Monetary Policy and the Zero Bound on Nominal Interest Rates

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- *The recent financial crisis and the ensuing recession brought renewed focus to the issue of monetary policy options when the interest rate is at or near zero.*
- *The objective of this article is to better understand how different types of monetary policy frameworks might help to lower the risk and cost of hitting the zero bound on nominal interest rates.*
- *When the policy interest rate is at or near its zero bound, an important tool for a central bank's stabilization policy is its influence over inflation expectations, and thereby real interest rates.*
- *Inflation targeting is a monetary framework that allows a central bank to influence inflation expectations, but in extreme circumstances, its influence may not be enough to avoid an economic slowdown. Inflation targeting augmented by a conditional commitment to a future course of policy may strengthen the influence of central bank actions on the economy.*
- *Alternatively, a credible price-level-targeting regime can better exploit inflation expectations, reduce the likelihood of hitting the zero bound, and lessen the economic costs of operating at the lower bound, while keeping long-term inflation expectations fixed on a target rate. Moreover, price-level targeting may offer better stabilization properties than an inflation-targeting framework.*

While the zero lower bound (ZLB) on nominal interest rates has always been an issue of underlying importance for monetary policy, its prominence has ebbed and flowed. During the 1990s, when Japan experienced a long period with a policy interest rate near zero, deflation, and weak economic performance, the issue received considerable attention. Based on this work and other experiences with the zero bound, the general view at the Bank of Canada in 2006, when the inflation-control agreement was renewed, was that episodes of operating at the zero bound were probably rare and manageable.[1] The Bank was not alone in this view. In a paper presented at the 2009 Jackson Hole Symposium on Financial Stability and Macroeconomic Policy, Carl Walsh summarized the general view before the crisis as follows, "In fact, most work suggests that the costs of the ZLB are quite small if the central bank enjoys a high level of credibility" (Walsh 2009, 10). The financial crisis of 2008 and its aftermath have brought these tentative conclusions into question.

Indeed, in the aftermath of the financial crisis, the outlook for global economic growth deteriorated significantly, and central banks in many advanced countries lowered their policy interest rates to historic lows. For example, by December 2009, the U.S. federal funds rate sat at 0.12 per cent, while in England, Switzerland, and Japan nominal interest rates were at 0.45, 0.25, and 0.10 per cent, respectively. At the same time, a number of central banks engaged in unconventional monetary policy, such as "credit easing," aimed at reducing risk premiums and improving liquidity and trading activity in financial markets that were temporarily impaired, and "quantitative easing," aimed at lowering longer-term rates on government or private assets and improving the availability of credit

1 This view was supported by several model-based simulation studies, such as Black, Coletti, and Monnier (1998). Other studies can be found in Amirault and O'Reilly (2001).

more generally in the economy.[2] In Canada, the Bank of Canada substantially expanded its short-term lending facilities in order to increase liquidity in the financial system and to support credit flows, and then moved aggressively to lower its overnight target rate, bringing it to 0.25 per cent in April 2009. At that time, the Bank also made a commitment, conditional on the outlook for inflation, to keep the overnight rate at that level until the end of the second quarter of 2010. To buttress its commitment, the Bank expanded the terms of its short-term lending facilities to correspond to the length of its conditional commitment. These events, as well as similar experiences around the world, have renewed the focus on the issue of monetary policy when the interest rate is at or near zero.

The purpose of this article is not to review these recent experiences, but rather to explore how different types of monetary policy frameworks might help central banks to lower the risk of hitting the ZLB on nominal interest rates and to reduce the economic costs of being at the ZLB. The first section presents an analytical framework for thinking about monetary policy and the zero bound on nominal interest rates, as well as the key role of inflation expectations in lowering the real interest rate. The next section discusses the role that different monetary policy frameworks might play in influencing inflation expectations, and in avoiding or minimizing time spent at the zero bound.

Monetary Policy Transmission: From Policy Rates to Real Economic Activity

Discussions regarding the Bank of Canada's monetary policy often centre on the target overnight rate, but it is important to bear in mind that the real interest rate is the key variable influencing the behaviour of households and firms, and thus aggregate demand. The real interest rate is defined as the nominal interest rate less expected inflation. That is,

$$r = R - \pi^e. \tag{1}$$

As an example, if we assume that inflation expectations (π^e) are anchored on a 2 per cent inflation target, and the nominal interest rate is 4 per cent, then the real interest rate is 2 per cent. So, in periods of economic weakness, the central bank could lower its policy interest rate (R) to, say, 2 per cent to induce the real interest rate (r) to fall to zero and thereby encourage economic activity. In extreme circumstances, such as the recent financial crisis, a negative real interest rate might be required to avert an economic slump. The central bank cannot reduce its policy interest rate below zero, however. So, in this example, it is impossible for the central bank to achieve a real interest rate lower than -2 per cent, even though the economic situation may call for a lower real interest rate.[3] In such a situation, the real interest rate is too high, and monetary policy is said to be facing a binding zero constraint on nominal interest rates.

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The savings and investment decisions of households and firms are not based on the real policy interest rate but on broader market interest rates. Examples of these broader rates include those on variable rate mortgages and commercial paper, etc. With some simplification, a representative real market interest rate (i) can be written as:

$$i = (R - \pi^e) + \sigma, \tag{2}$$

where the term σ captures various risk and liquidity premiums that lead to a credit spread between market and policy interest rates. Moreover, households and firms often use multi-period financial instruments, such as fixed-rate mortgages or long-term bonds, to conduct their business. A k-period real market interest rate may be loosely written as:

$$i_t^k = \sum_{j=0}^{k} i_{t+j}^e + \tau, \tag{3}$$

2 There are no universally accepted definitions of credit easing or quantitative easing. The definitions used here are taken from the Bank of Canada's framework for monetary policy at low interest rates (Annex to the April 2009 Bank of Canada *Monetary Policy Report*).

3 In theory, nominal interest rates cannot fall below zero, since rational agents would not purchase an asset yielding a negative nominal return when they could hold currency at a zero rate of return. In practice, however, most central banks have stopped short of lowering policy interest rates to zero in order to preserve the efficient functioning of short-term financial markets. For instance, the Bank of Canada considers that 25 basis points is the effective lower bound for the overnight target rate.

where i_t^k is a k-period real interest rate, i_{t+j}^e is an expected one-period real interest rate j periods in the future, and τ captures the term premium. This equation says that the k-period real interest rate comprises a series of expected one-period interest rates and a term premium, and by using different values of k, the equation traces the term structure of real interest rates. During the financial crisis, the credit spread and term premiums were unusually large, owing to illiquidity in credit markets and a perceived increase in risk.

According to equations (2) and (3), there are three ways to lower real market interest rates when the policy rate is at its lower bound. First, central banks can try to reduce the credit spread. Indeed, in the aftermath of the financial crisis, central banks implemented measures to improve the functioning of financial markets, with the goal of reducing spreads and thereby helping to lower market interest rates. Second, central banks can attempt to lower the term premium. In fact, several central banks undertook "quantitative easing" in an effort to lower the yields on multi-period financial instruments and thus stimulate economic activity. The third channel—and the focus of this *Review* article—is for central banks to attempt to influence the expected path of future interest rates and inflation expectations.

The efficacy of the attempts to reduce credit spreads and lower yields on multi-period financial instruments is currently being debated. Indeed, some academics and central bank economists, such as Eggertsson and Woodford (2003) and Carlstrom and Pescatori (2009), have questioned the relevance of these monetary policy measures when standard monetary policy is able to influence inflation expectations. As with many economic debates, it will take time to fully assess the effectiveness of these unconventional measures, and many open questions remain regarding the costs of exiting from these unconventional policies.

There is, however, little debate that when the policy interest rate is at or near its zero bound, the central bank's influence over inflation expectations is an important tool. How this influence should be used is a critical question for monetary policy, since it may require raising inflation expectations above an inflation objective for a period of time in order to achieve a sufficiently lower real interest rate. In other words, a central bank may need to convince households and firms that it will temporarily exceed its inflation objective but, at the same time, maintain its credibility and commitment to low and stable inflation. In principle, it is possible to raise inflation expectations above the inflation target by clearly communicating future monetary policy actions or "forward guidance" (see Eggertsson and Woodford 2003 and Walsh 2009). In particular, a central bank could commit to maintain a "low" interest rate policy even after rates rise from the zero bound. The commitment to hold the policy rate low for a longer period than under normal economic conditions, would lead to strong economic growth and higher anticipated inflation.[4] In the real world, a number of central banks implemented the idea of forward guidance or conditional commitment but in a different manner. Instead of attempting to raise inflation expectations, central banks sought to lower interest rates further along the yield curve by providing more certainty about policy rates over an extended period, while maintaining inflation expectations firmly anchored at the inflation target. A number of central banks enhanced their communications regarding the future path of the policy interest rate and made conditional commitments to hold the policy interest rates at or near zero over a specified period. For instance, the Bank of Canada, in the statement accompanying its April 2009 fixed announcement date wrote, "Conditional on the outlook for inflation, the target overnight rate can be expected to remain at its current level until the end of the second quarter of 2010 in order to achieve the inflation target." Similarly, the Sveriges Riksbank in their July 2009 *Monetary Policy Report* wrote, "The repo rate is expected to remain at this low level over the coming year."

Central banks sought to lower interest rates further along the yield curve by providing more certainty about policy rates over an extended period, while maintaining inflation expectations firmly anchored at the inflation target.

The preliminary evidence, at least in Canada, has been quite positive, as market participants embodied the conditional commitment on policy interest rates in market interest rates. Indeed, according to empirical work conducted by He (forthcoming), the Bank of

4 The efficacy of these types of forward-guidance measures is still in question. Levin et al. (2009), for example, use results based on a small macroeconomic model to argue that forward guidance alone may not be sufficient in the presence of a large and persistent shock. In contrast, Giannoni (2009) argues that forward guidance is, indeed, effective in his model. In fact, the best possible outcome in the Levin et al. paper can be achieved only with forward guidance.

Canada's conditional commitment appears to have resulted in a persistent lowering of Canadian interest rates since April 2009, relative to what would have been expected without it.

In the remainder of this article, we discuss approaches that may help a monetary authority temporarily raise inflation expectations while maintaining its credibility as an advocate of low inflation.

Monetary Policy at the Zero Bound

Inflation targeting

One way to lower the real interest rate, when one is at or close to the ZLB, might be to raise the target rate of inflation on a *permanent* basis. This may raise inflation expectations and work its way through financial markets via equations (1) to (3). For instance, John Williams (2009) has argued that the U. S. Federal Reserve should increase its implicit inflation objective from the 2 per cent currently viewed by market participants, to something between 2 and 4 per cent to minimize the chances of hitting the ZLB and reducing the economic costs associated with those occasions when it is hit. An IMF staff position paper by Blanchard, Dell'Aricca, and Mauro (2010) seems to support this conclusion, urging more research on the benefits of raising the inflation target from 2 to 4 per cent. In reply, opponents such as Deputy Governor Charles Bean of the Bank of England have written, "This is misguided. Aside from the dubious morality of redistributing wealth from savers to borrowers, we have seen from past experience that a bit of inflation has a nasty habit of turning into a lot of inflation."[5] Bean's warning echoes that of former Bank of Canada Governor John Crow (2009, 12): "I did not think that 4 per cent was a credible goal because I did not think that economic agents would believe that the authorities would stick to a number that promised, essentially, "inflation." That is to say, if 4 was okay, why not 5, why not 6, and so on?"

Rogoff (2008) has suggested that central banks should *temporarily* raise inflation targets in an effort to lower real interest rates and ameliorate debt problems. While an increase in inflation could certainly help to deleverage an economy, it would also entail the cost of undermining public trust by inducing an ad hoc redistribution of wealth from savers to borrowers. Moreover, the credibility of such a policy would always be in question, owing to uncertainty about its temporary status, and this implies that a central bank's ability to influence short-run inflation expectations could be compromised, resulting in less influence over real interest rates.

An inflation anchor is essential, especially when providing extraordinary guidance to markets.

The preceding paragraphs should not be interpreted as an argument against inflation targeting. In fact, a credible inflation target, at a low positive rate, helps to ensure that inflation expectations remain well anchored, allowing for negative real interest rates. As Carney (2009) notes, an inflation anchor is essential, especially when providing extraordinary guidance to markets.[6]

The one disadvantage of inflation targeting at the ZLB is that a period of below-target inflation will be followed by inflation returning to and staying at its target value. That is, the central bank does not attempt to compensate for a period of inflation below the target with a period of above-target inflation. Rational households and firms would, therefore, expect inflation to be below the target in the short run and to be equal to the inflation target in the longer run. The implication of this behaviour is that average inflation expectations would be lower than the inflation target, making it difficult for an inflation-targeting central bank to raise inflation expectations.

Despite this difficulty, some research has found that optimal forms of inflation targeting may be sufficient to avoid the zero bound. Schmitt-Grohé and Uribe (2007) study the zero-bound problem in a medium-scale dynamic stochastic general-equilibrium (DSGE) model with distortionary taxes and three shocks: one to aggregate productivity, one to investment-specific productivity, and one to government spending. Their model is calibrated to U.S. data and shows that under the optimal policy, the probability of the nominal interest rate approaching the zero bound is practically nil. Similarly, Christiano (2004) shows that, in a small macroeconomic model, an implausibly large economic shock is required to bring interest rates close

5 See Bean (2010). Empirical magnitudes of this redistribution effect for Canada can be found in Meh, Ríos-Rull, and Terajima (2010).

6 In cross-country empirical work, de Carvalho Filho (2010) finds that inflation-targeting central banks seem to generate better-anchored inflation expectations, even in the immediate aftermath of a financial crisis.

to zero. All of these studies, however, predate the latest financial crisis.

Recent experience would appear to contradict these predictions: inflation targeting has not been sufficient to avoid the zero bound. One reason may be that the shock was much larger than is considered within the bounds of normal. Amano and Shukayev (2009) propose an alternative explanation. They argue that the addition of a historically measured risk-premium shock to a medium-scale DSGE model specified along similar lines to that in Schmitt-Grohé and Uribe (2007) is sufficient to make the ZLB a binding constraint on monetary policy. In the model, the risk premium is defined as the returns on private assets (which have a time-varying risk component) less those on risk-free government bonds. Intuition for the "special" role of risk-premium shocks can be garnered from the observation that these shocks change the spread between the expected rate of return on capital and the risk-free rate. To accommodate the higher risk premium, this implies that either the expected rate of return on capital must increase, or the risk-free rate must fall, or both. For a wide range of plausible parameter configurations and inflation-targeting rules, Amano and Shukayev find that much of the increase in the risk premium is accommodated by a drop in the risk-free rate, thus increasing the probability of reaching the zero bound.

Price-level targeting

A credible price-level-targeting regime has an important advantage over inflation targeting when the policy interest rate is at or near zero. Unlike inflation targeting, price-level targeting is "history dependent," which means that periods of below-target inflation will be followed by periods of above-target inflation (to return the price level to its target). So, under price-level targeting, long-run inflation expectations will be stable, but short-term inflation expectations will rise or fall, depending on the current position of the price level relative to its target. If prices are currently below their target level, then short-term expectations of inflation will rise above the long-run average inflation rate. Thus, price-level targeting has a built-in mechanism to raise and lower expectations of inflation.

Many researchers, including Coulombe (1998), Duguay (1994), Svensson (2001), Wolman (2005), Amano and Ambler (2010), and Murchison (forthcoming), have noted the benefits of price-level targeting when the policy interest rate is at or near zero. In particular, these authors demonstrate that the ability of price-level targeting to influence inflation expectations via history dependence lowers the risk of reaching the ZLB on nominal interest rates, or at least reduces the economic costs associated with being there. Moreover, as Carney (2009) notes, price-level targeting may offer an additional benefit: since price-level targeting provides clear guidance on the expected price level, it may serve as a better anchor for inflation expectations than an inflation target during a financial crisis. This feature of price-level targeting gives the central bank more latitude to pursue other immediate concerns, such as financial stability, without compromising its monetary policy objective of maintaining price stability.[7] Price-level targeting resolves the inherent uncertainty about how temporary higher inflation would be.

Since price-level targeting provides clear guidance on the expected price level, it may serve as a better anchor for inflation expectations than an inflation target during a financial crisis. It also resolves the inherent uncertainty about how temporary higher inflation would be.

Amano and Ambler (2010) compare inflation targeting and price-level targeting under low trend inflation in a small, calibrated, DSGE model that explicitly takes into account the ZLB. Their conclusions, based on a solution method that allows for the effects of time-varying price dispersion and valid welfare comparisons, are fourfold: (i) Price-level targeting is more effective than inflation targeting in keeping an economy away from the zero bound on nominal interest rates; (ii) An economy under inflation targeting can remain stuck at the lower bound for prolonged periods; (iii) Price-level targeting allows an economy to reap the benefits of lower inflation while avoiding the risks of being stuck at the zero bound; and (iv) Price-level targeting yields a higher level of economic welfare than inflation targeting. While these conclusions are informative, the results do not allow us to draw any quantitative conclusions.

Murchison (forthcoming) examines the ability of inflation targeting and price-level targeting to mitigate the effects of the zero bound on nominal interest rates in ToTEM, a large-scale model of a small open economy

7 This idea is explored in forthcoming work by Christensen, Meh, and Moran.

calibrated to replicate important features of the Canadian economy. As such, this work can offer quantitative insights into the stabilization properties of the two targeting regimes when faced with the zero bound. The simulation results indicate that, relative to a version of the model without the zero bound, economic loss increases by about 2 per cent under an optimized inflation-targeting rule, whereas under an optimized price-level-targeting rule, the increase in loss is less than 1 per cent.[8]

In a recent paper, Coibion, Gorodnichenko, and Wieland (2010) compare inflation and price-level targeting in a New Keynesian model where the effects of trend inflation on the steady-state dynamics and loss function of the model are explicitly modelled. Since the model is micro-founded, it admits a welfare function that allows the authors to engage in normative analysis. The authors report many results, but the most striking is that price-level targeting raises welfare by a non-trivial amount for any steady-state rate of inflation. Moreover, by reducing the variance of inflation and output, price-level targeting lowers the frequency of zero-bound episodes.[9]

An important caveat to the results stated above regarding the apparent efficacy of price-level targeting is the assumption that it is fully credible. If households and firms do not understand the new framework or believe that the central bank will always follow a price-level-targeting rule, then its powerful effect on expectations of inflation will be dampened. To explore the implications of this key assumption, Cateau and Dorich (forthcoming) study a situation where the monetary authority shifts from inflation targeting to price-level targeting when the zero bound is hit. As expected, they find that price-level targeting works well under perfect credibility, but when imperfect credibility is introduced the effectiveness of price-level targeting is reduced. According to their qualitative results, greater degrees of imperfect credibility will increasingly reduce the ability of price-level targeting to help an economy avoid the zero bound on nominal interest rates.

Williams (2006) uses a macroeconomic model where economic agents have imperfect knowledge of their economy (including monetary policy) to study the impact of learning on the effectiveness of price-level targeting at the ZLB. Owing to the absence of complete information, households and firms must continuously re-estimate their forecasting model to form expectations. Williams finds that imperfect knowledge, especially about monetary policy, can undermine the effectiveness of price-level targeting in dealing with the effects of the lower bound. Interestingly, effective communication about monetary policy can reduce the costs associated with being at the zero bound, suggesting that forward guidance may, indeed, be a useful tool for dealing with the lower bound, even if a central bank practices price-level targeting.

Concluding Remarks

The zero bound on nominal interest rates is undeniably a concern for monetary policy-makers, but the problems that it raises are not insurmountable. When the ZLB is a binding constraint, it implies that the real interest rate is "too high." Therefore, creating expectations of higher inflation could be a powerful mechanism for mitigating the effects of the zero bound on an economy. Under inflation targeting, communicating future monetary policy actions, or forward guidance, may be an effective way to raise inflation expectations. Alternatively, research has shown that a credible price-level-targeting framework can reduce the likelihood of reaching the ZLB and lessen the costs of operating at the lower bound on an economy. Moreover, price-level targeting may help a central bank to address a financial-stability concern while keeping expectations of inflation anchored on its long-run objective. For price-level targeting to admit these benefits, the assumption of credibility is crucial: with diminished credibility, the effectiveness of price-level targeting in offsetting the effects of the zero bound falls. Clear central bank communication about monetary policy, however, may help to overcome the reduced effectiveness of price-level targeting arising from imperfect credibility or imperfect knowledge of the economy.

8 Economic loss is calculated as the sum of the variance of inflation and the variance of the output gap, multiplied by half the variance of the change in the policy interest rate.

9 In addition, Coibion, Gorodnichenko, and Wieland find that price-level targeting also leads to a lower level of optimal inflation relative to inflation targeting.

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