

August 30, 2019

Strengthening the current framework in view of the ELB and some considerations related to time-inconsistent strategies¹

I. Introduction and summary

With historically low levels of the longer-run equilibrium real interest rate (r^{LR}), the effective lower bound (ELB) on the federal funds rate is likely to bind more often in the future. In the first part of this memo, we review estimates of the risk of returning to the ELB and highlight some ways in which the current framework could be improved to overcome the constraint posed by the ELB—during both expansions and recessions. Policy strategies that involve overshooting the FOMC’s objectives—which are outside the current framework—could further help to address the ELB constraint, but they suffer from a time-inconsistency problem.² In the second part of the memo, we discuss possible ways to overcome this problem, drawing lessons from the experience of two foreign central banks that have tried to raise inflation after the Global Financial Crisis (GFC) using similar strategies.

We estimate the probability of future ELB episodes using several statistical and economic models. Given the low current estimates of r^{LR} , it is likely that the ELB will be a constraint in most future recessions. In these models, ELB episodes are often accompanied by periods of high unemployment and low inflation.

The increased likelihood that the ELB will bind in the future has implications for output and inflation, even during economic expansions. The high ELB risk may inhibit the Committee’s ability to sustainably raise inflation to 2 percent and to stabilize the labor market even when the federal funds rate is away from the ELB (“the low inflation bias problem”). We discuss a few ways to mitigate this problem within the current framework, such as pursuing a policy strategy that keeps the federal funds rate lower during expansions than the level that would be needed to achieve the 2 percent objective in the absence of the ELB. We also discuss a number of ways to strengthen the Committee’s use of its tools—including forward guidance (FG) and balance-sheet policies (BSPs)—within the current framework at the ELB: employing tools faster and

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² Two memos delivered to the FOMC on August 30—Arias and others (2019) and Hebden and others (2019)—discuss implementing policies that overshoot the FOMC’s inflation objective.

more aggressively than in the past; refining FG; enhancing communications, particularly by announcing in advance how the FOMC might respond to future ELB episodes.

To further alleviate the constraint posed by the ELB, the Committee could consider commitment policies, including policy strategies that involve overshooting the FOMC's objectives. However, these strategies may be sub-optimal from the perspective of a future Committee, making it difficult for the Committee to follow through on past promises. This time-inconsistency problem could render these strategies ineffective.

We argue that time-inconsistent strategies are more likely to be credible if (i) policymakers specify verifiable promises to which the Federal Reserve is held measurably accountable, (ii) policymakers explain them in a variety of public communications, (iii) the strategies are in effect in both expansions and recessions—allowing the public to learn about the strategy before the ELB binds—and (iv) the strategies rely on shorter-term promises. We discuss these considerations in the context of the recent experience in the Czech Republic and in Japan, where the central banks have embarked on policy strategies that have attempted to overshoot their respective inflation objectives.

Our memo is organized as follows. In section II, we present empirical evidence related to the probability of future ELB events and discuss how to mitigate the adverse consequences of the ELB constraint at and away from the ELB within the current framework. In section III, we discuss ways to overcome the time-inconsistency problem of overshooting strategies. Section IV concludes.

II. ELB risk and options to strengthen the current framework

Historically, the FOMC has lowered the federal funds rate by more than 4 percentage points during recessions. As of June, all responses to the Summary of Economic Projections indicate that the longer-run normal level of the federal funds rate is below 3.5 percent, and, after 10 years of sustained economic expansion, the federal funds rate is currently only slightly above 2 percent. If the U.S. economy were to enter a recession in the near future or during a period in which the federal funds rate is near participants' estimates of its longer-run normal level, the FOMC would be unable to lower the federal funds rate by as much as it has in past recessions. As a result, it is likely that the ELB will bind in almost all future recessions.

Table 1: ELB risk

	Probability of ELB by 2021:Q4	Probability of ELB by 2024:Q4	Probability of ELB by 2029:Q4
Time-Series Models			
Del Negro and others (2017)	21	35	51
Johannsen and Mertens (2018)	4	14	28
Lubik and Matthes (2015)	2	7	12
DSGE Models			
FRB Chicago, $r^{LR}=0.5$	13	23	41
FRB Chicago, $r^{LR}=1.0$	7	15	29
FRB Chicago, $r^{LR}=1.5$	4	9	19
FRB New York, $r^{LR}=1.9$	24	39	51
FRB/US Model (June 2019 SEP, $r^{LR}=0.5$)	27	48	68
Addendum			
Survey of Primary Dealers (Median, July 2019)	35	n.a.	n.a.

Sources: Survey of Primary Dealers; Federal Reserve staff calculations.

To explore the probability that the ELB will bind in the future, we consider estimates from a variety of models.³ The parameters of each model are estimated or calibrated using historical data, and thus reflect the historical behavior of monetary policy. Our simulations start in the second quarter of 2019. Table 1 displays the probability that the ELB will bind at some point up to selected dates, according to each model. Some models imply only a modest probability of returning to the ELB by the end of 2021, while others imply that the probability is greater than 20 percent. While differences in model specification and estimation lead to large differences in the probability of ELB episodes over the next few years, the FRB/US model and the DSGE models all imply substantial probability of an ELB episode sometime in the next

³ We consider three time-series models developed by Federal Reserve System staff: Del Negro and others (2017), Johannsen and Mertens (2018), and Lubik and Matthes (2015). We also consider dynamic stochastic general equilibrium (DSGE) models from the Federal Reserve Banks of Chicago and New York. See Campbell and others (2019) and Del Negro and others (2013). Finally, we include results from the FRB/US model under the June 2019 SEP-consistent baseline.

In the FRB/US model, we conduct our simulations under assumptions that abstract from BSP responses to ELB episodes, making the federal funds rate the primary tool of monetary policy. In the other models, BSPs are not explicitly modeled. If, in the FRB/US model, we instead assumed some BSP responses in recessions, the ELB probability would be somewhat lower. Given the uncertainties surrounding the effects of BSPs and how they might be employed in the future, we have opted to abstract from BSPs in our FRB/US simulations. Chung and others (2019) made the same assumption.

10 years. Two of the time series models we consider—the Johannsen and Mertens (2018) and the Lubik and Matthes (2015) models—imply relatively low probabilities of ELB events over the next 10 years, though the probabilities are still greater than 10 percent. These models differ from the others in that they include time-varying volatility of business cycle shocks, which can lead model simulations to include fewer, but more severe, recessions.⁴

In the time-series models that we consider, r^{LR} is estimated and the statistical uncertainty surrounding its value is incorporated into the expected probabilities reported in Table 1. In the FRB/US model and in the DSGE models that we consider, the results reported in Table 1 are conditional on a particular value of r^{LR} . To illustrate the importance of r^{LR} in determining the probability of ELB episodes, we consider simulations from the Chicago Fed DSGE model using different assumptions for r^{LR} , shown in the middle panel. Predictably, lowering r^{LR} raises the probability of hitting the ELB in coming years.⁵

Importantly, the models that we consider imply that ELB episodes tend to be associated with low levels of inflation and employment. In simulations using the FRB/US model, the unemployment rate rises to about 7 percent and inflation declines to a bit less than 1 percent in a typical ELB episode.⁶ In simulations using the Chicago Fed DSGE model, the output gap falls to about -4.4 percent and inflation declines to .2 percent in a typical ELB episode.⁷ The ELB also seems to significantly impair the Federal Reserve’s ability to stabilize the economy in the next ELB episode. According to the Chicago Fed DSGE model, on average, the output gap would be about 1½ percentage points narrower during ELB episodes if the federal funds rate was not constrained by the

⁴ The time-varying volatility of shocks in the Johannsen and Mertens (2018) and Lubik and Matthes (2015) models contributes to the relatively sharp rise in ELB probabilities with horizon because over longer periods there is a higher likelihood of a high-volatility episode.

⁵ The increase in the probability of hitting the ELB is not linear in the decline in r^{LR} ; decreasing r^{LR} from 1.5 to 1.0 increases the probability of returning to the ELB in the next 2 years by 3 percentage points, while decreasing r^{LR} from 1.0 to 0.5 increases the probability by 6 percentage points. These results indicate that, when r^{LR} is low, modest declines in r^{LR} can appreciably increase ELB risk.

⁶ In the FRB/US model, we assume that the federal funds rate evolves according to the inertial version of Taylor (1999) rule.

⁷ In the Chicago Fed DSGE model, the central bank responds to a four-quarter moving average of the twice and once lagged, current, and expected one-period-ahead log inflation (in deviations from the 2 percent objective) and log aggregate output (in deviations from its stochastic trend). In the simulation, $r^{LR} = 1$. The monetary policy rule is explained in further detail in appendix A.

ELB.⁸ Because we abstract from unconventional monetary policies in these simulations, these results suggest that a mix of FG and BSPs might be necessary to mitigate the consequences of the typical recession.

Because of the low level of r^{LR} , the Chicago Fed's DSGE model predicts that the ELB would bind if the shocks that caused the 2001 recession hit the U.S. economy again this year. Notably, the probability of hitting the ELB predicted by this model lies on the low end of the spectrum of the probabilities shown in Table 1, but the model predicts that the federal funds rate will return to the ELB, even in mild recession scenarios.⁹

All told, the model simulations we consider imply that future periods at the ELB are recurrent and likely to be accompanied by relatively poor economic performance and inflation below the FOMC's objective. Given the amount by which the Committee has reduced the federal funds rate during previous recessions, a reasonable estimate of the probability of the federal funds rate returning to the ELB by a given date is the probability of recession by that date.¹⁰ Taken together, these results imply that the ELB is likely to be an important consideration for policymakers in the future.

Options to strengthen the current framework away from the ELB

The federal funds rate has been above the ELB and the unemployment rate has been below most estimates of the natural rate of unemployment over the past several years. However, inflation has remained below the 2 percent objective. One possible explanation for a persistent inflation undershooting is related to the risk of returning to the ELB.¹¹ To the extent that the ELB constrains the Federal Reserve's ability to stimulate the economy during recessions, ELB risk creates downward pressures on expected inflation, which can put downward pressure on inflation today. As a result, the

⁸ Furthermore, this model predicts that the ELB constraint would be responsible for more than half of the contraction in output if the shocks that caused the 2001 recession were to hit the U.S. economy later this year.

⁹ Similar results hold in the FRB/US model. Details of the simulation using the Chicago Fed's DSGE model are in appendix A.

¹⁰ Note that the probability of returning to the ELB by a particular date is not the same as the probability of being at the ELB between now and that date. Also, the probability of being at the ELB is not the same as—and is likely to be higher than—the probability of being in a recession, because, under most plausible assumptions regarding the stance of monetary policy, the policy rate is kept at the ELB for a while even after a recession formally ends.

¹¹ Other hypotheses for persistently low inflation includes a series of temporary deflationary shocks and the possibility that there is still more slack in the economy, among many others.

ELB can cause inflation to fluctuate around a level below the 2 percent inflation objective even in normal times.¹²

Existing studies suggest that this low inflation bias induced by ELB risk might be quantitatively important. Hills and others (2016) find that, under a standard Taylor-type rule, an unconditional ELB risk of 20 percent implies a low inflation bias of 0.3 percentage points in a model calibrated to match some key features of the U.S. economy. Amano and others (2018) investigate low inflation bias in a model in which households are relatively risk-averse, and find the magnitude of the bias can be far larger than those reported in Hills and others (2016). Some authors have also reported that the size of the low inflation bias is nontrivial even under the optimal discretionary policy.¹³

The low inflation bias induced by ELB risk may entail reputation loss for the Federal Reserve if the private sector loses confidence in the FOMC's ability of bringing inflation back to target after a prolonged period of economic expansion. Furthermore, a prolonged period of low inflation might spur doubts about whether or not the FOMC is still interpreting its inflation target as symmetric.

Within the current framework, there are a few tactics that could address the low inflation bias problem.¹⁴ First, if policymakers react more aggressively to the deviation of inflation from the target than they currently do, the bias could be reduced.¹⁵ Second, adopting a strategy of being more accommodative than what would be warranted in the absence of ELB risk—regardless of where inflation and the unemployment rate are—can eliminate the low inflation bias. In the context of interest-rate feedback rules, this strategy is captured by lowering the intercept of the interest-rate rule.¹⁶ Finally, the low

¹² This bias is discussed in Adam and Billi (2007), Nakov (2008), Hills and others (2016), Seneca (2016), Bianchi and others (2019), and Mertens and Williams (2019).

¹³ Nakata and Schmidt (2019) report a low inflation bias of 0.6 percentage points in a calibrated model with sticky wages and sticky prices. Seneca (2016) reports a deflationary bias ranging from 0.1 to 0.3 percentage points in a stylized, but calibrated, sticky-price model.

¹⁴ Policies that increase inflation and employment at the ELB, which are discussed in the next subsection, also mitigate the low inflation bias through expectations. Here, we focus on policies that are implemented away from the ELB. All tactics considered here are within the current framework because they do not involve systematic overshooting of the inflation objective; they merely reduce the low inflation bias.

¹⁵ See Nakata and Schmidt (2019). In the extreme case in which policymakers act *as if* they only care about the inflation leg of the dual mandate, they can eliminate the low inflation bias problem. Note that eliminating the low inflation bias does not necessarily imply a more positive output gap. Higher inflation in normal times helps increase inflation and output in recessions, through expectations. Under certain conditions, better stabilization outcomes in recessions allow policymakers to achieve a smaller output bias even with a higher inflation in normal times.

¹⁶ See Nakata and Schmidt (2016). They show that lowering the intercept of the interest-rate rule by about 50 basis points would eliminate the low inflation bias in a model of Hills and others (2016).

inflation bias can also be eliminated if policymakers adjust the federal funds rate less aggressively when inflation is above target than when inflation is below target.¹⁷ This last strategy is similar in spirit to an *opportunistic re-inflation* that takes advantage of increases in actual inflation to demonstrate a commitment to the FOMC’s symmetric inflation objective.

Through higher inflation expectations, the benefits of overcoming the low inflation bias in normal times spills over to ELB episodes in the form of smaller declines in output and inflation. Mitigating the low inflation bias can come at the cost of leading the economy to run persistently hotter in normal times; this cost might not be small if the Phillips curve is flat or if there are adverse financial stability implications of running the economy hotter.

Options to strengthen the current framework at the ELB

Various authors have argued that the ELB constrained monetary policy in significant ways during at least some of the 2008-2015 period and that, absent any large changes in the economic environment or monetary policy, it is likely to keep doing so in the future.¹⁸ The limited efficacy of monetary policy supported by these studies suggests that rethinking the current framework is appropriate. This is the object of the next section and future memos. At the same time, there are at least three reasons to study ways in which the current framework can be strengthened. First, abandoning a framework that has been carefully designed and tested in practice can be a risky step to take and will always involve some uncertainty. Second, studies have argued that there might be scope to enhance the effectiveness of communication within the current framework.¹⁹ Third, a

¹⁷ As shown in Bianchi and others (2019), this asymmetric strategy removes the inflationary bias because it raises the risk of inflation on the upside so as to offset the downside risk due to the ELB. They also show that that this strategy is not time-inconsistent.

¹⁸ Eberly and others (2019) estimate that in the absence of an ELB, the federal funds rate would have been approximately -5 percent under pre-GFC business-as-usual monetary policy. They also estimate that unconventional policies, which include FG and BSPs, offset perhaps only 1 percentage point of the ELB constraint as actually implemented since 2008. Campbell and others (2016) find similar quantitative results using a different methodology and a different model. Chung and others (2019) conclude that the current framework can only partially offset the immediate effects of significant recessionary shocks. See appendix B-I for a review of studies arguing that the ELB did not meaningfully constrain monetary policy.

¹⁹ Recent empirical studies show that the way in which unconventional policies are framed and communicated to the public is key for these tools to have the desired effects. Using the Chicago Fed DSGE model, Campbell and others (2016) show that, during the Great Recession, improved macroeconomic outcomes from unconventional monetary policy appeared only after the introduction of the calendar-based forward guidance in August 2011 and continued later on with the introduction of state-contingent FG. Using the FRB/US model, Engen and others (2015) find similar results. Eberly and others (2019) suggest different ways to strengthen communication.

recession and the constraints associated with the ELB may hit the economy before any changes to the framework can be decided and implemented.

Acting sooner and stronger

Looking back, sooner and stronger actions by the Federal Reserve at the beginning of the Great Recession would likely have been beneficial. Simulations from the Chicago Fed DSGE model indicate that a more aggressive combination of FG and BSPs designed to keep the expected path of the federal funds rate at the ELB through 2013:Q3 would have reduced the unemployment rate by an average of 2 percentage points during the Great Recession. If, in addition to this stronger policy, the federal funds rate had been cut to its effective ELB as soon as 2008:Q1 (instead of 2008:Q4), the average unemployment rate through 2012:Q4 would have been reduced by an extra 0.9 percentage points.²⁰ Similar conclusions are supported by Eberly and others (2019).²¹

As discussed in the memo “Monetary Policy and Economic Performance since the Financial Crisis,” longer or firmer FG and larger or more prolonged BSPs were likely possible without major adverse consequences as we now know, with the benefit of hindsight, that they had minimal negative side effects.²² Looking forward, sooner-and-stronger policies may continue to be a viable way to strengthen the current framework in quantitatively meaningful ways. Chung and others (2019) perform stochastic simulations that extend many years into the future assuming the systematic use of sooner-and-stronger policies. Compared to a BSP analogous to the one actually deployed after the crisis, a BSP that is consistent with the current framework and deployed right after an adverse shock hits the economy (the sooner part) and expands the balance sheet to a maximum size of 8 trillion dollars (the stronger part) reduces peak unemployment by 0.35 percent and increases the lowest level of inflation from 1 percent to 1.3 percent.²³

²⁰ The peak unemployment rate would have been reduced by an extra 1.7 percent. Details are shown in appendix B-II.

²¹ Eberly and others (2019) consider the effects of a policy that would have flattened the yield curve by 2 percentage points for 18 months starting in December 2008. This counterfactual policy would have shaved slightly more than 1 percentage point off of the cyclical peak of the unemployment rate and would have reduced the unemployment-rate gap by an average of 1.7 percentage points over the first four years of the recovery. Inflation would have been higher, though on average still below the 2 percent objective.

²² Caldara and others (2019).

²³ The peak balance sheet size during the Great Recession was 4.5 trillion dollars. We infer the effects of the “BSP analogous to the one actually deployed after the crisis” from Chung and others (2019) by assuming BSP effects are linear in the pertinent range.

Communicating in advance the intended monetary policy actions at the ELB

There could be many benefits of announcing the ways that the FOMC plans to use its tools at the ELB in advance of the next recession. One benefit is that it would influence expectations even before the ELB binds, which would make the tactic an automatic stabilizer. As the private sector begins to expect a recession, they will also expect the central bank to lower interest rates in the future, prompting interest rates and term premiums to respond ahead of any actual FOMC actions. Another benefit would be that disclosure of future policy intentions clarifies the Committee’s policy response function to the public, a point explored in the context of makeup policies in memo “How Robust Are the Alternative Strategies to Key Alternative Assumptions?”.²⁴

The FOMC would have to determine how to communicate its monetary policy strategy at the ELB in advance. One option would be to incorporate the strategy into the Committee’s Statement on Longer Run Goals and Monetary Policy Strategy. In any communication about its policy strategy at the ELB, the Committee would have to determine the degree of specificity of the description of its strategy. While more-specific communications may help shape expectations about likely policy actions at the ELB, they may also jeopardize the Committee’s credibility if the communicated strategy does not account for unforeseen circumstances. Next, we explore how state-contingent FG can help simultaneously make communications as specific and as credible as possible.

Refining Forward Guidance

Firmer or longer guidance about the future path for the federal funds rate reduces uncertainty about that path and is more likely to be effective at driving expectations of the private sector towards the announced path. However, guidance that is too firm or about actions too far into the future can be inconsistent with the current framework; such announcements have a high likelihood of putting the Committee in a future situation in which inflation is above the FOMC’s 2 percent inflation objective. In those circumstances, the current framework calls for increasing interest rates to reduce inflation, which may clash with a firm form of FG announced earlier.

By specifying in advance the situations in which the provided FG will cease to apply, state-contingent FG may help maintain credibility by minimizing the possibility of such time-inconsistent situations. Avoiding overshooting the Committee’s inflation objective during times of full employment is a necessary condition to remain consistent with the current framework. At the same time, having specified when the guidance ceases to apply allows for firmer guidance in all other situations, influencing expectations more effectively. Of course, it is possible that to satisfactorily achieve its objectives, the

²⁴ Hebden and others (2019).

FOMC may require policies that are simply not possible to implement in a time-consistent way, even with the use of state-contingent FG. We explore this idea in the next section.²⁵

III. Departing from the current framework with strategies that overshoot the FOMC’s objectives

Strategies that involve overshooting the Committee’s inflation and employment objectives—such as flexible price level targeting or average inflation targeting—perform well in many theoretical models, but are time-inconsistent. These policies may require future policymakers to follow through on commitments made by current policymakers even when doing so is not optimal at the time the future policymakers need to follow through on the commitment.²⁶ In this section, we discuss some ways in which the Committee could try to at least partially overcome this challenge. We also review recent attempts by two foreign central banks—the Czech National Bank (CNB) and the Bank of Japan (BOJ)—to overshoot their inflation objectives, highlighting some actions that appeared to have been successful and some potential pitfalls.

The time inconsistency of strategies that overshoot the FOMC’s objectives

Policy strategies that involve overshooting the FOMC’s objectives perform well in many theoretical models when the public is assumed to have a perfect understanding of the policy strategy and its implications for the economy now and in the future, and when policymakers are assumed to credibly commit to following through on their past promises. Under these assumptions, policymakers are able to utilize strategies that affect private-sector expectations in more-beneficial ways than without a commitment to overshooting. In a recession, they can raise inflation and employment expectations to improve outcomes during the recession.²⁷

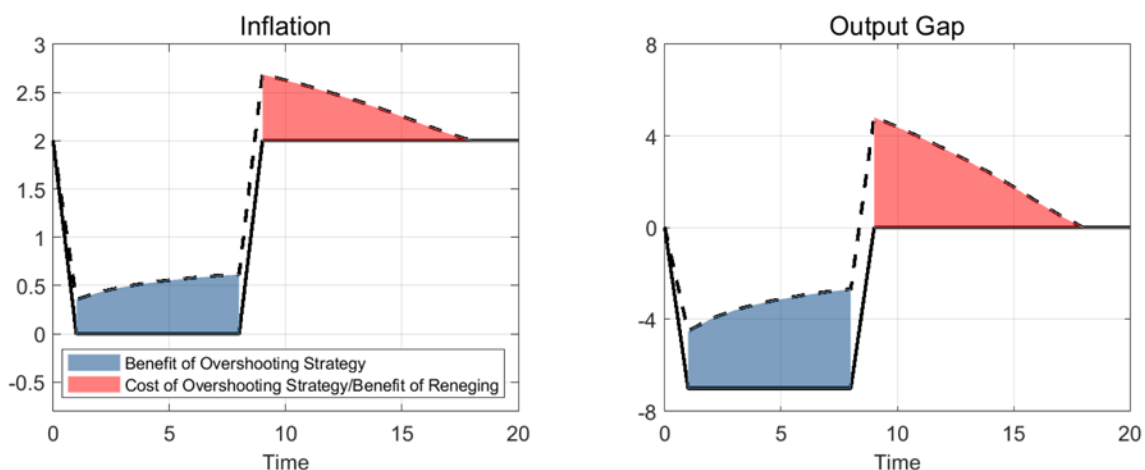
²⁵ In addition, with or without time-inconsistent policies, state-contingent FG can help anchor inflation expectations. Just as having the interest rate respond more than one-for-one to inflation deviations from the target anchors expectations in the absence of an ELB (the Taylor principle), one way to help anchor expectations when interest rates are at the ELB may be to keep interest rates at the ELB for an amount of time that sufficiently responds (is extended) in response to deflationary forces. See Duarte (2019).

²⁶ Time-inconsistency is not unique to overshooting strategies. In general, any forward guidance policy—including those that do not involve overshooting—can imply that future policymakers may want to depart from the previous commitment under some circumstances. However, we focus on overshooting strategies in this section because the time-inconsistency problem is most salient when there is an explicit commitment for inflation overshooting. Similarly, a commitment to any interest-rate rule can imply time-inconsistent behaviors under some circumstances.

²⁷ See, for example, Eggertsson and Woodford (2003), Adam and Billi (2006), Jung and others (2005), and Werning (2012). The extent to which higher inflation and income expectations stimulate economic activity today is an empirical question. Many standard models have been recently criticized because expectations of events far in the future have implausibly large effects on inflation and output today.

From the policymakers' perspective, a policy that overshoots the FOMC's inflation and employment objectives after a recession involves an intertemporal tradeoff between the future costs of overshooting and the current benefits of lower unemployment and higher inflation. Figure 1 illustrates this tradeoff. The figure shows the level of inflation and the output gap during and after a recession that begins in the first period and ends in the ninth period. The solid black line shows economic outcomes when the policymaker acts optimally in response to the shock that causes the recession but is unable to commit to future policy actions. In this case, inflation falls below the FOMC's 2 percent objective during the recession and returns to 2 percent immediately after the recession ends. The dashed black line shows economic outcomes under the optimal policy when policymakers can commit to policies that overshoot their objectives in the future. In this case, inflation and output do not fall by as much during the recession. After the recession ends, inflation overshoots the 2 percent objective and output overshoots its potential level.

Figure 1: Illustration of time inconsistency



Source: Authors' calculation.

Notes: Solid black line: optimal policy without ability to commit to future policy actions; dashed black line: optimal policy with ability to commit to future policy actions.

Once the recession passes, policymakers have already reaped the benefit of higher inflation expectations and would prefer, from that point forward, the outcomes under the optimal policy without the ability to commit, but are left with the task of delivering on past promises to overshoot their objectives, which is costly.²⁸ The problem of having the incentive to renege on past promises is known as time inconsistency. If the public does not believe at the onset of the recession that policymakers will follow through on the

²⁸ For a more detailed exposition of this incentive to renege on past promises, see appendix C.

promise, the overshooting strategy is not effective in stimulating inflation and output during the recession. Thus, this time-inconsistency problem is a key challenge to overcome for policy strategies that promise to overshoot the Committee's objectives.²⁹

Addressing the time-inconsistency problem

Overcoming time-inconsistency problems facing policymakers is easiest with widespread public support for the policy strategy.³⁰ With widespread support, it is more likely that Congress and the public will encourage future policymakers to follow through on promises made by their predecessors, and hence that future policymakers will agree to follow through on earlier promises.

While this memo focuses on ways to overcome time-inconsistency problems associated with sustaining policies that overshoot the FOMC's objectives, low and stable inflation is actually a time-inconsistent outcome in many models because of the incentive the central bank has to deliver unexpected inflation to raise output.³¹ The experience of high and volatile inflation in the 1970's followed by decades of low and stable inflation have generated broad agreement that the Federal Reserve should balance its dual mandate in such a way that its actions deliver low and stable inflation. This broad agreement has helped reduce or eliminate policymakers' incentive to generate high inflation by surprise.

In addition to building widespread public support, there are several tactics that could mitigate the time inconsistency problem. In particular, the Committee may be able to make overshooting strategies more credible if it provides the public with easily verifiable promises, if it explains its intended policy strategy in a variety of public communications, if the policy strategy is in effect both in expansions and recessions, and if the time-horizon of its promises is relatively short.

Communications with the public are one of the most important tools the Committee has for achieving its objectives. If, after a recession, the Federal Reserve reneges on the promise to overshoot the inflation and employment objectives, it is reasonable to assume that the public will not believe similar promises in future recessions.³² In addition to rendering a particular overshooting policy ineffective,

²⁹ Kydland and Prescott (1977) pioneered work on time inconsistency in macroeconomics.

³⁰ Taylor (1983) argues that society has found ways to overcome time-inconsistency problems when the benefits of overcoming time inconsistency are obvious. He cites the preservation of existing patents, which creates a monopoly distortion but encourages innovation, as an example.

³¹ In Barro and Gordon (1983), reputational considerations could overcome the time-inconsistency problem and keep inflation low, while the best time-consistent policy delivered higher inflation.

³² If policymakers fail to deliver an inflation overshoot due to unexpected shocks, it might be challenging for them to convince the public that they are not reneging on promises but rather that they are simply unable to deliver promises.

reneging on past promises may also erode confidence in the Federal Reserve and undermine future communications. If these reputational costs are large, policymakers may find it optimal to follow through on the promise of overshooting.³³ Policy strategies that involve easily verifiable promises and to which the Federal Reserve can be measurably held accountable—as opposed to those that are state-dependent in complicated ways or that rely on unobserved variables such as the output gap or equilibrium real rates—are likely to be most credible because it would be obvious to the public if policymakers reneged on past promises.³⁴

Communicating a policy strategy that overshoots the FOMC’s objectives through a variety of channels, including the FOMC’s Statement on Longer-Run Goals and Monetary Policy Strategy, would make it particularly costly for future Committees to deviate from that strategy. To the extent that the Federal Reserve’s communications to the public about its policy strategy are most effective when delivered consistently and over a long period, Committee members may feel uneasy about deviating from the articulated strategy for short-term gains.

It may take time for the public to learn about the Federal Reserve’s policy strategy and to form an opinion about the appropriateness of the strategy. As a result, policy strategies that are in effect both at and away from the ELB—such as strategies that target a price index or a measure of past average inflation both in expansions and recessions—offer the public the opportunity to verify the Federal Reserve’s willingness to follow through on past promises and gauge the effectiveness of the strategy. Policymakers may have a more difficult time credibly establishing policy strategies that are activated only during ELB episodes because they would have to explain their unique actions in a period of economic stress without first demonstrating their commitment to, or the effectiveness of, the policy strategy.³⁵

Policymakers are more likely to be able to credibly commit themselves to future actions than they are able to commit different future policymakers. Policymaker tenure

³³ See Nakata (2015, 2018), Nakata and Sunakawa (2019), and Walsh (2018) for formal analysis of this mechanism in a model with the ELB.

³⁴ Another unobserved variable that is useful in specifying makeup strategies in economic models is the shadow policy rate (see, for example, Kiley and Roberts (2017) and Reifschneider and Williams (2000)). Bernanke (2017) argues for a price-level targeting rule over a shadow rate policy rule on the grounds that the shadow rate is unobserved and thus it is not easy for policymakers to communicate the strategy to the public.

³⁵ See Svensson (2019). In the context of policy strategies that are activated only during ELB episodes, it is possible that the public may have hard time learning about the overshooting strategy in the first ELB episode after the adoption of the strategy, but that they will have learned the strategy for subsequent ELB episodes.

thus places some limitation on the ability of the FOMC to commit to future actions.³⁶ A term of the Chair is 4 years. Since 1951, Board members have remained in their positions for an average of a little more than 6 years.³⁷ While Federal Reserve Bank Presidents have a longer average tenure of just over 9 years, the rotation of Bank Presidents on the FOMC may limit their ability to influence a future FOMC's decision on whether to follow through on earlier promises.³⁸ As a result, promises to overshoot that have a horizon of a few years or less are more likely to be credible, though the FOMC in a very severe recession may desire to promise to overshoot its objectives more than a few years into the future.³⁹

Lessons from other countries

The Czech Republic

The Czech Republic is a small open economy closely linked to the euro-area economy. In 2011, the economic outlook in the Czech Republic deteriorated, and, in February 2012, the CNB cut its policy rate to its ELB. In November 2013, the CNB provided further policy accommodation by implementing a policy that prevented the exchange value of the Czech Koruna from rising above a value of 1/27 euro.⁴⁰ See appendix E for details on the Czech economy and monetary policy at the time.

Throughout the period, the CNB provided forward guidance on the likely timing of the exit from this exchange rate ceiling policy.⁴¹ That guidance was accompanied by the publication of inflation projections. According to the published CNB's forecasts from 2013 to 2017—shown by the blue lines in figure 2—their strategy involved two ingredients. One is to depart from the exchange rate ceiling when inflation exceed—or is expected to exceed in the near future—the CNB's 2 percent inflation target and the other

³⁶ Taylor (1983) made a similar point.

³⁷ These statistics are computed excluding current FOMC participants.

³⁸ Additionally, if FOMC participants determine that it is appropriate to publicly review the FOMC's policy strategy on a recurring basis, the period over which they could commit themselves to a policy strategy may be limited by the periodicity of those reviews.

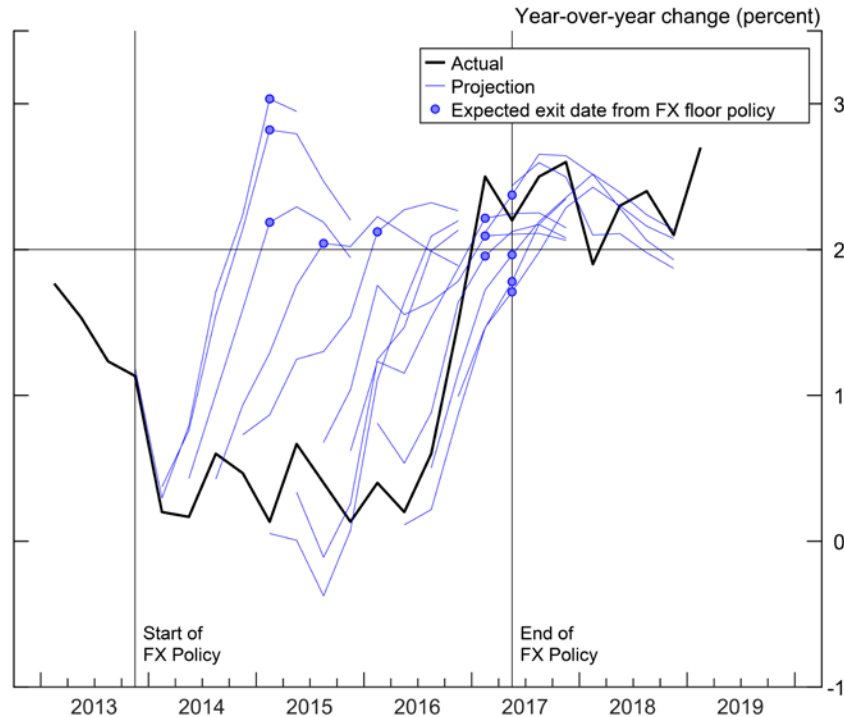
³⁹ There are more-drastic actions the Committee could take that might bind future policymakers to past promises by imposing financial costs on the Federal Reserve if the promises are not kept. See appendix D.

⁴⁰ This policy prevented an appreciation of the Czech Koruna relative to the euro, which would help to keep import prices from falling, thereby supporting the CNB's efforts to raise inflation.

⁴¹ For example, in February 2014, the CNB stated "*The Bank Board foresees this exchange rate commitment being maintained at least until the start of 2015.*" The CNB also made it clear that the ELB policy is maintained at least as long as the exchange rate floor policy is in place. Thus, the forward guidance about the duration of the exchange rate floor policy was also providing some forward guidance about the duration of the ELB.

is to let inflation return to 2 percent within one or two years after the exit. In a policy note explaining the exchange rate ceiling policy, CNB staff economists characterize their strategy as containing “*an element of temporary price-level targeting (PLT), which is recommended in the economic literature as a tool for overcoming the risk of deflation and escaping the ZLB.*”⁴² In 2017, inflation rose above 2 percent, the CNB removed the exchange rate ceiling and shortly thereafter departed from the ELB.⁴³ Since 2017, inflation has remained slightly above 2 percent.

Figure 2: Inflation projections from the CNB



Source: The Czech National Bank, Inflation Report. The series is the headline CPI inflation.

Notes: The blue dots indicate the inflation rate in the quarter in which the exchange rate floor policy was projected to terminate.

To our knowledge, there is no assessment of how much the inflation overshooting projections helped improve macroeconomic outcomes in 2013-2017. However, the CNB did follow through on waiting to exit from the exchange rate ceiling policy until inflation exceeded the target. Thus, their policy can be seen as a success, at least in a narrow sense.

A number of features of the CNB’s strategy may have contributed to its success. First, the published forecasts and promises of the central bank were generally over time

⁴² See Franta and others (2014).

⁴³ Inflation also rose in the euro area at that time, which likely aided the rise of inflation in the Czech Republic.

horizons of three years or less. As discussed earlier, policymakers are more likely to fulfill a promise they have made in the recent past than a promise made by their predecessors a long time ago.

Second, the CNB's strategy had widespread support among economists and the public. Indeed, the governor changed in July 2016 before the exchange rate ceiling policy ended. Nevertheless, the change in governorship did not influence the CNB's willingness to overshoot the inflation target.⁴⁴ In fact, all monetary policy decisions during the exchange rate ceiling policy were unanimous.

Third, the size of the projected overshoot of inflation was small, substantially less than needed to fully make up past inflation shortfalls. This approach is reminiscent of the “tempered” application of the overshooting commitment policy suggested by Yellen (2018). In particular, the CNB did not adopt price-level targeting or average-inflation targeting, which would have forced the CNB to keep the exchange rate ceiling policy much longer and to generate inflation overshooting that would have been much larger and more persistent than what was realized. Instead, the CNB—while projecting *some* inflation overshoot—flexibly adjusted the size and persistence of the inflation overshoot as the time progressed, taking into account various concerns. One lesson is that there is a continuum of makeup strategies and that it is likely to be easier to implement less ambitious overshooting policies, though their benefits would be smaller.

Fourth, in addition to its inflation target of 2 percent, the CNB specifies an inflation range of 1 percent to 3 percent as a part of its broader monetary policy strategy, which may have aided communications to the public related to overshooting 2 percent. In particular, within this inflation-range framework, the inflation rate prior to the inflation overshooting commitment policy was often above 2 percent, perhaps making it easier for the public to expect inflation rates to be temporarily above 2 percent at some point in the future. Accordingly, the CNB's experience raises the question whether having an inflation range could be helpful in generating inflation fluctuations around the 2 percent objective—instead of a level that averages slightly below objective.

Japan

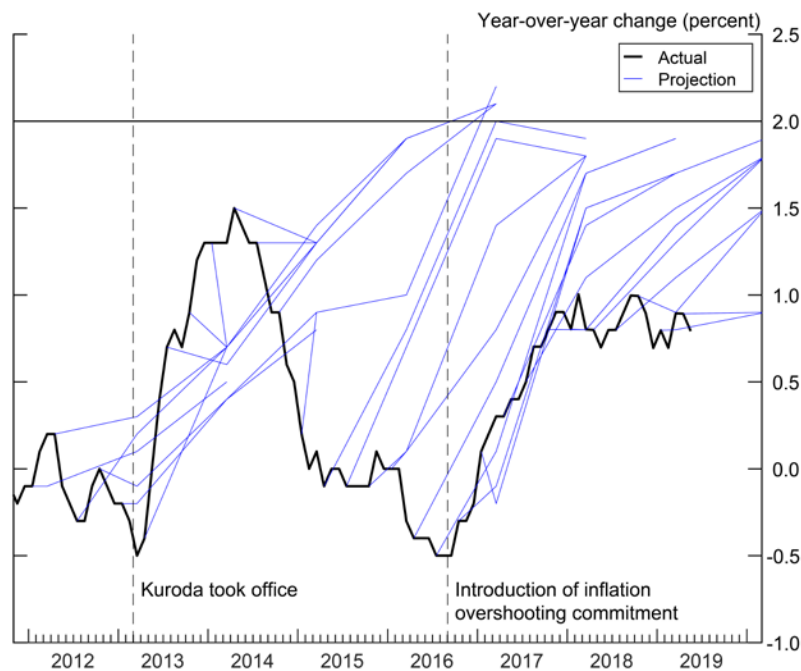
Since the late 1990s when the BOJ lowered its policy rate to the ELB for the first time, the BOJ has provided various forms of FG regarding its interest rate and BSPs (see appendix F for the evolution of FG language by the BOJ). In September 2016, the BOJ committed itself to “*expanding the monetary base until the year-on-year rate of increase in the observed consumer price index (CPI) exceeds the price stability target of 2 percent and stays above the target in a stable manner.*”

⁴⁴ The current Governor, Jiří Rusnok, was a Board member at the CNB from March 1, 2014 to June 30, 2016. He became Governor on July 1, 2016.

The BOJ has yet to achieve 2 percent inflation and continues to pursue its strategy to overshoot its inflation objective, making a holistic evaluation of the policy from start to finish impossible. However, the policy has been in place for nearly three years without achieving the inflation goal. In what follows, we highlight three key differences between the overshooting policies of the BOJ and the CNB.

The first difference is that the BOJ’s commitment was generally seen by market participants and seasoned observers of the Japanese economy as a minor deviation from previous FG, whereas the CNB’s policy was perceived as a brand-new policy initiative and was widely discussed among the public in the Czech Republic. In Japan, the inflation overshooting commitment was introduced together with a major policy initiative, the yield-curve-control policy, but as a separate policy initiative, which might have helped create the perception that the overshooting commitment was a minor deviation of previous FG.

Figure 3: Inflation projections from the BOJ



Source: The actual inflation series is computed as the year-on-year percent change in the BOJ’s core CPI measure, available at the BOJ’s website. From January 2011 to December 2015, we use the BOJ’s tax-adjusted core CPI inflation series, also available at the BOJ’s website. Inflation projections are from “Outlook for Economic Activity and Prices” by the BOJ.

The second key difference is that the time horizon in which the overshooting occurs in Japan is unspecified and potentially far into the future, whereas the time horizon was relatively short in the Czech Republic, as discussed earlier. Figure 3 shows the evolution of the BOJ’s inflation projections since 2012. Even after the introduction of the new policy in September 2016—indicated by the second dashed vertical line—the

inflation projection did not qualitatively change. The BOJ's inflation projections have always shown that inflation approaches from below to 2 percent within the next two-to-three years. Some inflation overshooting is presumably expected to occur after that projection horizon, but cannot be seen in the projection. The lack of any guidance on the likely date in which the inflation overshooting occurs might have made the public less confident about the BOJ's commitment.

The third key difference between Japan and the Czech Republic is the dynamics of inflation before the inflation overshooting commitment policy was introduced. Unlike in the Czech Republic, where inflation had fluctuated both above and below 2 percent before the inflation overshooting policy, inflation had been running well below 2 percent for more than two decades in Japan. It might be difficult for households and firms to imagine an economy with inflation running above 2 percent if they have not lived in such an economy for a very long time.

IV. Conclusion

In this memo, we analyzed the ELB risk facing policymakers and its implications for economic activity and inflation, during both recessions and expansions. We discussed ways in which the current framework could be strengthened, both at and away from the ELB. We also discussed some tactics for sustaining time-inconsistent policy strategies that overshoot the FOMC's objectives, which are outside of the current framework.

Some of the ideas we highlight for possibly strengthening the current framework might also benefit other frameworks, including frameworks that involve overshooting the FOMC's objectives. An important empirical issue that we do not resolve in this memo is the extent to which policy strategies that overshoot the FOMC's inflation objective might be able to outperform the existing framework. The potential benefits of strategies that overshoot the Committee's objectives may or may not outweigh the costs of departing from the current framework, which has been in place for a number of years. These topics are, in part, discussed in two other memos delivered to the FOMC on August 30: Arias and others (2019) and Hebden and others (2019).

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Appendix A: The Federal Reserve Bank of Chicago’s DSGE model using shocks from the 2001 Recession

The Federal Reserve Bank of Chicago’s DSGE model is a New-Keynesian model in which the central bank follows a Taylor-type rule with interest rate smoothing:

$$R_t = \rho_R R_{t-1} + (1 - \rho_R)[r^{LR} + 2 + \psi_1 \pi_t^{gap} + \psi_2 y_t^{gap}].$$

Here, R_t is the federal funds rate, $\psi_1, \psi_2 > 0$,

$$\pi_t^{gap} = 0.25 \times E_t \sum_{j=-2,-1,0,1} (\pi_{t+j} - 2)$$

$$y_t^{gap} = 0.25 \times E_t \sum_{j=-2,-1,0,1} (y_{t+j} - y_{t+j}^*)$$

π_t is per-period inflation, y_t is output, y_t^* is potential output.

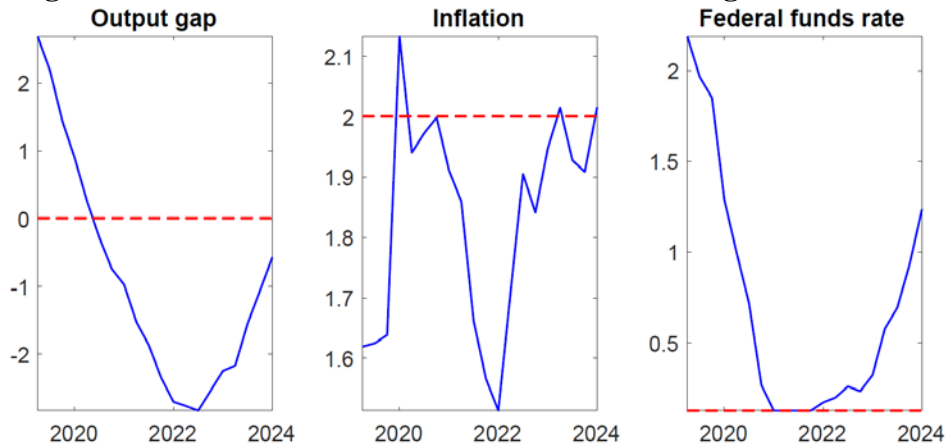
The model is solved under the assumption of rational expectations. Using the Chicago Fed DSGE model, we assess whether the federal funds rate would have become constrained by the ELB if, in 2019, the U.S. economy were hit by the same sequence shocks that caused the 2001 recession, which was less severe than many of the recessions of the postwar period.⁴⁵ The model allows us to back out the modal point estimate of the shocks from 2001:Q1 through 2005:Q4. We assume that this sequence of shocks hits the economy starting in 2019:Q4.

The blue line in figure A.1 shows the results of the simulation. The model predicts that the federal funds rate would become constrained in this scenario. Furthermore, the ELB constraint materially worsens the recession by adding 1.5 percent to the fall of the output gap (not shown). Our analysis is conservative since we set the long-term real interest rate r^{LR} to be equal to 1 percent, which is higher than the value implied by the June 2019 SEP.

Given that the 2001 Recession was considerably less severe than the recession that follows the GFC, these results suggest that the ELB is likely to become a recurrent and pervasive feature of the environment in which the Federal Reserve will be operating going forward.

⁴⁵ The model is described in the appendix of Campbell and others (2016) and Campbell and others (2019).

Figure A.1: Simulation results from the FRB Chicago DSGE model



Note: Horizontal axis is time. Vertical axis: the output gap is expressed in percentage points. The rate of inflation is defined as year over year and is expressed in percent. The federal funds rate is annualized and in percent.

Source: Federal Reserve staff calculations.

As shown in the left panel of figure A.1, the output gap falls with a considerable delay, reaching its trough four years after the onset of the recession. However, according to the National Bureau of Economic Research's recession dating committee, the 2001 recession lasted for only 4 quarters (2001:Q1-2001:Q4). Such a delayed trough in these simulations stems from the job-less feature of the post-2001-recession recovery combined with the fact that the output gap is mainly identified by observed hours worked in the model. According to the model the output gap reached its lowest value after the 2001 recession only in 2005:Q1.

Appendix B-I: Does the ELB constrain monetary policy?

There are two main strategies that the academic literature has followed to show that the ELB does not meaningfully constrain monetary policy.

One strategy is to show that properties of key macroeconomic variables, such the volatility of inflation or the responsiveness of bond yields to news, remained unchanged at the ELB, while they should have indeed changed if the ELB was a substantial constraint on monetary policy.⁴⁶ One advantage of this approach is that it is empirically driven and requires relatively minimal assumptions. A shortcoming is that looking at properties of macroeconomic variables is only an indirect way to assess the severity of

⁴⁶ See, for example, Debortoli and others (2019), Wu and Xia (2016), and Swanson and Williams (2014).

the ELB constraint. In addition, this methodology can only be used to understand past events and is well suited to consider neither counterfactuals nor future scenarios.

The other strategy embeds FG and BSPs into structural economic models that are calibrated so that the impact of FG and BSPs on the yield curve or other relevant variables matches the empirically estimated ones.⁴⁷ This methodology tends to find that BSPs are generally more powerful than FG, especially when models include limited commitment or limited credibility.⁴⁸ One challenge for this methodology is that the size of the effects of unconventional policies, particularly for BSPs, is still an unsettled dispute. For example, Greenlaw and others (2018) argue that the effects of LSAPs in many studies may be overstated because they do not take into account that they taper off quite quickly. In response, Swanson (2018) argues that the increase in bank lending that resulted from BSPs lasted for several months, and that the conclusion of Greenlaw and others (2018) is mostly driven by a single observation, the announcement of the first LSAP. Another challenge is that it requires that FG and BSPs be specified according to rules that prescribe in advance how they respond to economic shocks. In this class of models, the central bank's commitment to such rules has powerful effects on private sector expectations, which in turn translate to significant effects on economic outcomes.

The way in which the FOMC implemented and communicated FG and BSPs during the GCF was quite different from how they operate in these class of models. First, they were new policies, neither anticipated nor immediately apprehended. Second, the model-implied behavior of FG and especially BSPs do not accurately portray the way they have been implemented since 2008. Third, many models assume central bank behavior that is not consistent with the current monetary policy framework. It is therefore more appropriate to interpret these models as statements about possibilities for the future rather than as evidence that monetary policy was not constrained by the ELB during the GFC and its aftermath. When we discuss concrete ways to strengthen the framework, some of our proposals draw from insights provided by this strand of the literature.

Appendix B-II: The gains from acting sooner in response to the Great Recession

In this section, we use the Chicago Fed DSGE model to evaluate quantitatively the effects of acting sooner and more aggressively in lowering the path of futures federal funds rate during a severe economic downturn. To this end, we run an alternative simulation in which the Great Recession and the ensuing recovery are used as an ideal

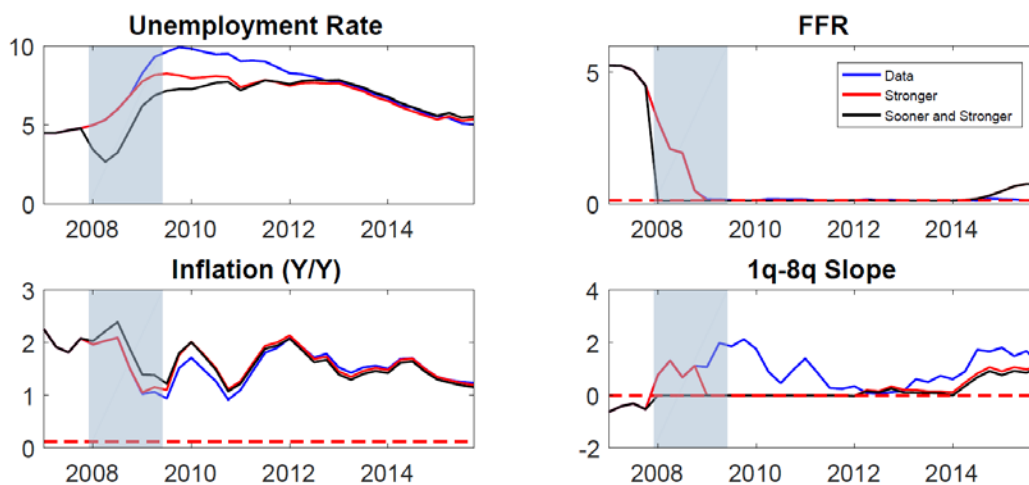
⁴⁷ See, for example, Kiley (2018) and Sims and Wu (2019).

⁴⁸ Matching the empirical size of the effects of FG on yields requires models to posit a mechanism to attenuate the *forward guidance puzzle*, which further limits the effectiveness of FG when compared to more standard New Keynesian models like Eggertson and Woodford (2003).

laboratory to test alternative policies. In figure B.1, we simulate the model under three alternative policy scenarios and show the dynamics of the unemployment rate, the PCE core inflation rate, the federal funds rate, and the slope of the path of futures federal funds rate between 1 quarter and 8 quarters maturities.

The first scenario—shown by the blue line—relies on the policy that was actually implemented.⁴⁹ The second scenario—shown by the red line—is based on an alternative policy that follows the same timing as the actual policy but the central bank uses better communication and completely flattens out the path of futures rates from 2008:Q4 through 2011:Q3, which was when the path of futures rate was successfully flattened out by the introduction of the calendar-based forward guidance. This second scenario is an example of stronger policy in that the FOMC communications is more effective in flattening the path of futures rates. The third scenario—shown by the black line—is conditioned on a policy that would have lowered the current rate more quickly (the federal funds rate reaches 0.125%, the ELB, already in 2008:Q1) and the FOMC’s communications would have effectively flattened out the path of future rates starting in 2008:Q1 until 2011:Q3. This is an example of sooner and stronger policy.

Figure B.1: Sooner and stronger monetary stimulus in the Great Recession



Notes: Simulations from the DSGE model of the Federal Reserve Bank of Chicago using the estimated shocks from 2007:Q1 through 2015:Q4 and the estimated initial state vector in 2006:Q4. The simulations are done under three alternative monetary policy strategy.

There are two main takeaways. First, comparing the red and the black lines shows that acting sooner would have delayed the start of the recession and would have reduced the unemployment rate by an average of 2 percentage points during the Great

⁴⁹ Since the policy rule features forward guidance shocks that are estimated in the data, we allow the central bank to use unconventional monetary policies to deviate from the pre-Great-Recession Taylor-type rule as suggested by the data on the current and expected path of the federal funds rate.

Recession (2007:Q4-2009:Q2) compared to just acting more strongly later. Second, comparing the blue and the red lines suggests that imperfect communications gave rise to important headwind at the beginning of the recession and contributed to increasing the peak of the unemployment rate by 1.7 percentage points. Better communications would have lowered the unemployment rate by an average of 0.9 percentage points from the onset of the Great Recession through the end of 2012. The latter result suggests that having developed the ability of quickly flattening the path of the federal funds rate (with the introduction of the calendar-based FG in August 2011 and with the state-contingent FG in December 2012) will be an important asset for the FOMC going forward.

Appendix C: Detailed discussion on time-inconsistency

In this appendix, we describe the nature of the time-inconsistency problem of makeup strategies in detail. Under a makeup strategy, at the beginning of a deep recession, policymakers promises to overshoot the inflation objective by holding interest rates lower than they would be without trying to overshoot. If credible, the public will raise their inflation expectations. That will stimulate current demand by lowering real interest rates, and help to stabilize inflation by keeping longer-run expectations higher than they would be otherwise. However, when the economy progresses to the point at which inflation is at target, employment is at full-employment, and expectations are near the inflation objective, it would make sense to ask why we do not just stop there. Hence the time inconsistency, and the need for a commitment device.



Appendix D: More-drastic approaches to implement time-inconsistent strategies

The Committee could bind future policymakers to past promises by imposing financial costs on the Federal Reserve if the promises are not kept. For example, the Committee could write interest-rate options on Treasury securities so that the Federal Reserve would make capital losses if it raised (or lowered) interest rates before a certain date.⁵⁰ Alternatively, the Committee could increase the size of its balance sheet to a point where it would be difficult to maintain positive remittances to the Treasury unless the federal funds rate remained at low levels for an extended period.⁵¹

While these actions may bind future Committees to past promises, it would likely be difficult to tailor these actions to the precise implementation of a policy strategy. In the case of writing options on Treasury securities, contracts may not depend on economic outcomes in ways that the Committee would want and premiums on long-dated contracts may interfere with effective implementation. The strategy of expanding the balance sheet large enough to make it likely that the Federal Reserve would incur capital losses if it took certain actions carries other risks. Those risks include the unknown effects of the Federal Reserve having that large of a footprint in financial markets and the institutional risks associated with the public perceiving the policy strategy as irresponsible.

Appendix E: Some details on the exchange rate policy by the Czech National Bank

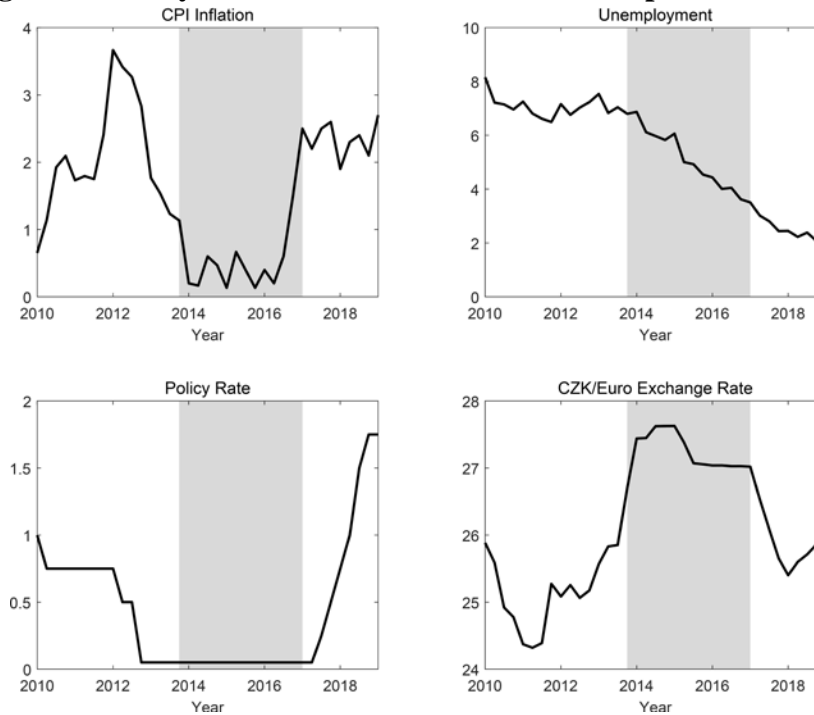
The Czech Republic is a small open economy closely linked to the Euro Area economy. In 2011, the slowdown in the Euro Area economy and continuing domestic fiscal consolidation began to darken the outlook for the Czech economy. By the second half of 2012, inflation was below the 2 percent target and output was below potential. The economy was projected to weaken further. In November 2012, the CNB cut its policy rate to its ELB, 0.05 percent. Yet, the projection at the time suggested that a further accommodation was needed to support stronger growth and a return of inflation to the inflation target.

Against this backdrop, in November 2013, the CNB introduced the exchange rate ceiling policy in which the CNB will not allow the currency to fall below 2.7 CZK/Euro. The exchange rate ceiling was in place until April 2017. The departure from the exchange rate ceiling was followed by the departure of the policy rate from the ELB a few months later. Figure E.1 shows the evolution of key macro variables in the Czech Republic since 2010.

⁵⁰ See Clouse and others (2003) for a discussion of the Federal Reserve writing options on Treasury securities. Small and Clouse (2005) discuss when the Federal Reserve may be authorized to write such options.

⁵¹ See Jeanne and Svensson (2007), Berriel and Mendes (2015), and Bhattarai and others (2015).

Figure E.1: Key macro variables in the Czech Republic since 2010



Sources: FRED, Federal Reserve Bank of St. Louis.

Throughout the period of the exchange rate ceiling policy, the CNB provided forward guidance on the likely timing of the exit from the policy.⁵² For example, in February 2014, the CNB stated that

“The Bank Board foresees this exchange rate commitment being maintained at least until the start of 2015.”

As the economic situation worsened more than expected in 2014 and 2015, the CNB updated the forward guidance language to postpone the likely exit timing. In December 2015, the CNB stated that

“According to the forecast, sustainable fulfilment of the target, which is a condition for a return to conventional monetary policy, will occur from early 2017.”

While the CNB did not provide any numerical guidelines for what “sustainable fulfilment” means, the forward guidance about the likely timing of the exit was always accompanied by the publication of the inflation projection, allowing us to infer the conditions under which the exit occurs.

⁵² The CNB also made it clear that the ELB policy is maintained at least as long as the exchange rate floor policy is in place. Thus, the forward guidance about the duration of the exchange rate floor policy was also providing some forward guidance about the duration of the ELB.

Figure 2 in the main text shows the inflation projection from all policy meetings during the exchange rate ceiling policy. According to these projections and from our communication from the CNB staff, their strategy is guided by two principles. The first is to depart from the exchange rate ceiling once inflation reaches or exceeds the 2 percent target. The second is to let inflation return to 2 percent within one or two years after the exit, sometimes raising it further from the level at the exit before letting it converge back to 2 percent.

The CNB intended to keep the inflation overshooting to be short-lived, typically lasting one to two years. For example, in the February 2014 projection, inflation is projected to exceed the target and reach 2.8 percent in 2015:Q1, but slow down to 2.2 percent by the end of 2015. In the February 2016 projection, inflation is projected to reach 2 percent in 2017:Q1, peaks at 2.2 percent in 2017:Q3, and slows down to 2.1 percent in 2017:Q4. In the February 2017 projection, right before the exchange rate ceiling policy was abandoned, inflation is projected to exceed the target and reach 2.1 percent in 2017:Q1, peak at 2.7 percent in 2017:Q3, and slows down to 2.1 percent in 2018:Q3.

After the exit of the exchange rate ceiling policy in April 2017, inflation averaged 2.4 percent and 2.2 percent in the remainder of 2017 and in 2018, respectively, roughly in line with what was projected in the February 2017 projection.

The CNB's strategy is a type of makeup strategy. Indeed, in a policy note explaining the exchange rate ceiling policy, CNB staff economists characterize their policy as containing "*an element of temporary price-level targeting (PLT), which is recommended in the economic literature as a tool for overcoming the risk of deflation and escaping the ZLB.*" Svensson (2019) concurs with their characterization, saying that "[t]he Czech National Bank has successfully used a variant of the Foolproof Way—with a currency depreciation and temporary peg, but without a price-level target—to achieve its inflation target."

However, the CNB's makeup strategy is distinct from the temporary PLT because the CNB did not aim to *fully* make up the inflation undershooting of the past. The magnitude and persistence of the projected inflation overshooting is such that they only partially make up the past inflation undershoots. For example, inflation averaged 0.5 percent from 2014 to 2016. If the CNB were to fully make up this inflation undershooting, say over the next three years, the CNB would have had to generate 3.5 percent inflation every year. However, that was clearly not the intension of the CNB.

According to the February 2017 projection, the CNB projected an overshooting of 40 basis points over the next seven quarters.⁵³

The CNB’s partial makeup approach seems pragmatic as it allows policymakers to take into account various other concerns in deciding the magnitude and persistence of the inflation overshooting. In this respect, the CNB approach is reminiscent of the “tempered” application of overshooting commitment suggested by Yellen (2018). Yellen (2018) suggested some “tempering” in the application of lower-for-longer policies on the ground that there are risks associated with these policies. Such risks include concern for unanchoring of inflation expectations, financial stability concerns of lower-for-longer policy, and uncertainty regarding how people form expectations. Also, committing to a specific PLT path can raise concern that the Fed may not be able to achieve that target (note that the Fed has been struggling to even hit the 2 percent target) and loss of credibility if policymakers persistently fail to achieve that target.

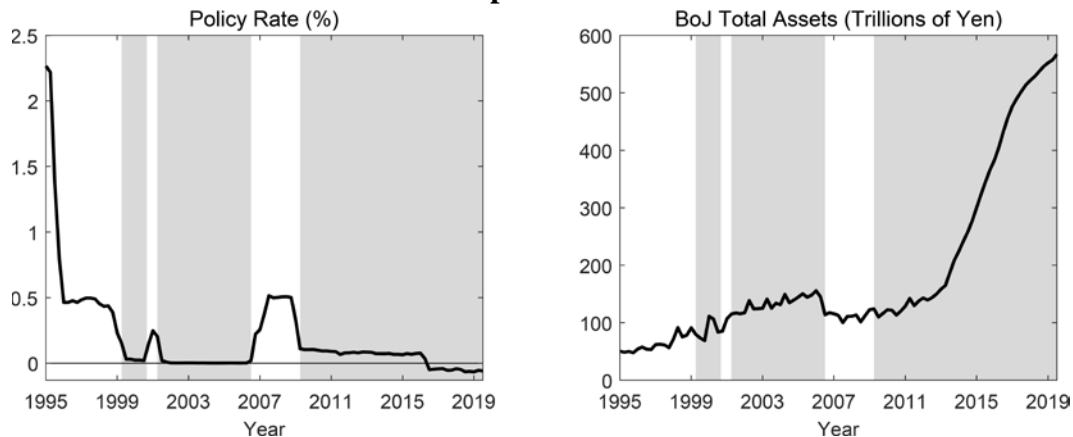
How effective was the CNB’s overshooting commitment policy? This is a tough question to answer. The CNB’s overshooting commitment is forward guidance about the exchange rate ceiling policy and the interest rate policy. Even without the overshooting commitment, the deployment of these two policies is supposed to stimulate economic activity. The overshooting commitment is something that enhances these two policies, but it is difficult to know exactly what would have happened if the exchange rate ceiling policy and the ELB policy had been adopted in a way that would not imply the inflation overshooting. We are not aware of any systematic analysis of this issue.

Appendix F: Forward guidance language used by the BOJ

BOJ is the first advanced economy to face the ELB constraint in the post WWII era. In February 1999, the BOJ lower the policy rate to the ELB for the first time. After a liftoff from the ELB in August 2000, the BOJ adopted quantitative easing policy in March 2001 and lowered the policy rate again to the ELB in September 2001. The quantitative easing policy ends in March 2006 and the second ELB policy ends in July 2006. The Global Financial Crisis forced the BOJ to lower the policy rate back close to the ELB in December 2008 and the policy rate has been at or very close to the ELB thereafter. See figure F.1 for how the policy rate and the size of the balance sheet have evolved since 1995.

⁵³ Franta and others (2014) state, “[t]he chosen strategy incorporated this element of PLT without explicit regime change, the ultimate ambition being to return to the standard inflation targeting regime, as the CNB’s public commitment was made solely in terms of the nominal exchange rate as a monetary policy instrument, not in terms of the future price level.”

Figure F.1: Evolution of the policy rate and balance sheet in Japan since 1995-present



Source: The BOJ policy rate series is the quarterly average of the “Call rate, Uncollateralized Overnight/Average” with mnemonic “FM02’STRACLUCON” and is available at the BOJ website. The total assets series is from the BOJ’s “Economic Statistics Monthly” publication, available in Haver under the mnemonic “japan’ACTT”.

Notes: Shaded areas indicate periods in which the policy rate is at or very close to what was considered to be the ELB at that time.

The BOJ has provided various forms of forward guidance regarding the stance of monetary policy. In April 1998 two months after the first ELB policy was first introduced, then-Governor Masaru Hayami stated that the policy rate would be kept at the ELB “*until deflationary concerns are dispelled.*” In 2001 when the quantitative easing policy was introduced, the BOJ stated that the QE policy would be in place “*until the consumer price index (excluding perishables, on a nationwide statistics) registers stably a zero percent or an increase year on year.*”

In October 2010 when the policy rate was lowered from “around 0.1 percent” to “around 0 to 0.1 percent,” the BOJ stated that it would “*continue the virtually zero interest rate policy until it judges that price stability is in sight on the basis of the understanding of medium- to long-term price stability.*” Throughout the third ELB episode that began in December 2008, the BOJ modified forward guidance languages several times.

One particularly interesting forward guidance by the BOJ is the inflation overshooting commitment language, which was introduced in September 2016 and has been in use since then. In the monetary policy statement, the BOJ stated, “*the Bank commits itself to expanding the monetary base until the year-on-year rate of increase in the observed consumer price index (CPI) exceeds the price stability target of 2 percent and stays above the target in a stable manner.*”

This forward guidance is the only one in which the BOJ to accommodative monetary policy stance until the inflation *exceeds* the target in a stably manner.

Evaluating the performance of this BOJ's overshooting commitment policy is difficult for multiple reasons. First, because the BOJ has yet to raise the policy rate from the ELB—unlike the CNB—it will remain to be seen whether the BOJ will deliver on this promised inflation overshooting when the time comes. Second, the inflation overshooting commitment policy was introduced at the same time when another major policy—yield-curve control—was introduced. As a result, it is not clear how one can disentangle the effects of these two policies.

Despite these limitations, by examining the evolution of key macro variables as well as inflation expectations data, we can get some idea about whether the BOJ's inflation overshooting commitment is believed by the public and whether the policy has had its intended effects.

Figure F.2 shows a measure of long-run inflation expectations in Japan since 2008. From 2008 to 2011, the LR inflation expectation measure was hovering above 1 percent. In 2012, the measure declines somewhat. From late 2012 to mid-2014, the measure sharply increased, driven by the weakening of yen due to Kuroda's accommodative monetary policy, rising oil prices, and the consumption tax hike in April 2014. Since mid-2014 to early 2016, the paths of these expectations reversed the course, due to a sharp decline in oil prices in 2015, a slow-down in growth that followed the consumption tax hike of April 2014.

Figure F.2: Evolution of long-run inflation expectations in Japan since 2008



Source: Consensus Forecasts, Inc.

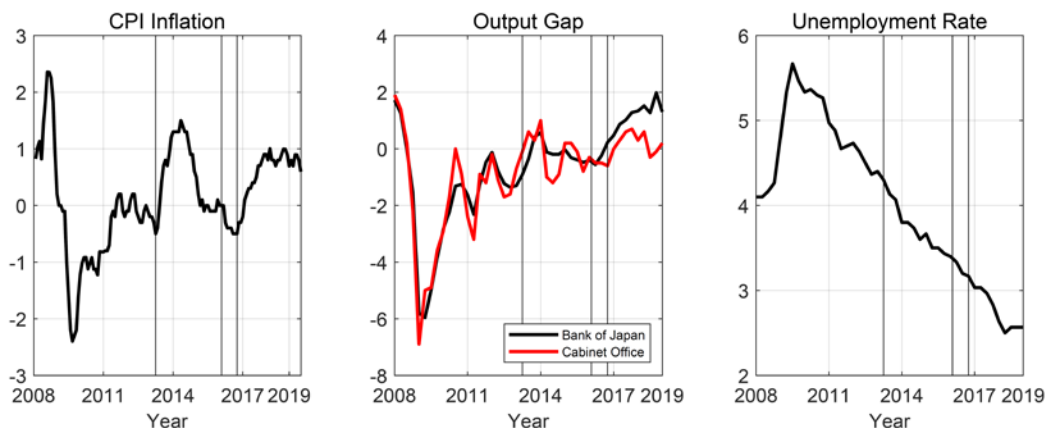
Notes: The three vertical lines are when current Governor Kuroda took office (March 2013), when the policy interest rate went negative (January 2016), and when the BOJ announced its inflation overshooting commitment (September 2016).

The inflation overshooting commitment policy and the yield-curve-control policy of September 2016 do not seem to have had much effect on inflation expectations. In 2016 and 2017, the inflation expectations have been stable at around 1.3 percent. Since then, the measure declines a bit and currently stands at 1.1 percent, a level consistent with the average value from 2008 to 2011.

There is also no clear break in September 2016 for macroeconomic variables. As shown by figure F.3, since the Global Financial Crisis, inflation and output have been on a steady upward trend, while the unemployment rate has been on a downward. It is hard to detect any clear structural break in these variables around September 2016

All told, the effectiveness of the overshooting commitment policy seems to be have been limited at best in Japan. At least, it is fair to say that it was not a “game-changer.”

Figure F.3: Inflation, output gap, unemployment rate in Japan since 2008



Sources: The inflation series is computed as the year-on-year percent change in the BOJ's core CPI measure, available at the BOJ website. From January 2011 to December 2015 are from the BOJ's tax-adjusted core CPI inflation series, also available at the BOJ website. The BOJ output gap measure is available at the BOJ website, and that of the Cabinet Office is available at their website. The unemployment rate is from FRED-Federal Reserve Bank of St. Louis

Notes: The three vertical lines are when Kuroda took office (March 2013), when the policy interest rate went negative (January 2016), and when the BOJ announced its inflation overshooting commitment (September 2016).