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Harnessing the benefit of state-contingent forward guidance

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Introduction

Since 1991, the Bank of Canada and the Government of Canada have jointly established an inflation-targeting framework.[1] While the framework has evolved, its core—keeping inflation close to the 2% target within a range of 1% to 3%—has remained unchanged since 1995. Over the past 30 years, this framework has been successful in keeping inflation low, stable and predictable. Inflation expectations have remained fairly well anchored. Such success contributes to macroeconomic stability and provides monetary policy with greater flexibility to account for output, employment and financial stability considerations.

Over the past few decades, neutral interest rates in Canada and elsewhere have been declining (Mendes 2014; Del Negro et al. 2019). Indeed, at the time of the 2016 inflation-target renewal, the Bank estimated that the nominal neutral rate was in the range of 2.75% to 3.75% (with a 3.25% midpoint). In the latest 2022 update, the range was estimated to be between 2% and 3% (Faucher et al. 2022).[2] Many factors are contributing to this downward trend, including long-term forces such as slowing global growth and shifts in saving and investment preferences (Mendes 2014; Rachel and Smith 2017). A lower neutral rate of interest implies that there is less room for conventional monetary policy to respond to adverse shocks before hitting the effective lower bound (ELB), all else being equal. A lower neutral rate also increases the likelihood that a central bank's policy rate will reach its ELB in future economic downturns.

One approach to addressing the challenges associated with lower neutral rates is to use extended monetary policy tools such as forward guidance.[3] In this note, we consider two monetary policy frameworks with varying degrees of history dependence—average inflation targeting (AIT) and an enhanced form of flexible inflation targeting with state-contingent forward guidance. Such forms of forward guidance embed history dependence which requires the central bank to make up for past deviations from target; in other words, bygones are not bygones.[4] We contrast their performance with traditional flexible inflation targeting (FIT) in terms of:

- the cost of the ELB in a low neutral rate environment
- the extent of improvements to macroeconomic outcomes at the ELB

We find that a FIT rule augmented with state-contingent forward guidance helps deliver results comparable to an AIT rule. If the guidance is fully understood by agents in the private sector (households and firms), it can shape their expectations and behaviour. This influence over private-sector expectations is particularly beneficial when the policy rate is constrained by the ELB.

Measuring the cost of the effective lower bound

The Bank of Canada operates under a FIT regime with an explicit inflation target defined in terms of year-over-year consumer price index (CPI) inflation rates. While it has no explicit target for output or employment, the Bank nonetheless seeks to ensure the economy is running near capacity since inflation will be more sustainably at target if there is neither excess demand nor excess supply. We approximate this regime by estimating a simple policy rule that responds to year-over-year CPI inflation, the output gap and some degree of smoothing. We refer to this estimated rule as the **historical rule**:

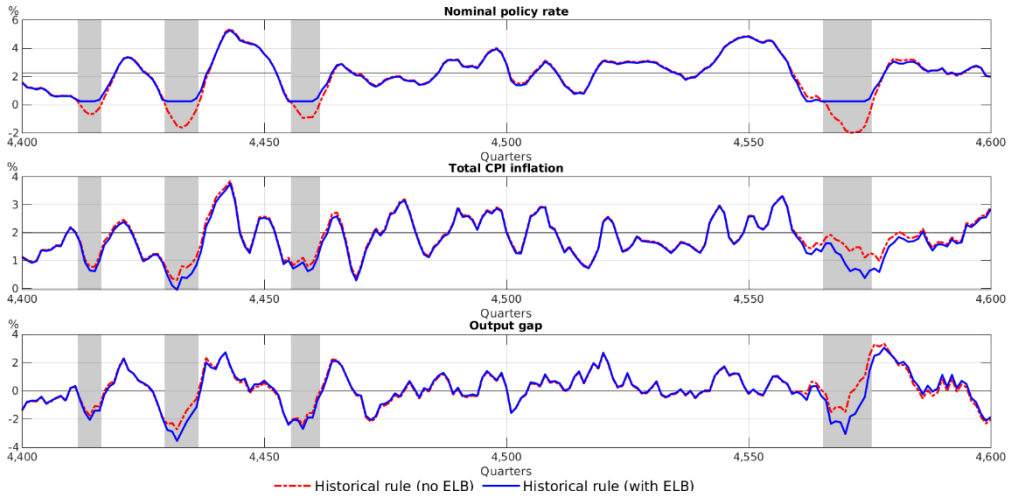
[1] See Amano, Carter and Schembri (2020) and Carter, Mendes and Schembri (2018).
[2] At the time of this analysis during the 2021 Monetary Policy Framework Renewal, we used the 2021 estimate that the Canadian nominal neutral rate was in the range of 1.75% to 2.75% (with a 2.25% midpoint).
[3] See Dorich, Mendes and Zhang (2021) for a detailed comparison of monetary policy strategies for Canada.
[4] See Woodford (2003) for a definition of history dependence and discussion of its role in monetary policy.

$$i_t = \max\{i^{ELB}, 0.85i_{t-1} + (1-0.85)\left[i^* + \gamma_{yy}\left(\boldsymbol{E_t}\boldsymbol{\pi}_{\boldsymbol{t+4}}^{\boldsymbol{CPI,yy}} - \bar{\pi}\right) + \alpha_{yy}\tilde{x}_t\right]\}, \qquad (1)$$

where i_t is the annualized quarterly nominal short-term interest rate that is subject to a threshold; i^{ELB}.[5] i^* is the neutral rate of interest; $\pi_{t+4}^{CPI,yy}$ denotes forecasted one-year-ahead (year-over-year) CPI inflation; $\tilde{x_t}$ is the output gap; $\bar{\pi}$ is the 2% inflation target; and γ_{yy} and α_{yy} are the policy coefficients on inflation's deviation from its target and from the output gap, respectively.

We conduct stochastic simulations in the most recent version of the Terms-of-Trade Economic Model (ToTEM) to evaluate alternative specifications of the policy rule.[6] Since the rules account for periods of both constrained and unconstrained monetary policy, we focus primarily on the performance of the rules at the ELB. **Chart 1** shows a sample of stochastic simulations over a 50-year period. ELB episodes are when the desired interest rates (dashed red lines) fall below the ELB.

Chart 1: Stochastic simulations in the Terms-of-Trade Economic Model with effective lower bound episodes



Notes: This is a 200-period sample (from the 4,400th to the 4,600th period) of a stochastic simulation of 72,000 periods. The shaded areas represent the ELB episodes. CPI is consumer price index.

The ELB introduces an asymmetry to inflation risks. Since central banks are constrained in responding to adverse shocks that push the economy toward the ELB, downside risks become challenging to deal with. As shown in **Table 1**, the ELB binds about 16% of the time, with an average duration of about a year and a half. Compared with the outcome when there is no ELB, economic losses are slightly more significant. The unconditional mean of inflation is 1.87%, indicating some disinflationary bias associated with the ELB. The constraint on the policy rate to reach the desired level of accommodation when the ELB is binding also leads to a slightly negative output gap with a mean of -0.03.

[5] The ELB refers to the level below which nominal interest rates cannot fall. The Bank considers the ELB threshold i^{ELB} to be 25 basis points. The choice for a slightly positive threshold value is motivated in part by concerns that lenders and borrowers need an incentive to transact in financial markets. There are also uncertainties about the impact of very low interest rates on markets.

[6] The most recent version of ToTEM is estimated using Bayesian methods over the 1995–2016 period; see Corrigan et al. (2021). The rest-of-the-world block in ToTEM is composed of the United States, Japan, China, the euro area, oil-importing emerging-market economies (such as India and Turkey), oil-exporting emerging-market economies (such as Russia and Saudi Arabia) and some advanced economies (such as the United Kingdom and Australia). Monetary policy in the rest-of-the-world block in ToTEM is characterized by an AIT monetary policy rule, motivated by the recent discussion of the new policy regime by the US Federal Reserve (see Hebden et al. 2020).

Table 1: The historical rule cannot fully mitigate the cost of the effective lower bound

Framework	Proportion of periods at the ELB (%)	Average duration of ELB (quarters)	CPI inflation (year-over-year)		Output gap		Unemployment gap	
			Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
Historical rule (no ELB)	--	--	2	0.72	0	1.36	-0.03	0.94
Historical rule (with ELB)	16	7	**1.87**	0.82	**-0.03**	1.54	**0.11**	1.02

Notes: ELB is effective lower bound. CPI is consumer price index. St. dev. is standard deviation.

The bold and shaded cells indicate the cost associated with the ELB: the unconditional mean of inflation has fallen below the 2% target, the output gap is now slightly negative, and the unemployment gap is now positive, relative to the historical rule without an ELB.

The presence of the ELB introduces a negative bias to the mean of inflation.[7] This could potentially lower long-run inflation expectations, making it more difficult for the central bank to bring inflation back to target. At the same time, the ELB also leads to increases in inflation and volatilities in the output gap. Overall, the historical rule alone cannot fully mitigate the macroeconomic cost of the ELB. That said, the size of the ELB cost identified in our analysis is small. This is because the underlying model is estimated over 1995 to 2016, a sample that includes the Great Moderation period.[8] Further, we assume for this study that the central bank retains full credibility, even when inflation drops below the target and the policy rate is constrained by the ELB.

The cost of the ELB is also reflected through the probability of an ELB episode and how long it lasts once the policy rate becomes constrained. In light of the decline in the neutral rate, we find that the ELB probability increased from 6% in 2016 to about 17% in 2021, and that the average duration increased from 2.3 quarters in 2016 to about 7 quarters in 2021.[9]

Average inflation targeting and the benefit of history dependence

To address the ELB challenge, we start by comparing AIT to a typical FIT rule. Under AIT, bygones are not bygones. The commitment of AIT to make up for past deviations of average inflation from its target introduces history dependence in monetary policy and helps shape the expectations of private agents (including households, firms and financial market participants), when confronted with the ELB (Amano et al. 2020). For example, suppose that the economy is hit by an adverse shock—large enough to push nominal interest rates to the ELB and to lower inflation below its target. Under AIT, agents understand that the central bank would make up for the miss in order to bring average inflation back to the 2% target. The central bank does this by being accommodative, thus delaying the start of the liftoff period and allowing for inflation to temporarily overshoot its target. This helps support higher inflation expectations when the nominal rate remains at the ELB, thereby lowering the current real interest rate to provide additional stimulus to the economy. By doing so, AIT helps address the downward bias in average inflation associated with the ELB.

In this note, we characterize AIT as a framework that targets a finite *three-year* average of CPI inflation at 2%. We approximate the AIT regime by assuming a simple rule:

$$i_t = \max\left\{i^{ELB}, 0.85 i_{t-1} + (1-0.85)\left[i^* + \gamma_{3y}\left(\boldsymbol{E_t}\boldsymbol{\pi}_{\boldsymbol{t+4}}^{\boldsymbol{CPI,3y}} - \bar{\pi}\right) + \alpha_{3y}\tilde{x}_t\right]\right\}, \quad (2)$$

[7] We report year-over-year total CPI inflation, which encompasses more history dependence than current inflation.

[8] The Great Moderation spans from the mid-1980s to 2007 and marks a period of relative macroeconomic stability.

[9] The historical rule already embeds a high level of inertia (with an interest rate smoothing parameter calibrated at 0.85), in line with previous Bank research. The relatively low magnitude of the ELB cost is also attributed to the fact that the model is estimated over the 1995–2016 period, with one short-lived ELB period (during the 2008–09 global financial crisis). For more details on modelling assumptions, see Bank of Canada (2021).

where both the policy coefficients on inflation deviation from its target, $\gamma_{3y,}$ and the output gap, $\alpha_{3y,}$ are optimized by minimizing the delegated loss function corresponding to an AIT regime.

As shown in **Table 2**, history dependence embedded in AIT delivers better performance than FIT at the ELB. In ToTEM, AIT narrows the average output gap to -1.54% during ELB periods from -1.93% under FIT. Similarly, average year-over-year CPI inflation during ELB periods increases from 0.79% under FIT to 0.88% under AIT.

Table 2: Average inflation targeting best mitigates the negative bias in CPI inflation during effective lower bound episodes

Framework (with ELB)	Proportion of periods at the ELB (%)	Average duration of ELB (quarters)	CPI inflation (year-over-year)		Output gap		Unemployment gap	
			Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
Historical rule	16	7	0.79	0.73	-1.93	1.42	1.19	0.96
Average inflation targeting	**29**	8	**0.88**	0.71	**-1.54**	1.43	**1.07**	0.96

Notes: ELB is the effective lower bound. CPI is consumer price index. St. Dev. is standard deviation.

The bold and shaded cells indicate the gain of a monetary policy framework that embeds history dependence (AIT) relative to the historical rule: the mean of inflation and output is now more positive while the mean of the unemployment gap is lower. This comes at the cost of an increased proportion of time at the ELB.

Adopting state-contingent forward guidance

While it performs better than FIT at the ELB, AIT can lead to volatility in the real economy when the policy rate is not at the ELB. In particular, the need to follow periods of above-target inflation with periods of below-target inflation means that monetary policy would sometimes have to engineer a slowdown. In models with fully rational expectations, a short period of weakness is usually enough because price- and wage-setters anticipate the decline in future inflation and moderate their respective price and wage increases. In more realistic models such as ToTEM, where a fraction of price-setters follows backward-looking rules of thumb, departures from rational expectations undermine the performance of history-dependent frameworks. The practical limitation of AIT motivates us to explore whether the benefits of history dependence could be captured at the ELB without adopting an alternative history-dependent framework.

In this context, central bank communication through forward guidance has been shown to offer some merits in anchoring inflation during ELB episodes. The Bank of Canada's conditional commitment in April 2009, for instance, highlights how much the most likely path of the policy rate depends on the state of the economy. Similarly, the unemployment thresholds used by the Federal Reserve and the Bank of England during the 2008–09 global financial crisis also underscore the importance of an increasingly explicit threshold that measures economic slack.

Motivated by these examples, we design an enhanced FIT framework by augmenting the historical rule in equation (1) with two forward guidance thresholds:

- current year-over-year CPI inflation has reached or exceeds the 2% target
- the output gap is closed or positive[10]

[10] We perform a sensitivity analysis to a variety of measures of slack. For example, the general conclusion remains robust when we consider an unemployment gap.

The general performance of the "historical rule with forward guidance (FG)" is superior to AIT.[11] As shown in **Chart 2**, panels a and b, the historical rule with FG mitigates all the cost associated with the ELB, leading to inflation at target and a closed output gap. When we focus on the ELB episodes, the historical rule with FG also improves the macroeconomic outcome compared with its history-dependent counterparts. As seen in **Chart 2**, panels c and d, the additional accommodation helps improve the mean outcome of both inflation and the output gap by removing the negative bias. In particular, forward guidance mitigates the most disinflationary bias, leading to a conditional mean of inflation at 1.14% during the ELB periods, significantly higher than a level of 0.79% under the historical rule with ELB. It narrows the output gap by 0.45% relative to that under the historical rule. In addition to an improved mean outcome, the historical rule with FG lowers the volatilities relative to the historical rule with ELB. For example, the volatility in inflation is lowered by 0.06% with forward guidance.

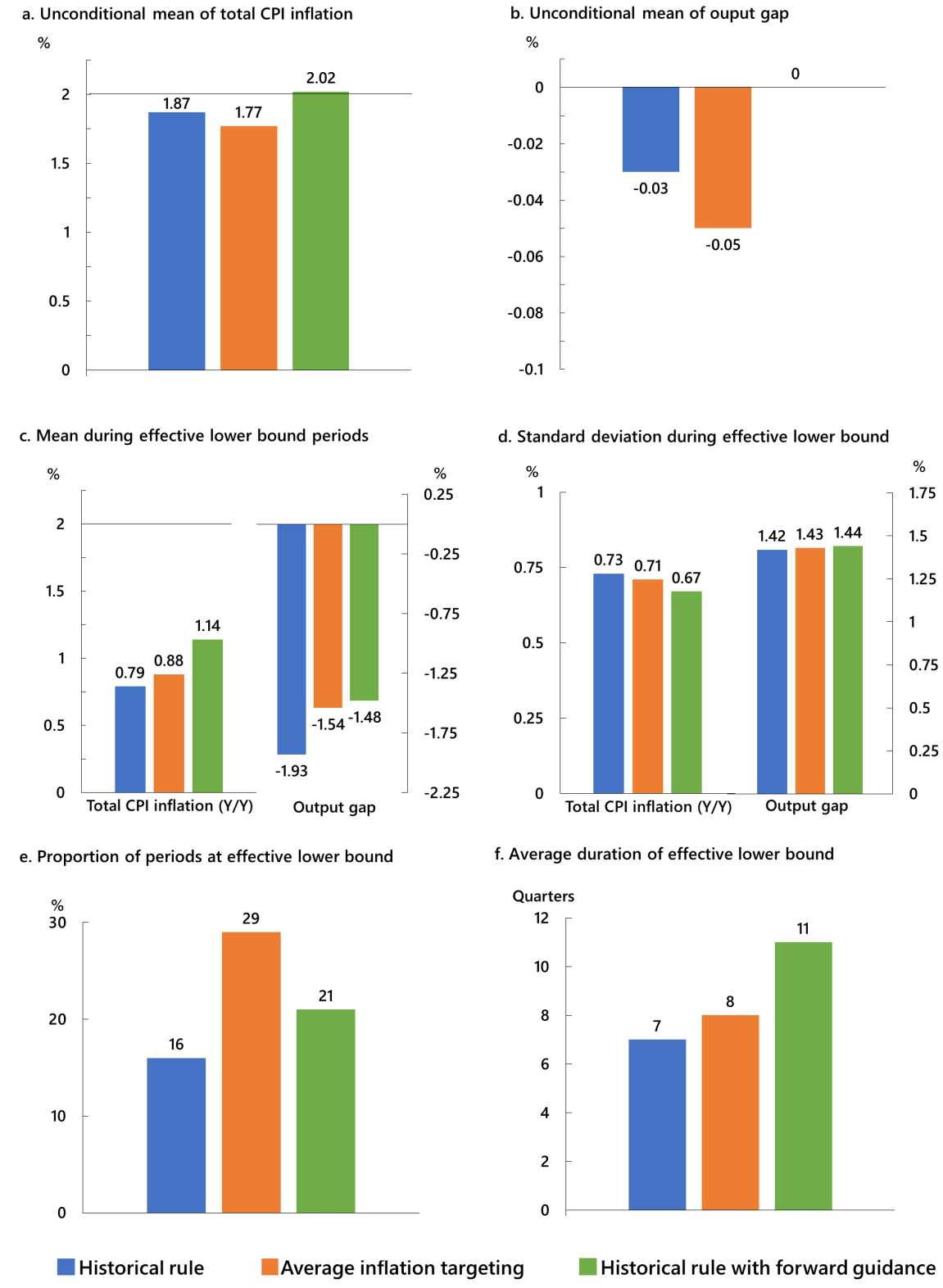
There is some cost associated with implementing such guidance. Since forward guidance is built within the historical rule without optimizing the monetary policy rule, the probability of hitting the ELB is higher than under the historical rule without FG (**Chart 2**, panel e). For instance, we estimate the ELB probability to be 21%, about 5% higher than that under the historical rule without FG. It is, however, still 8% lower than the estimated ELB probability under the AIT rule.

Implementing forward guidance also requires some additional accommodation to support the economy transitioning away from the ELB.[12] As shown in **Chart 2**, panel f, the average duration of these simulated ELB episodes under the historical rule with FG is extended on average by four quarters relative to that under the historical rule alone. The considerations of the ELB duration are balanced by relatively less volatile movement in interest rate changes, a desirable aspect in economically challenging times.

[11] This finding is consistent with the evidence from the 2020 "Let's Talk Inflation Survey" by the Bank of Canada and Bang the Table. Such guidance following year-over-year inflation is easier to understand than AIT following the multi-year average of inflation. Laboratory experiments also show that participants have a greater difficulty understanding more history-dependent regimes. In addition, in laboratory experiments in an artificial economy with a learning-to-forecast environment, AIT performs poorly relative to FIT following a large shock that leads to a binding ELB (Kostyshyna, Petersen and Yang 2022).

[12] For example, in response to the COVID-19 pandemic, the Bank of Canada used an extended monetary policy tool kit, including forward guidance. The Bank communicated that the Governing Council "will continue to hold the policy interest rate at the effective lower bound until economic slack is absorbed so that the 2 percent inflation target is sustainably achieved." See Bank of Canada (2020).

Chart 2: Conditional performance of alternative contingent rules during effective lower bound periods



Notes: ELB is the effective lower bound. CPI is consumer price index. Y/Y is year-over-year.

Conclusion

Falling neutral interest rates globally imply that there is less room for central banks to respond to adverse shocks before hitting the ELB and greater probabilities of ELB episodes in future economic downturns. To address the ELB challenge, this note considers two alternative monetary policy frameworks with varying degrees of history dependence: average inflation targeting and an enhanced form of flexible inflation targeting with state-contingent forward guidance.

Under AIT, inflation could temporarily overshoot the target after an ELB episode where inflation remains below the target for a while. The anticipation of the low-for-longer policy rate needed to generate this overshoot provides stimulus when it is most needed during the ELB episode. In contrast, away from the ELB, plausible departures from rational expectations of households and firms can render history-dependent frameworks destabilizing. These practical limitations of AIT motivate us to explore whether the benefits of history dependence could be captured at the ELB within the FIT framework, without adopting an alternative history-dependent framework.

The enhanced framework of FIT with threshold-based forward guidance is shown to deliver results comparable to an optimized AIT. The FIT approach uses the flexibility of the Bank of Canada's current monetary policy framework to provide additional stimulus, without the commitment to make up for past misses of the inflation target. Communicating and exercising such patience would qualitatively mimic some features of AIT. Overall, our analysis shows that providing this type of state-contingent guidance whenever the policy rate reaches the ELB can deliver some of the key benefits of AIT. In particular, such an approach succeeds in keeping average inflation closer to 2% and improving inflation, output and employment outcomes when the ELB is binding. As with AIT, this approach would also result in situations where inflation temporarily overshoots the target after undershooting it for a period. Similarly, this approach yields a relatively higher ELB probability and slightly prolonged ELB durations. The Bank is researching and analyzing how to harness the overall benefit of state-contingent forward guidance with careful consideration of financial stability while also ensuring the successful anchoring of inflation expectations.

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