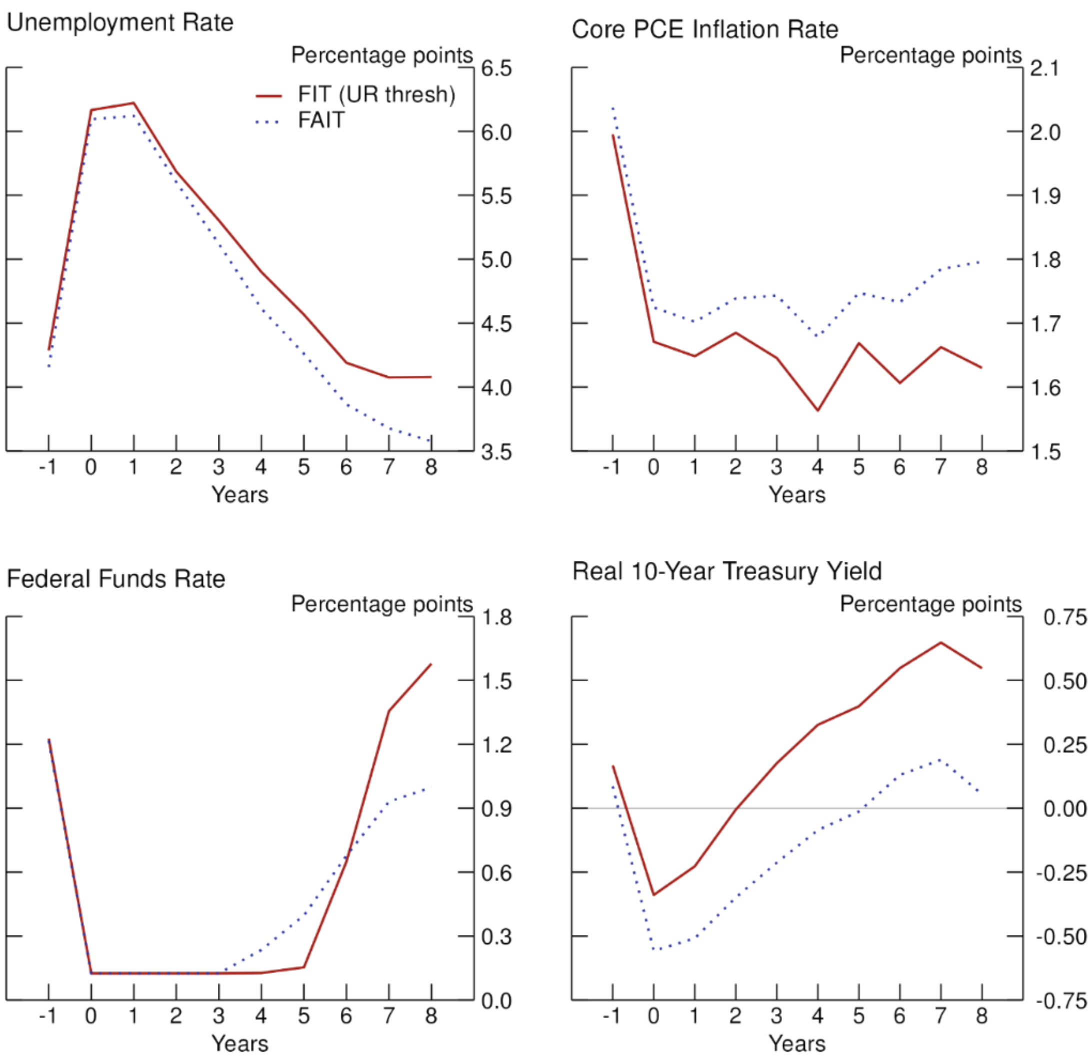
A.1.5 VAR expectations

Figure A.1.5.1 shows median outcomes in a recession under both FIT and FAIT, under the assumption that, while asset market participants form model-consistent (MCAP) expectations, all other agents forecast using simple time-series models.[42] The response of the model to shocks is quite different under MCAP than it is under the version of the model used in the main text, which assumes model-consistent expectations for both asset market participants and wage- and price-setters.[43] For this reason, the distribution of outcomes used for figure A.1.5.1 is the set of draws that result in a recession and a binding ELB under FIT, assuming MCAP expectations–a different set of draws than used in other comparable figures elsewhere in this paper.

[42] These assumptions might be appropriate for an economy in which financial market participants understand the implications of the monetary policy strategy for current and future asset prices, but households and firms, while forward-looking, form expectations on the basis of general historical regularities and are not very attentive to or knowledgeable about the strategy and its implications for future economic performance. Evidence pointing in this direction includes Coibion and others (2023a), who find that the 2020 revision to the Statement had little effect on household expectations a year after its introduction, Coibion and others (2023b), who find experimentally that forward guidance about the future policy rate path has only small effects on expected real interest rates and McClure and others (2025), who find that inflation expectations of managers behave similarly to those of survey respondents in general.

[43] See Hebden and others (2020) for a more complete discussion of the role of expectations for outcomes under FAIT.

Figure A.1.5.1: Median outcomes under alternative policy rules at the ELB in a recession (MCAP expectations)



Notes: Authors' estimates.

A.2 Sectoral shocks and supply constraints

A.2.1 Model

In this section, we present optimal policy results from a model with sectoral shocks and supply constraints. The model is a simplified version of the one used in Comin, Johnson and Jones (2023) and described in Comin, Johnson and Jones (2025). The model features two sectors—goods and services—whose prices are sticky. The occasionally binding constraint is on goods production.

A.2.2 Impulse response to an aggregate productivity shock

We use a simulation from the stylized macroeconomic model to illustrate the optimal monetary policy response to a positive and persistent increase in the level of aggregate productivity.[44] We assume in this subsection that both sectors are the same. In this case, the model aggregates to the standard and stylized three-equation New Keynesian model described in, for example, Galí (2008). In the next subsection, we will adjust the model and introduce an occasionally binding sectoral capacity constraint on goods production.

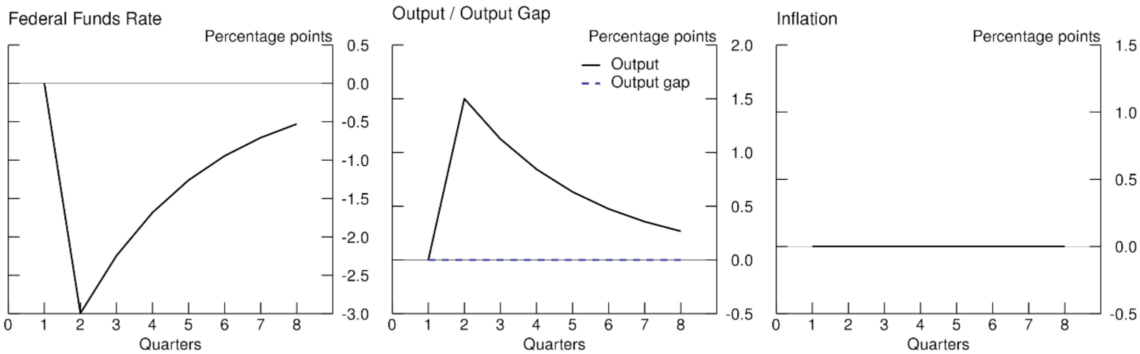
We plot the response of the federal funds rate, output and the output gap, and inflation in figure A.2.2.1 following this shock. All else being equal, in response to a positive productivity shock, output would increase and inflation would drop. Under optimal monetary policy, the federal funds rate (left panel) declines to support aggregate demand, and actual output rises to its new potential level. The interest rate declines under optimal policy because the shock is temporary and households would like to save some portion of the additional income, raising the aggregate savings curve.[45] The output gap closes (middle panel). With the output gap closed, inflation remains at target (right panel). For this type of shock, under optimal policy, there is no conflict between stabilizing inflation and the output gap.[46]

[44] In all simulations discussed in this section, inflation expectations are well anchored at the target, and optimal monetary policy is computed under discretion and weighs aggregate inflation and output gap deviations.

[45] If the shock had instead permanently raised the level of productivity—and, over time, the level of output—the optimal response would have been to raise the interest rate.

[46] The modern literature on New Keynesian models refers to this situation as "divine coincidence." See Blanchard and Galí (2007) and Galí (2008).

Figure A.2.2.1: Impulse responses: Productivity shock under optimal policy



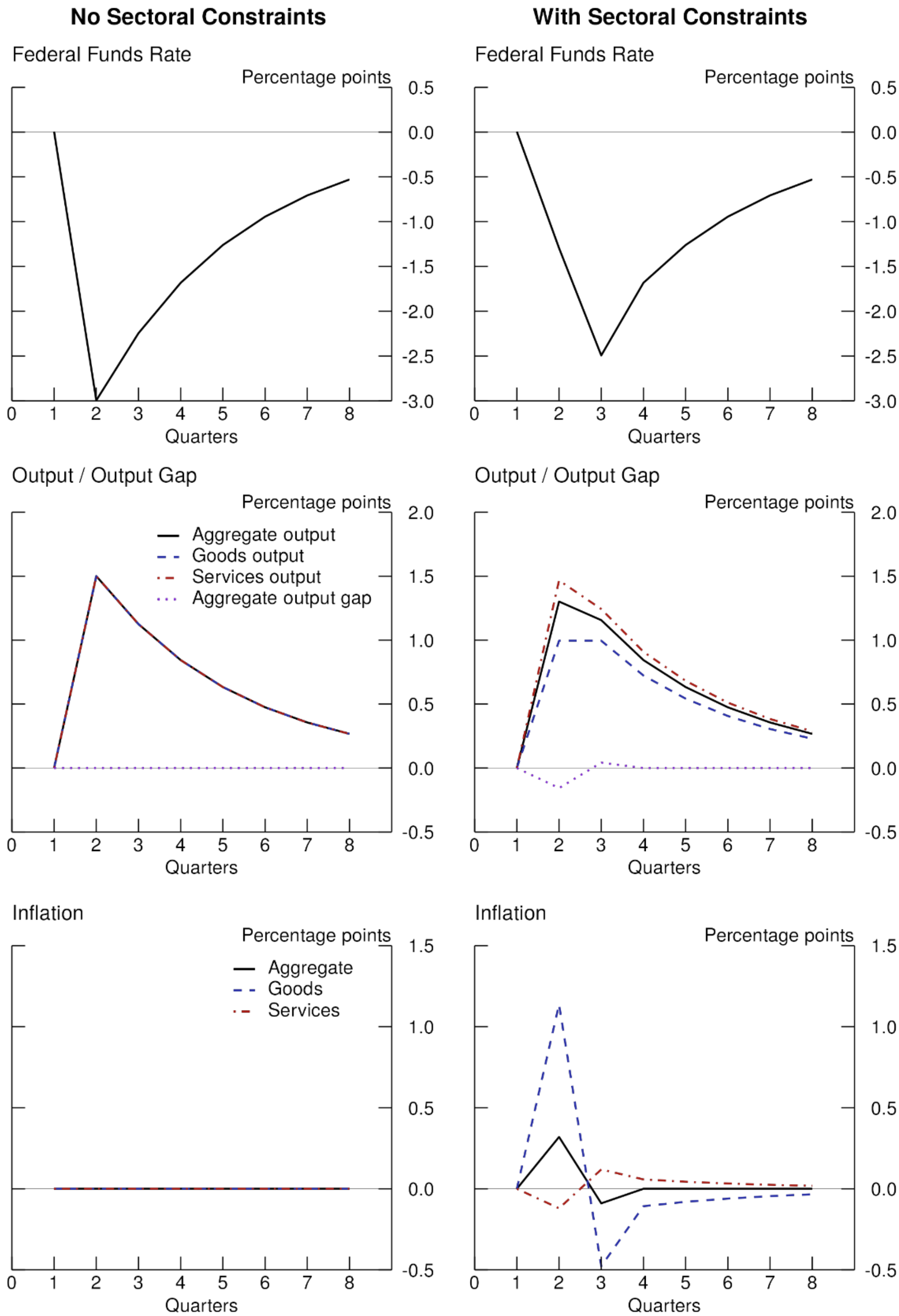
Notes: Authors' estimates. The figure plots impulse responses of model variables relative to their steady states.

A.2.3 Impulse response to an aggregate productivity shock with occasionally binding sectoral capacity constraints

We illustrate how sectoral dynamics may change prescriptions for optimal monetary policy with a scenario in which an aggregate productivity shock causes the capacity constraint on the production of one of the sectors to bind. In contrast to the previous section, the aggregate productivity shock in this case affects the production and productivity of the sectors differently. A heterogenous response of output and prices across sectors prevents the central bank from stabilizing inflation and closing the aggregate output gap.

Figure A.2.3.1 compares the optimal response presented in the previous subsection (the left column) with the optimal policy when the aggregate shock has different consequences across sectors because of the presence of sector-specific capacity constraints (the right panel). In particular, in the scenario shown in the right-hand panels, the aggregate productivity shock causes output in the goods sector to run up against its capacity constraint. For simplicity, in the simulation, we assume that the capacity constraint binds for two quarters after the shock. When goods production hits the constraint (dashed blue line in the middle right panel), that sector is unable to immediately benefit from higher aggregate productivity and the supply of goods cannot expand to meet any additional demand. The price of goods must then rise to balance supply and demand for goods (bottom right panel). Under optimal monetary policy, the funds rate declines, just as in the previous example (top right panel). However, if policy were to ease as much as in the previous example, given the increase in prices in the goods sector, inflation would be much higher. Accordingly, policy does not ease as much as it would in the unconstrained case and the output gap becomes slightly negative. Output and prices in the services sector fall as well. The reduction in services prices is not enough to compensate for the increase in goods prices and, all told, aggregate inflation rises slightly.

Figure A.2.3.1: Impulse response: Aggregate productivity shock under optimal policy with and without sectoral constraints



Notes: Authors' estimates. The figure plots impulse responses of model variables relative to their steady states.

A.2.4 Impulse response to a sectoral capacity shock

Here, we consider outcomes in response to a negative shock to the capacity of goods production that lasts for one period. We compare two cases, one in which monetary policy suboptimally fully stabilizes aggregate inflation, and a second in which policy is set optimally. The key result of this exercise is that, if a supply shock originates in one sector of the economy, fully stabilizing aggregate inflation may entail unwelcome volatility of relative prices and output, misallocation of resources, and a costly decline in aggregate output.

The impulse responses shown in the left column panels of figure A.2.4.1 illustrate outcomes where the funds rate is suboptimally set to keep inflation at target ("Inflation Stabilization").[47] Goods production declines, as shown in the middle left panel in dashed blue. When the capacity constraint in the goods sector binds, goods output falls to the constrained level and goods inflation spikes (bottom left panel). In order for aggregate inflation to be stable (the sole objective of the central bank in this simulation), services inflation must fall to offset higher goods prices, so monetary policy tightens notably to induce a contraction in services output (top left panel). As a result, aggregate output falls, with production in both sectors declining. Once the shock abates, aggregate output returns to its baseline value, while monetary policy returns to a neutral stance, although sectoral dynamics persist. Specifically, goods output continues to undershoot its long-run level and services output overshoots, while inflation in the goods sector turns negative and inflation in services is positive.[48]

The impulse responses shown in the right column panels of figure A.2.4.1 present outcomes following the goods sectoral supply shock when policy is set optimally. In contrast to the aggregate inflation stabilization policy, optimal policy tolerates some aggregate inflation in the period of the shock (quarter 2), thereby mitigating the decline in aggregate output.[49] A comparison of outcomes under these two policies illustrates the inflation-output tradeoff monetary policy may face following a sectoral supply shock.

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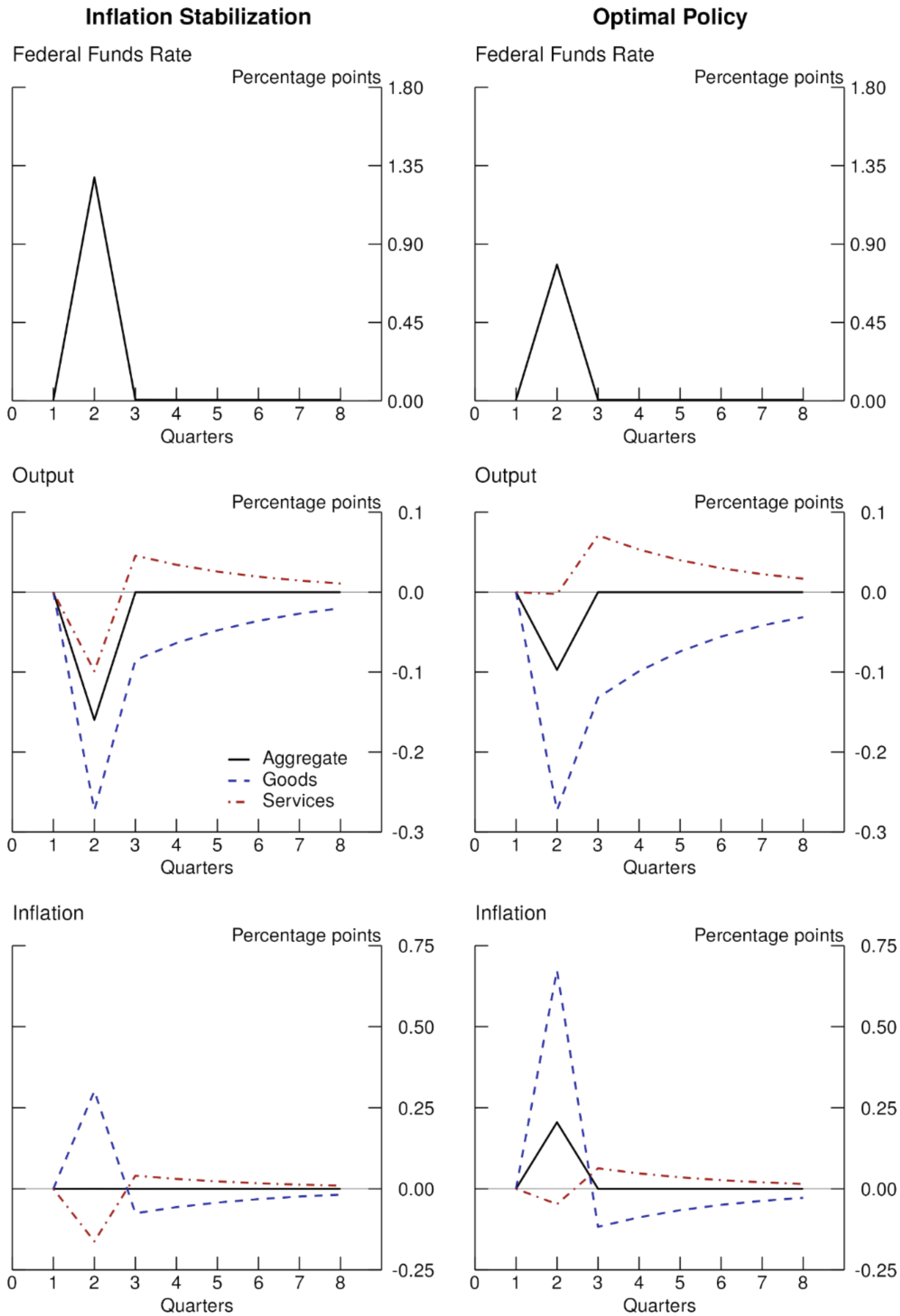
[47] In figure A.2.4.1, we plot aggregate variables using solid black lines, and sectoral variables using dashed blue (for goods) and dot-dashed red (for services).

[48] This exercise is only an illustration, as the policy lags in this stylized model are very short, and in more complex models aggregate inflation dynamics might be more persistent.

[49] In addition, in this simulation, goods inflation is higher under optimal policy compared with the full inflation stabilization policy. In part, this reflects how, under optimal policy, aggregate output does not fall as much as it does under the inflation stabilization policy, so that the demand for goods relative to services is also higher.

Figure A.2.4.1: Impulse response: Sectoral production shock under optimal and inflation stabilization policies



Notes: Authors' estimates. The figure plots impulse responses of model variables relative to their steady states.

A.3 Nonlinearities in the slope of the Phillips curve

A.3.1 Model

In this section, we use the model with nonlinearities from Blanco and others (2024) to compute the impulse response below. Details of the equations of the model can be found in Blanco and others (2024).

In computing the optimal policy, we maximize household preferences, given below, subject to the model's equilibrium constraints:

$$\sum_{t=0}^{\infty} \beta^t \left(\frac{c_t^{1-\sigma}}{1-\sigma} - \frac{l_t^{1+\gamma}}{1+\gamma} \right),$$

where β is the household discount factor, c_t is household consumption, l_t is household labor supply, and σ, γ are parameters.

In simulations in which monetary policy is following a Taylor rule, we use a version of the inertial Taylor rule: $R_t = 0.81R_{t-1} + 0.19(R^{LR} + \pi^{LR} + 2.04(\pi_t - \pi^{LR}) + 0.08ygap_t)$, where the values for the Taylor rule parameters are taken from Smets and Wouters (2007).

A.3.2 Impulse response to supply shock with nonlinearities

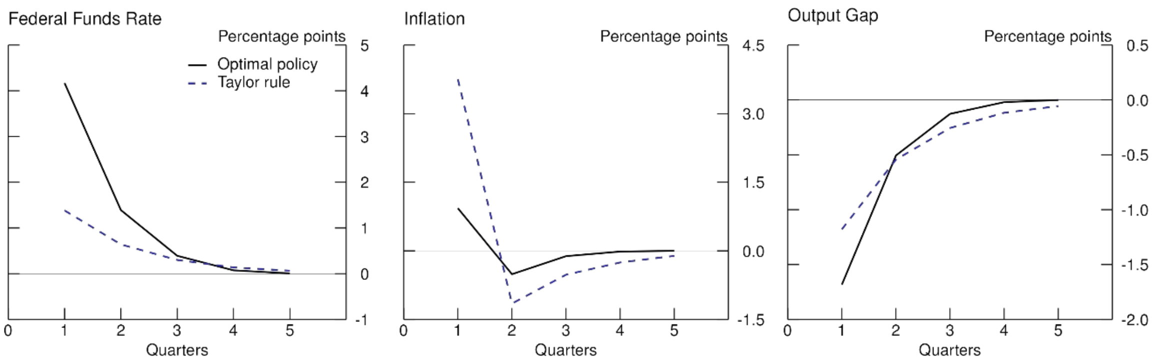
In figure A.3.2.1, we illustrate the optimal monetary response to supply shocks in the presence of nonlinear inflation dynamics.[50] Panel A compares outcomes under optimal policy (the solid black line) with those arising under a Taylor rule (the dashed blue line) that is intended to describe the behavior of policymakers in normal times. As can be seen in the middle panel, reacting to shocks as in normal times may lead to large deviations of inflation from target in the presence of nonlinearities. Instead, optimal monetary policy reacts expeditiously and forcefully, keeping inflation under control, at the cost of a somewhat weaker output gap.[51]

[50] We consider a cost-push shock that temporarily raises the cost of labor. Expectations of all agents in the model are model-consistent and long-run inflation expectations are anchored at the target rate.

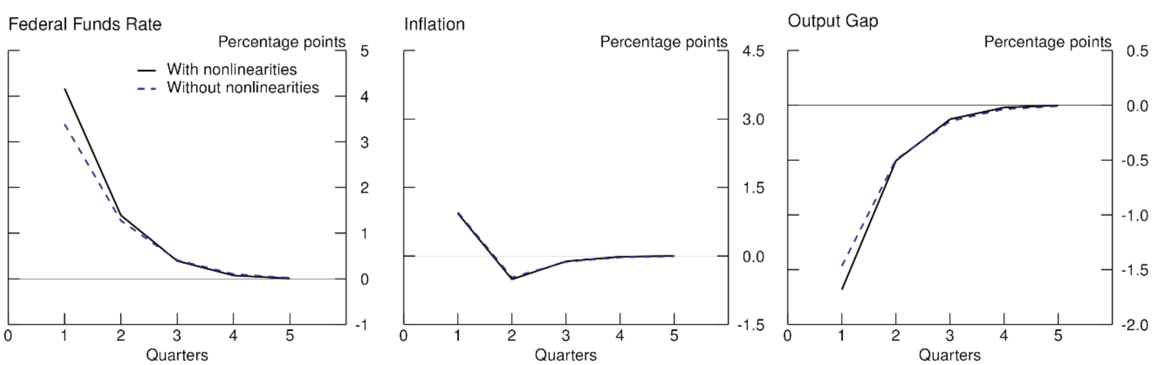
[51] The example considered here illustrates the optimal policy starting from at-target inflation. If, instead, inflation is already notably above target, the nonlinearities may imply that the output loss associated with a reduction in inflation is lower than in normal times, assuming that inflation expectations remain well anchored.

Figure A.3.2.1: Impulse responses in the Three-Equation New Keynesian Model with nonlinearities

Panel A: Optimal policy and Taylor rule policy in the case of a supply shock, model with nonlinearities



Panel B: Optimal policy in the case of a supply shock, models with nonlinearities and without nonlinearities



Notes: Authors' estimates. The figure plots impulse responses of model variables relative to their steady states.

To complement these results, panel B conducts an alternative exercise: It contrasts outcomes under optimal policy in the baseline model with nonlinearities (the same solid black line as in panel A) with those in a counterfactual model where nonlinearities are not present (the dashed blue lines). The simulations illustrate that, in the presence of nonlinearities, the optimal prescription is for policymakers to react with more force to increases in inflation.[52]

[52] Optimal policy calls for a persistently negative output gap, and inflation that falls below baseline after the first period, because such a path lowers the incentive to raise prices initially, helping to limit the spike in inflation.

A.3.3 Simulations of a version of the FRB/US Model with nonlinearities in the slope of the Phillips curve

In this section, we present simulations of a version of the FRB/US model that incorporates nonlinear inflation dynamics. More specifically, the linearized price Phillips curve of the model is replaced by the system of nonlinear equations that describes price setting in the model of Blanco and others (2024). The model is simulated under the assumption of model-consistent expectations on the part of asset-market participants and wage- and price-setters.

We perform the same experiments as in appendix A.3.2. For this purpose, the supply shock under consideration is a 1 percent negative shock to the level of total factor productivity that unwinds gradually over five years. The optimal policy chooses the path of the federal funds rate that minimizes a loss function that penalizes movements in the inflation gap, the unemployment gap, and changes in the policy rate. Different weights are associated with these three objectives. We consider a weighting structure that assigns a lower penalty to movements in the unemployment gap and changes in the policy rate (low inertia).

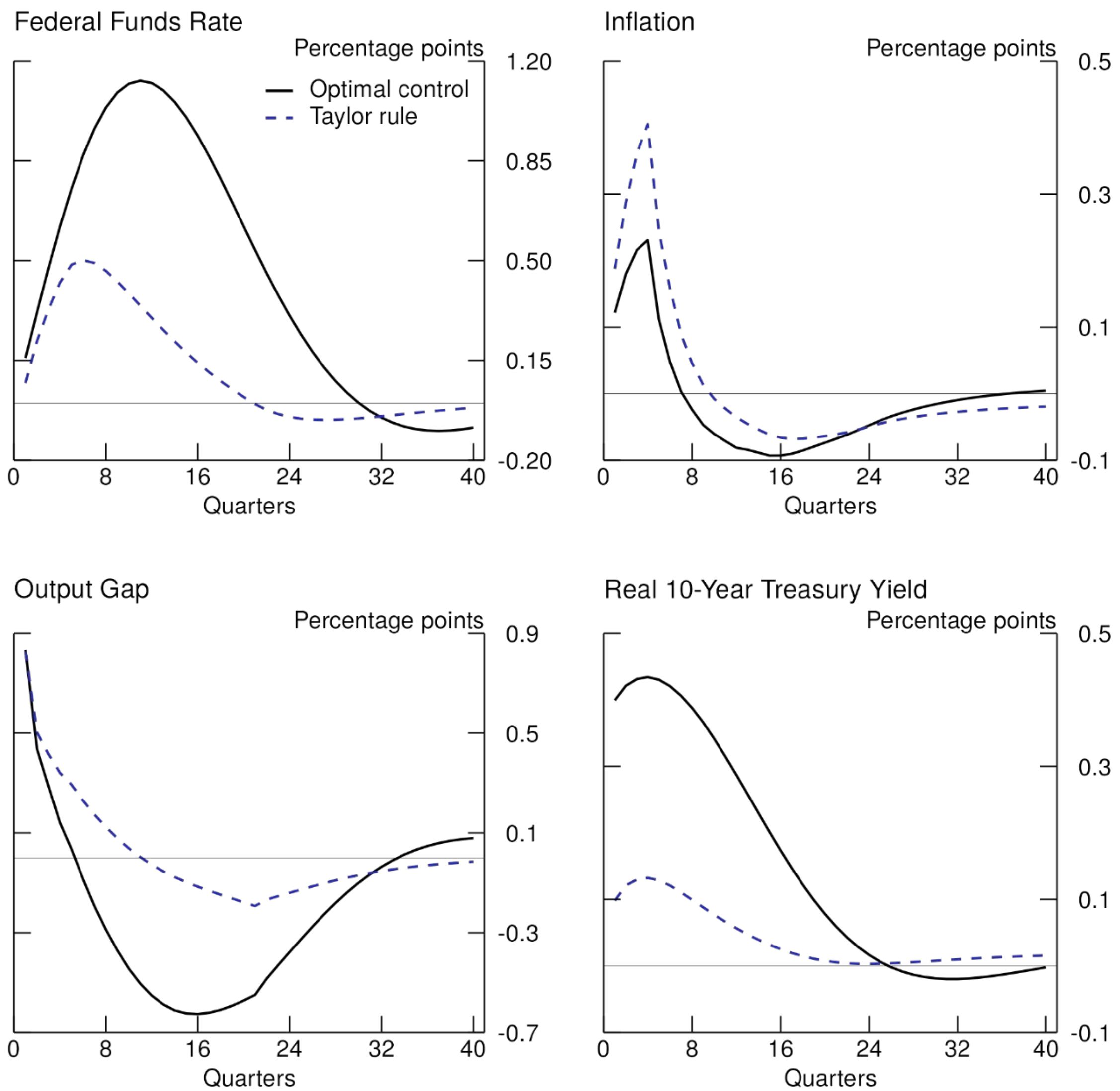
Panel A of figure A.3.3.1 compares outcomes under the optimal policy (the solid black lines) with those arising when monetary policy is conducted according to a standard Taylor rule (the dashed blue lines).[53] As can be seen from the responses of the federal funds rate and the 10-year real rate and as was the case in the model of the previous subsection, the optimal policy reacts more expeditiously and forcefully than the Taylor rule, which helps contain the rise in inflation induced by the shock.

Panel B of figure A.3.3.1 contrasts outcomes under optimal policy in the model with nonlinearities (the same black lines than as in panel A) with those in a counterfactual model where nonlinearities are shut down (the dashed blue lines). Once again, we see that policymakers react more forcefully to increases in inflation in the presence of nonlinearities. Unlike in the example of the previous subsection, this more forceful reaction of monetary policy is initially not sufficient to fully offset the additional inflation brought by nonlinearities. However, from period 6 onward, inflation is lower in the case with nonlinearities on account of both a lower output gap and a steeper Phillips curve (the sacrifice ratio is lower with nonlinearities).

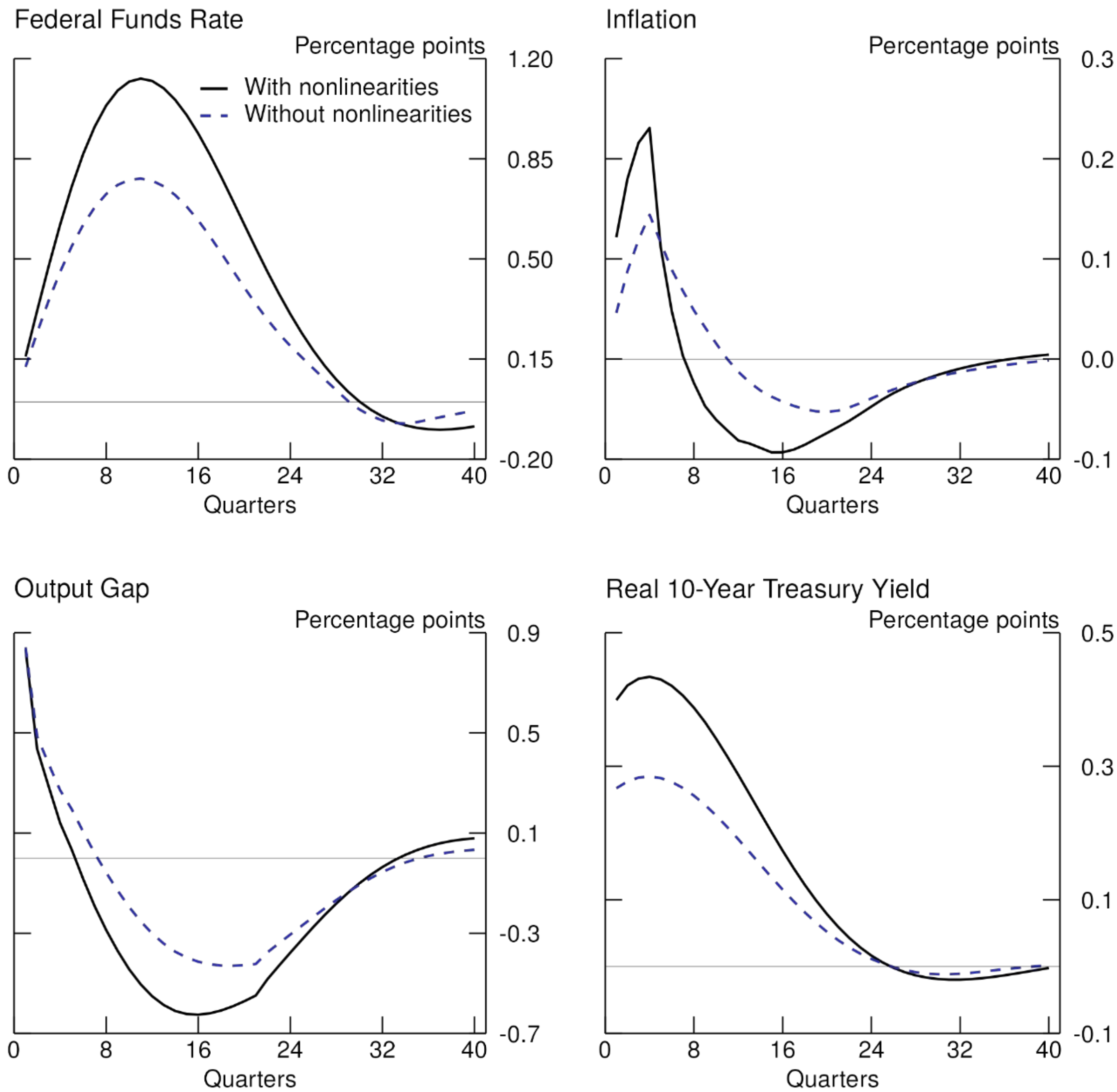
[53] The equation for the Taylor rule is the same as that under FIT in appendix A.1 above with $\phi_i = 0.81$, $\phi_\pi = 1.5$, and $\phi_y = 1$.

Figure A.3.3.1: Impulse responses to a supply shock in the FRB/US model

Panel A: Optimal policy and Taylor rule, model with nonlinearities



Panel B: Optimal policy, model with nonlinearities and without nonlinearities



Notes: Authors' estimates.