# The Zero Bound on Nominal Interest Rates: Implications for Monetary Policy

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- *The lower bound on nominal interest rates is typically close to zero, since households can earn a zero rate of return by holding bank notes.*
- *The average inflation rate, the size of the shocks hitting an economy, the formation of inflation expectations, and the conduct of monetary policy itself all influence the risk of hitting the zero bound. The balance of evidence suggests a small risk of encountering the zero bound when average inflation is at least 2 per cent.*
- *Central banks considering an inflation target much below 2 per cent must factor in possible difficulties that the zero bound on nominal interest rates might present for the conduct of monetary policy.*

Price stability is generally viewed among both academics and practitioners as the most appropriate long-run objective for monetary policy. In Canada, the benefits of low, stable, and predictable inflation are clear. Since the Bank of Canada adopted an explicit inflation target in 1991, both the level and volatility of short- and long-maturity interest rates have declined. In addition, real growth has been higher and more stable than in previous decades (Longworth 2002). Monetary policy aimed at achieving low and stable inflation, in conjunction with sound fiscal policy, has resulted in a stronger, more resilient economy that is better equipped to weather shocks.

Canada's strong economic performance since the adoption of a 2 per cent inflation target raises the question of whether the Bank of Canada should lower the target further. Even when measurement error is factored into the consumer price index (CPI) (see Rossiter 2005), 2 per cent inflation does not correspond to true price stability. Targeting a rate of inflation closer to zero may further reduce resource misallocations resulting from inflation uncertainty and reduce the frequency of price changes, thereby lowering menu costs.[1] In addition to the possible transition costs associated with a reduction in the target, however, two main arguments have traditionally been advanced against the idea of targeting a very low rate of inflation. The first stems from the concern that it may be more difficult to adjust real wages downwards when inflation is low because this would also entail a

1. Interpreted literally, the term menu costs refers to the costs associated with having to reprint menus each time a restaurant updates its prices. The term is typically used more broadly to describe costs associated with changing prices in general.

reduction in the nominal wage, and workers may be reluctant to accept such reductions (Akerlof, Dickens, and Perry 1996; Fortin 1996; and Fortin et al. 2002).[2] The second argument is that central banks could encounter difficulties conducting monetary policy in a very low-inflation environment because nominal interest rates cannot go below zero (Summers 1991).

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Recent experience in Japan, in which nominal short-term interest rates remained close to zero for more than seven years and real annual growth in gross domestic product (GDP) averaged just 1.7 per cent over the same period, suggests that the zero interest rate bound remains a significant and relevant practical issue for monetary policy.

In this article, we examine the impact of the zero bound on nominal interest rates, the likelihood that the constraint will bind, the ways that monetary policy can reduce this likelihood, and alternative policies to stimulate the economy when the zero bound binds. We begin by reviewing the underlying mechanism of the zero-bound problem and then assess the risk of hitting the zero bound, including the potential implications. In the following section, we review the main factors that influence this risk, with special emphasis on the role played by monetary policy design. We then discuss some policy alternatives that are available to the central bank for stimulating the economy when interest rates are stuck at zero. In the final section, we draw some conclusions on the general implications of the zero bound for monetary policy in Canada.

## Why Are Nominal Interest Rates Bounded at Zero?

Central banks typically implement monetary policy by adjusting a very short-term nominal or "money" interest rate, such as the overnight rate in Canada. The nominal interest rate on an asset refers to the rate of return expressed in money terms, so a one-year, $100 bond with a rate of 6 per cent will pay the holder $106 at maturity. But in an economy with positive inflation, the purchasing power of money will decline over the course of that one-year period. The actual increase in the purchasing power of goods and services associated with the bond is referred to as the real interest rate. This relationship is summarized by the Fisher identity: The real interest rate is equal to the nominal interest rate minus the expected inflation rate:

Real Rate = Nominal Rate - Expected Inflation

Since households in the economy derive utility from the purchases of goods and services, it is the real rate of interest that is most relevant to their economic decisions. Therefore, monetary policy actions will influence demand only to the extent that adjustments to the nominal interest rate feed through to the real interest rate. In the case of an inflation-targeting central bank like the Bank of Canada, the task of monetary policy is to reduce real short-term interest rates when economic events, or shocks, occur that cause inflation to fall below the target and, symmetrically, to raise real interest rates when shocks cause inflation to go above the target.

This suggests that the normal conduct of monetary policy involves a degree of variation in the level of short-term interest rates over a business cycle. Of course, the larger the shock, all else being equal, the larger will be the adjustment to interest rates that is required to return output to potential and inflation to the target over a reasonable time horizon. In response to a significant deterioration in economic conditions, a deep recession, for example, the central bank may wish to lower the nominal interest rate below zero. Since households can always earn a zero rate of return by holding bank notes, however, no rational person would willingly agree to purchase a security yielding a negative nominal return. In practice, therefore, the lower bound on nominal interest rates is typically very close to zero,[3] and this bound may prevent a central bank from reducing the real interest rate sufficiently to return the economy to its potential level over the desired time horizon.[4]

2. Crawford and Wright (2001) argue that while downward nominal wage rigidities exist, the magnitude of their real effects is extremely small.

3. Technically, the lower bound would literally be zero only in a world where there are no costs to holding cash. As discussed in Yates (2004), to the extent that there are variable costs associated with holding money, such as monitoring and storage costs, then the lower bound on nominal interest rates would be slightly negative.

4. For a comprehensive review of the literature on the zero bound on nominal interest rates, see Yates (2004) and Amirault and O'Reilly (2001).

Whether the zero bound causes significant short-run damage to an economy will depend on what happens once interest rates reach zero. In a benign scenario, with no further negative shocks, low real interest rates may gradually return output to potential and inflation to the target, albeit more slowly than desired. Suppose, instead, that a significant negative shock to demand hits the economy, and the central bank finds itself unable to further reduce real interest rates. Recalling the Fisher identity, if the nominal rate is stuck at zero, any shock that lowers inflation expectations will raise the real interest rate. A deflationary spiral occurs when high real interest rates depress demand, which further reduces inflation expectations, and so on. The result can be a long period of weak demand growth and deflation.

## Historical Estimates of the Risk of Hitting the Zero Bound

While there is no debating the existence of a lower bound on nominal interest rates, its relevance to policymakers depends entirely on the probability that it will limit the central bank's ability to reduce real interest rates. Owing to limited historical experience with interest rates close to the zero bound, probability estimates are typically computed via simulations with economic models.

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Results for Canada are reported by Lavoie and Pioro (2007); Babineau, Lavoie, and Moreau (2001); Black, Coletti, and Monnier (1998); and Cozier and Lavoie (1994). For an average inflation rate of 2 per cent and an average real interest rate of 3 per cent, probability estimates of the nominal interest rate equalling zero range from about 1 per cent to 4 per cent. In addition, Lavoie and Pioro (2007) report that, with an inflation target of 2 per cent, the probability of falling into a deflationary spiral is effectively zero (see Table 1). As we discuss in the next section, these probabilities depend importantly on a number of factors, including the average rate of inflation in the economy. Therefore, for a central bank considering an inflation target that is significantly lower than 2 per cent, the threat of the zero bound cannot be ignored.

## Factors That Influence the Risk of Hitting the Zero Bound

The factors affecting the probability of hitting the zero bound can be divided into two categories: those that influence the mean, or average, level of the interest rate and those that affect its volatility, or variation, around that mean. As we discuss in detail below, the conduct of monetary policy in general can have an important bearing on both the mean and the variance of nominal interest rates.

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Beginning with the first set of factors, the Fisher identity discussed in the previous section stipulates that the average nominal interest rate over a given period of time is equal to the average real interest rate plus the average expected inflation rate, where the latter should be approximately equal to the inflation target, provided the target is viewed as credible. The lower the inflation target, the lower will be the nominal interest rate, on average, and the higher will be the likelihood that the zero bound is encountered. Lavoie and Pioro (2007) estimate that targeting zero, rather than 2 per cent, inflation would increase the likelihood of hitting the zero bound approximately threefold, from 3.8 to 12.1 per cent (see Table 1). Moreover, not only does the likelihood increase as the inflation target is reduced, but it increases at an increasing rate, meaning that the

**Table 1**

**Performance of Various Policy Rules under Inflation Targeting**

| Average (targeted) inflation rate | Degree of history-dependence | Probability of hitting zero bound | Probability of deflationary spiral |
|---|---|---|---|
| 2 per cent | Low | 17.0 | 0.0 |
| | High | 3.8 | 0.0 |
| 0 per cent | Low | 35.4 | 0.2 |
| | High | 12.1 | 0.2 |

Note: Results taken from Lavoie and Pioro (2007)

relationship is non-linear. Consequently, the constraint created by the zero bound on nominal interest rates has been used as an argument against targeting a very low level of inflation, typically below 1 or 2 per cent.

The second set of factors that are important for determining the probability of hitting the zero bound are those that affect the variability of short-term nominal interest rates. As discussed in the previous section, central banks adjust short-term interest rates in an effort to achieve their target(s) in response to unexpected economic developments or shocks. Therefore, the degree of variation in short-term nominal interest rates generated by monetary policy actions will depend on the variability of the shocks faced by the economy. All else being equal, the higher the variance of shocks, the more volatility is required in interest rates in order to achieve the target.

While the variance of economic shocks is clearly an important determinant of interest rate volatility, it is not the sole factor. The manner in which private sector expectations are formed, coupled with the means by which monetary policy actions are implemented and communicated, can have a significant influence on the variability of short-term interest rates for a given variance of shocks and the central bank's objective.

Central banks have direct control over a very short-term nominal rate, such as the overnight rate, whereas it is the market-determined real interest rate across the yield curve that is most relevant to aggregate demand and inflation. The impact on the economy of a given change in the nominal short rate will depend, therefore, on the extent to which it is reflected in longer-maturity real rates. Thus, for a given maturity, the Fisher identity indicates that the response of the real rate can be greater than, equal to, or less than the change in the nominal rate, depending on whether inflation expectations rise, remain the same, or decline in response to the change.

The link between short- and long-maturity interest rates is provided by what is commonly referred to as the expectations theory of the term structure. This theory posits that, in the absence of uncertainty, the current rate of return on an *n*-period bond should equal the average expected rate of return on one-period bonds over the next *n* periods, provided the bonds are equivalent in every other respect.[5] Therefore, according to the expectations theory of the term structure, the response of longer-maturity interest rates to a change in monetary policy will depend on how long the change is expected to last. All else being equal, movements in short-term interest rates that are perceived by the market to be long lasting will exert a greater influence on longer-term nominal rates.

When we combine the Fisher identity with the expectations theory of the term structure, we see that, for a given reduction in the policy interest rate, longer-maturity real interest rates will decline by more if the reduction is perceived to be long lasting and if inflation expectations rise. From the point of view of a central bank wishing to avoid the zero bound, this is the best-case scenario, since even a small reduction in the nominal interest rate can be highly stimulative to the economy.

*Central banks seeking to minimize the probability of encountering the zero bound should credibly commit to a history-dependent monetary policy.*

On the basis of this reasoning, Woodford (1999) argues that central banks seeking to minimize the probability of encountering the zero bound should credibly commit to a history-dependent monetary policy, i.e., the central bank must convince the public that interest rate reductions implemented today will remain in place well into the future. In other words, the current level of the short-term policy interest rate will be highly correlated with its level in previous periods. Clearly, this will act to lower longer-maturity nominal interest rates through the expectations theory of the term structure. Provided that private sector inflation expectations are forward looking in nature,[6] however, such a history-dependent policy will also act to raise longer-term inflation expectations, thereby further reducing the real interest rate. The reasoning is straightforward: Interest rate cuts that are viewed as long lasting will be more stimulative to the economy and will therefore raise expectations of future inflation more than cuts that are perceived as highly transitory.

5. The assumption of no uncertainty is somewhat unrealistic, but does not alter the fundamental point that changes in longer-term interest rates tend to reflect expected changes in short-term rates over the same horizon. In reality, longer-maturity instruments tend to incorporate a term premium.

6. Inflation expectations are said to be forward looking if they are based on a particular view of the future state of the economy, such as the future level of demand relative to long-run supply. This contrasts with adaptive expectations, whereby agents base their view of future inflation on the level of inflation over the recent past.

In the context of policies that are set according to a mathematical rule, a simple strategy for incorporating history-dependence is to set the current level of the short-term interest rate partly as a function of its lagged value. For instance, the famous Taylor rule (1993), which posits that interest rates respond to the current level of inflation (relative to the target) and the current level of output relative to potential output, can be modified to permit a role for the lagged interest rate, thereby introducing additional inertia. Using the Terms-of-Trade Economic Model (ToTEM), Lavoie and Pioro (2007) show that increasing the weight on the lagged interest rate from 0.3 to 0.8 reduces the probability of encountering the zero bound on nominal interest rates from 17 per cent to less than 4 per cent when the average inflation rate is 2 per cent (see Table 1), a significant decline.

To summarize, if expectations are forward looking, then a central bank that can credibly commit to history-dependence can effectively trade off the average size of interest rate changes against the duration of the change. This will reduce the volatility of short-term nominal interest rates and reduce the probability of hitting the zero bound. An oft-cited example of such central bank communications is the statement by the Federal Reserve in 2003 that, "In these circumstances, the Committee believes that policy accommodation can be maintained for a considerable period" (FOMC 2003). Of course, the extent to which such statements influence private sector expectations will depend critically on their perceived credibility.

One special case of a history-dependent monetary policy is a price-level target (Woodford 1999; Eggertsson and Woodford 2003). Unlike an inflation target, where the central bank sets monetary policy to return the rate of change in the price level to some pre-specified level, a price-level target involves returning the price level itself to either a fixed level or a time-varying path. Under inflation targeting, bygones are bygones in the sense that the central bank makes no explicit attempt to make up for past deviations of inflation from the target.

To see why the distinction is important for the issue of the zero bound, consider a situation in which the central bank targets 2 per cent inflation but, because of weak demand, current inflation is below the target. If the central bank's inflation target is credible, agents' medium-term inflation expectations will be about 2 per cent, since they believe that the central bank will take whatever actions are necessary to achieve their target. Now consider the same situation, but instead of the central bank targeting 2 per cent inflation, they target a price level that increases by 2 per cent each year. With inflation currently below 2 per cent, the price level will fall below the desired level. Consequently, to return the price level to its targeted path, the central bank will have to allow inflation to exceed 2 per cent for a period of time. If this policy is viewed as credible by the public, medium-term inflation expectations will be higher under a price-level target than under an inflation target, meaning that the real interest rate will decline by more. In this sense, the adoption of a price-level target represents a commitment to a policy of history-dependence.

The above discussion suggests that adopting a target path for the price level can effectively allow the central bank to achieve a lower average rate of inflation in the economy without increasing the likelihood of encountering the zero bound on nominal interest rates. Using a small, forward-looking New Keynesian model, Wolman (1998) demonstrates that the optimal rate of inflation is very low, even when an explicit account of the implications of the zero bound is factored in. Wolman finds that when a policy of targeting the price level is followed and inflation expectations are forward looking, the constraint on nominal interest rates imposes essentially no constraint on real interest rates. Similarly, Wolman (2005) shows that price-level targeting combined with forward-looking price-setting behaviour implies that the real implications of the zero bound for monetary policy are very small.

*Adopting a target path for the price level can allow the central bank to achieve a lower average rate of inflation without increasing the likelihood of encountering the zero bound.*

It has also been shown that taking pre-emptive actions to prevent the zero-bound constraint from binding will also limit its implications. Results from Lavoie and Pioro (2007) and Kato and Nishiyama (2005) suggest that central banks should implement a more aggressive interest rate response when expected inflation falls below its desired level and the nominal interest rate approaches the zero lower bound.

To summarize, for a given variance of economic shocks, there is a higher likelihood that, in a very low inflation

environment, the zero-bound constraint will restrict the ability of policy-makers to respond to changes in output and inflation. Taken in isolation, this would suggest that a lower average level of inflation would lead to more frequent and deeper periods of weak economic activity.[7] Central banks can reduce the incidence of the constraint on the zero bound, however, by credibly committing to a monetary policy that is highly inertial or history-dependent, meaning that policy changes tend to be very long lasting. When inflation expectations are highly forward looking and monetary policy is regarded as credible, central banks can exploit the expectations channel as a means of stabilizing the economy without inducing additional volatility in short-term interest rates. One special case of a history-dependent monetary policy is a commitment by the central bank to a target for the path of the price level. Recent research suggests that very low average rates of inflation can be achieved without significant distortions arising from the zero-bound constraint when such a policy is adopted.

## Policy Options at the Zero Bound

There are various alternatives to stabilize output and inflation when the interest rate reaches zero and the standard policy tool (lowering the policy interest rate) is no longer available. Alternatives to the interest rate channel suggested in the literature can be divided into three groups: increasing liquidity, affecting expectations, and taxing currency holdings.

Even when the interest rate is zero, central banks can continue to increase the monetary base and liquidity in the economy, using one of several possible mechanisms. First, the central bank could print money to finance tax cuts or additional government spending (Feldstein 2002). With a tax cut, the impact on aggregate demand and inflation expectations will depend on the proportion of the tax cut that is saved. If consumers believe that the policy change is temporary, or will be reversed at some point in the future (Goodfriend 2000), the impact on private consumption might be quite small.[8] In addition, adjusting tax and spending instruments takes time and may not be an effective way to quickly counteract the zero bound in the very short run.

A second possibility would be for the central bank to purchase long-term bonds or private equities, which would lead to a reduction in the liquidity premium embodied in longer-maturity interest rates. Third, the central bank could buy foreign currency assets. This will cause a depreciation of the domestic currency, which will stimulate the economy (Bernanke 2000; Meltzer 2001). A devaluation of the currency may not be possible, however, if the home country's major trading partners are also confronted with the zero-bound problem and attempt to follow the same strategy.

The second group of policy alternatives attempts to influence real interest rates through inflation expectations. A price-level target or a high inflation policy could then be announced when the zero bound is hit. However, a promise to target a higher inflation rate or to bring the price level back to its targeted level will not affect expectations if private sector agents doubt the central bank's ability, when constrained by the zero bound, to deliver on that promise. Similarly, a high-inflation policy may not affect expectations if agents believe that the monetary authority will return to a low-inflation regime once the constraint created by the zero bound no longer binds. In other words, the public may believe that the central bank will eventually renege on its promise of higher inflation once the benefits have been fully realized.

The announcement of a commitment to higher inflation may thus need to be accompanied by actions that support it. For example, Svensson (2001) proposes establishing, for a period of time, a target path for the price level that corresponds to positive inflation (inflation expectations) and is reinforced by an announced devaluation of the currency.

The final alternative to be considered is a tax on currency holdings (Gesell 1934; Keynes 1936; Buiter and Panigirtzoglou 2001; and Goodfriend 2000). The zero bound on short-term interest rates exists because people have the option of holding cash, which bears a zero nominal rate of return. Any means by which this rate of return can be lowered below zero will correspondingly lower the effective floor on nominal interest rates. One possibility would be to tax cash. This policy could potentially have large social costs, however, and its success would depend on the feasibility of enforcement.

## Conclusion

The consensus in the literature is that the risk of encountering the zero lower bound on nominal interest rates is small at an average rate of inflation of 2 per cent or higher, but increases quickly as average inflation falls below 2 per cent. The size of the shocks hitting the economy, the way in which inflation expectations are

7. This statement ignores any potential benefits of lower average inflation.

8. Expanding the monetary base proved largely ineffective in Japan during the period when nominal interest rates were close to zero.

formed, and the manner in which monetary policy actions are implemented and communicated are all critical factors in the calculation of the risks.

Probability estimates based on variances from historical data may be misleading. There is a vast and interesting literature documenting a reduction in the variance of inflation and output growth in Canada and many other countries over the past two decades or so, the so-called "great moderation." Although the exact cause of this decline is still not known with certainty, it may mean that the risk of hitting the zero bound is lower than reported in the literature. At the same time, as noted in Yates (2004), if we are uncertain about the probability of hitting the zero bound, it may be prudent to assume that our estimates of that probability are too small, rather than too large.

The implications of the zero bound are also lower when monetary policy is credible and expectations are well anchored. The adoption of a regime that targeted price levels could further minimize the risk of hitting the zero bound, but it does not provide a foolproof means of escaping it. In the end, without a perfect alternative to the interest rate channel, central banks choosing an inflation objective must weigh the costs generated by greater output and inflation variability if the zero bound binds vs. the benefits of lower average inflation. The policy choice should thus depend on a careful analysis of these costs and benefits based on the social preferences associated with them.

## Literature Cited


Akerlof, G. A., W. T. Dickens, and G. L. Perry. 1996. "The Macroeconomics of Low Inflation." *Brookings Papers on Economic Activity* 1: 1–59.

Amirault, D. and B. O'Reilly. 2001. "The Zero Bound on Nominal Interest Rates: How Important Is It?" Bank of Canada Working Paper No. 2001-06.

Babineau, B., C. Lavoie, and N. Moreau. 2001. "Risques et conséquences d'atteindre la borne inférieure du taux d'intérêt nominal de court terme." Department of Finance Working Paper No. 2001–22.

Bernanke, B. S. 2000. "Japanese Monetary Policy: A Case of Self-Induced Paralysis?" In *Japan's Financial Crisis and Its Parallels to US Experience*, 149–66, edited by R. Mikitani and A. S. Posen. Special Report 13. Washington, D.C.: Institute for International Economics.

Black, R., D. Coletti, and S. Monnier. 1998. "On the Costs and Benefits of Price Stability." In *Price Stability, Inflation Targets, and Monetary Policy*, 303–42. Proceedings of a conference held by the Bank of Canada, May 1997. Ottawa: Bank of Canada.

Buiter, W. H. and N. Panigirtzoglou. 2001. "Liquidity Traps: How to Avoid Them and How to Escape Them." In *Reflections on Economics and Econometrics: Essays in Honour of Martin M. G. Fase*, 13–58, edited by W. F. V. Vanthoor and J. Mooij. De Nederlandsche Bank NV.

Cozier, B. and C. Lavoie. 1994. "Is There a Floor to Nominal Interest Rates? Evidence and Implications for the Conduct of Monetary Policy." Paper presented at Canadian Economics Association Meeting, University of Calgary, June.

Crawford, A. and G. Wright. 2001. "Downward Nominal-Wage Rigidity: Micro Evidence from Tobit Models." Bank of Canada Working Paper No. 2001-7.

Eggertsson, G. B. and M. Woodford. 2003. "The Zero Bound on Interest Rates and Optimal Monetary Policy." *Brookings Papers on Economic Activity* 1: 139–211.

Federal Open Market Committee (FOMC). 2003. "Statement." 16 September. Available at <http://www.federalreserve.gov/boarddocs/press/monetary/2003/20030916>.

Feldstein, M. 2002. "The Role for Discretionary Fiscal Policy in a Low Interest Rate Environment." National Bureau of Economic Research (NBER) Working Paper No. 9203.

Fortin, P. 1996. "The Great Canadian Slump." *Canadian Journal of Economics* 29 (4): 761–87.

Fortin, P., G. A. Akerlof, W. T. Dickens, and G. L. Perry. 2002. "Inflation and Unemployment in the U.S. and Canada: A Common Framework." Département des sciences économiques, Université du Québec à Montréal Working Paper No. 20-16.

## Literature Cited (cont'd)


Gesell, S. 1934. *The Natural Economic Order: A Plan to Secure an Uninterrupted Exchange of the Products of Labor, Free from Bureaucratic Interference, Usury and Exploitation* [1929]. Translated from the 6th German edition by P. Pye. San Antonio, TX: Free-Economy Publishing Co.

Goodfriend, M. 2000. "Overcoming the Zero Bound on Interest Rate Policy." *Journal of Money, Credit and Banking* 32 (4): 1007–35.

Kato, R. and S.-I. Nishiyama. 2005. "Optimal Monetary Policy When Interest Rates Are Bounded at Zero." *Journal of Economic Dynamics and Control* 29 (1–2): 97–133.

Keynes, J. M. 1936. *The General Theory of Employment, Interest and Money.* London: Macmillan.

Lavoie, C. and H. Pioro. 2007. "The Zero Bound on Nominal Interest Rates: Implications for the Optimal Monetary Policy in Canada." Bank of Canada Discussion Paper No. 2007-1.

Longworth, D. 2002. "Inflation and the Macroeconomy: Changes from the 1980s to the 1990s." *Bank of Canada Review* (Spring): 3–18.

Meltzer, A. H. 2001. "Monetary Transmission at Low Inflation: Some Clues from Japan in the 1990s." *Monetary and Economic Studies* 19 (S-1): 13–34.

Rossiter, J. 2005. "Measurment Bias in the Canadian Consumer Price Index." Bank of Canada Working Paper No. 2005-39.

Summers, L. 1991. "How Should Long-Term Monetary Policy Be Determined?" *Journal of Money, Credit and Banking* 23 (3): 625–31.

Svensson, L. E. O. 2001. "The Zero Bound in an Open Economy: A Foolproof Way of Escaping from a Liquidity Trap." *Monetary and Economic Studies* 19 (S-1): 277–312.

Taylor, J. B. 1993. "Discretion versus Policy Rules in Practice." *Carnegie-Rochester Conference Series on Public Policy* 39: 195–214.

Wolman, A. 1998. "Staggered Price Setting and the Zero Bound on Nominal Interest Rates." Federal Reserve Bank of Richmond *Economic Quarterly* 84: 1–22.

——. 2005. "Real Implications of the Zero Bound on Nominal Interest Rates." *Journal of Money, Credit and Banking* 37 (2): 273–96.

Woodford, M. 1999. "Commentary: How Should Monetary Policy Be Conducted in an Era of Price Stability?" In *New Challenges for Monetary Policy,* 277–316. Proceedings of a symposium sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, 26–28 August.

Yates, T. 2004. "Monetary Policy and the Zero Bound to Interest Rates: A Review." *Journal of Economic Surveys* 18 (3): 427–81.