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Abstract

This paper surveys the literature on the zero bound on the nominal interest rate. It addresses questions ranging from the conditions under which the zero bound on the nominal interest rate might occur to policy options to avoid or use to exit from such a situation. We discuss literature that examines historical and country evidence, and literature that uses models to generate evidence on this question. There seems to be a consensus that the probability of encountering the zero bound is relatively low, especially if the inflation target established for the monetary authority is 2 per cent or more. There is some indication in the model work that the likelihood of encountering the zero bound increases at an increasing rate for lower inflation targets. Various caveats apply to drawing conclusions for Canada from the papers we surveyed, among them the paucity of historical experience where a zero bound has occurred, the risk of making inferences using data (or parameters) from different monetary regimes, the relatively few studies using Canadian data, and the weight to give to credibility.

JEL classification: E31, E52, E58, E61
Bank classification: Inflation targets; Monetary policy transmission; Credibility

Résumé

Les auteurs font un survol de la littérature consacrée au plancher limitant le taux d'intérêt nominal à zéro. Les questions sur lesquelles ils se penchent vont des conditions dans lesquelles le taux nominal peut tomber à zéro aux mesures à envisager pour prévenir un scénario de ce genre ou faire remonter le taux au-dessus de zéro le cas échéant. Les auteurs passent en revue les résultats présentés jusqu'ici pour divers pays et différentes périodes ainsi que les études des chercheurs qui se servent de modèles dans un cadre de simulation pour étudier la question. On semble s'entendre sur le fait que la probabilité que le taux nominal se heurte à la valeur plancher de zéro est relativement faible, surtout si la cible établie par les autorités monétaires en matière d'inflation est d'au moins 2 %. Les analyses fondées sur l'utilisation de modèles indiquent que cette probabilité augmente à un rythme croissant lorsque la cible d'inflation diminue. Un certain nombre de mises en garde s'imposent au sujet des conclusions à tirer de ces travaux en ce qui concerne le Canada, vu le petit nombre de cas où le taux nominal est descendu à zéro dans le passé, les dangers que présente l'emploi de données (ou de paramètres) dérivant de différents régimes monétaires, le peu d'études qui mettent à contribution des données canadiennes et le rôle incertain de la crédibilité.

Classification JEL : E31, E52, E58, E61
Classification de la Banque : Cibles en matière d'inflation; Transmission de la politique monétaire; Crédibilité

1. Introduction

With many countries experiencing low rates of inflation in the last few years, and more and more of those countries adopting explicit low-inflation targets, there has been increased focus by policy-makers and researchers on the question of the optimal rate of inflation. Friedman (1969) proposed that the optimal inflation rate should be the negative of the real interest rate so that, via the Fisher equation, the nominal interest rate would be zero and real cash balances would be held at zero marginal cost. More recently, researchers (a well-known example is Summers 1991) have suggested that target inflation should be positive to allow for such real-world problems as nominal wage rigidities; the potential ineffectiveness of monetary policy for stabilization purposes, given that the nominal interest rate is bounded at zero; and positive biases in the measurement of inflation.

This paper focuses on the implications for monetary policy of the zero bound on the nominal interest rate. We survey the recent, growing literature on the various aspects of this question, and assess it critically. Section 2 provides a simple statement of why a zero bound for nominal interest rates exists and what it might mean for monetary policy. Sections 3 and 4 review selected literature to see what evidence, both from historical experience and from model-based analysis, is provided for the possibility of a zero bound emerging. The implications of this literature for the choice of an inflation target are presented and critiqued. Sections 5 and 6 consider how monetary policy can contribute to moderating or offsetting the constraining effects of a zero nominal bound. Section 7 reviews the literature on experiences in other times and other places in the context of the earlier material for further lessons. Section 8 presents some conclusions.

2. Why is there a Zero Bound and What does it Mean?

The easiest way to see why a zero bound exists for the nominal interest rate is to note that money has a sure pecuniary rate of return of zero (abstracting from such things as insurance costs, storage costs, and taxes) and a non-pecuniary return, particularly in its roles as a unit of account and medium of exchange, higher than that on other financial assets.[1] If the market-clearing rate of interest for a close, but not perfect, substitute for money is negative, it is obvious that an agent can maximize returns by holding onto money at a zero interest rate rather than by using it to buy a close substitute at a negative rate of interest.

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1. Goodfriend (2000), among others, notes that since “the inconvenience and physical costs of storing currency are not literally zero at the margin, nominal interest rates can be slightly negative” (p.1, footnote 3).

While the monetary policy transmission mechanism is complex, the mainstream paradigm for Canada is quite explicit and is broadly similar to that for a number of other countries. The first of three major linkages is from the Bank of Canada's instrument, the target band for the overnight (or one-day) interest rate, to other financial variables: the term structure of market interest rates, rates on deposits and loans at financial institutions (so-called "administered rates"), and the exchange rate. The second runs from financial variables to aggregate demand and the output gap. The third runs from the output gap, the exchange rate, and inflation expectations to inflation.

In the context of this transmission mechanism, it is possible to see that the existence of a zero bound on the nominal interest rate could limit the extent to which monetary policy can support or stimulate aggregate demand. This is because the existence of a zero bound places a floor under the real interest rate that will be higher given a lower rate of inflation. Of course, a number of other factors complicate the story, such as a time-varying risk premium between the policy rate and other interest rates, and the role of the level of the equilibrium real interest rate. If monetary policy is constrained in this way, the ultimate result would be an average level of output that is lower than it otherwise would be.

An extreme implication of the zero bound on nominal interest rates is that the economy could enter a liquidity trap. "In a liquidity trap, the economy is satiated with liquidity and the nominal interest rate is zero. By the Fisher equation, expected inflation equals the nominal interest rate minus the real interest rate. If the nominal rate is zero, expected inflation then equals the negative of the real interest rate. If the real interest rate is positive, we have expected deflation. In a steady state, actual deflation and expected deflation coincide. Thus, by a liquidity trap, I mean a situation with zero interest rates, persistent deflation and persistent deflation expectations" (Svensson 2000, p. 27).[2]

3. What is the Possibility of a Zero Bound Occurring?

The importance of the zero bound on nominal interest rates as a constraint on monetary policy depends on such factors as the nature, frequency, severity, and duration of the shocks to which the economy is exposed. The mix of these features will obviously vary across time and across countries, and is likely to be influenced by the monetary (and fiscal) policy regime in place. To the

2. While the evidence of a zero lower bound will be discussed more below, it is generally acknowledged that it is very rare for a liquidity trap to provide a practical constraint on monetary policy. The International Monetary Fund (1998, Box 4.1, footnote 1) gives the United States in the 1930s and Switzerland in the late 1970s as examples. Krugman (1998) argues that Japan is in a liquidity trap at present. At least some monetarists (for example, Allan Meltzer) would claim that a liquidity trap cannot exist.

extent that the shocks and the monetary (and fiscal) regime are different from those from episodes in history or in other countries, inferences on the basis of evidence drawn from these episodes can only be made with caution. For evidence from model simulations, the second type of evidence reviewed in this section, the monetary policy regime can be imposed and a representative set of shocks used. One apparent shortcoming here is that models must have values for parameters, including estimates of the long-run real interest rate, and these usually come from history, as do the representative shocks, thereby making them potentially subject to the Lucas critique. Emphasis should be given to results that are robust across models, parameterizations, and shocks.

On these points, evidence for both the United States and for Canada suggests that there have been recent breaks in the variability of output and/or inflation (for the United States see McConnell and Perez Quiros 2000, Nelson 2000, Watson 2000, and Taylor 2000b; for Canada see Debs 2001, and Crawford and Kasumovich 1996). With respect to basing the long-run real interest rate on an historical average, an obvious issue is whether the 1970s should be included, since the low ex post real rate most likely resulted from inflation being greater than expected by either economic agents or the monetary authority. Section 3.1 reviews the evidence from episodes, and the interpretations given to them, presented in representative papers from the literature, and section 3.2 does the same for the model-based analysis.

3.1 What historical data have researchers considered?

Plots of historical data for particular countries are interpreted by Clouse et al. (2000), Cozier and Lavoie (1994), the International Monetary Fund (1999), Johnson, Small, and Tryon (1999), Konieczny (1994), and Summers (1991 and 1996). Given the widespread use of the phrase the “Summers effect” to describe why a positive inflation rate might be preferred, it seems reasonable to begin with Summers (1991).

Summers (1991) notes that ex post real interest rates in the United States have been negative in about one-third of the years since World War II and the real after-tax rate at which corporations can borrow has been negative in about three-quarters of the years since World War II. He interprets this evidence to mean that it would be helpful for the monetary authority to at least have the option of generating negative real interest rates to stimulate the economy. As a result, he concludes that it would be useful to have a positive rate of inflation. Summers makes no distinction in his discussion between ex ante and ex post real interest rates, short and long real rates, and their relative importance for economic activity, or the role of the level of the relevant equilibrium real interest rate.[3]

3. To obtain a series of ex post (ex ante) real interest rates, actual (expected) inflation over the appropriate horizon is used to adjust the relevant nominal interest rate.

Konieczny (1994) examines both ex ante and ex post real interest rates for Canada, before and after tax, for a range of savings instruments. Data for the ex ante rates are examined for the period 1975–92 and for ex post rates for the period 1961–92. Konieczny states that while the real interest rate on liquid funds (chequable savings accounts) is systematically negative, interest rates on accounts with limited liquidity are rarely negative. The latter observation pertains to accounts that are illiquid (long-term deposits) and accounts with substantial liquidity (non-chequable savings deposits). He argues that the period of negative rates in the second part of the 1970s in Canada was caused by the slow adjustment to the unprecedented increase in the inflation rate and was not an equilibrium phenomenon. His discussant, McPhail (1994), underscores this observation of expectational errors by noting that estimated ex ante real rates of return on deposits were generally positive in this period. While Konieczny is willing to interpret the performance of the rate on chequable savings account as favouring a Summers effect, McPhail counters that this transactions account was unrepresentative after the introduction of daily interest savings accounts in the late 1970s, since the rates of return on those latter types of accounts did move with inflation.

Cozier and Lavoie (1994) use a longer time frame than Summers and Konieczny to assess how low nominal short-term interest rates can fall in Canada. They examine 90-day treasury bill rates since 1935, noting that they were lowest during and just after the Great Depression (often close to zero). The treasury bill rate was around 1.25 per cent in the early 1950s. They interpret their evidence for the 1930s as being consistent with the notion of an interest rate floor for market-determined interest rates of close to zero at that time, with the low nominal rates of the early years of the Depression implying very high real rates because of the substantial deflation at that time. Turning to more recent evidence—that for the 1980s—they note that the spread between the prime lending and savings deposit rates rose sharply, averaging about 4.5 per cent, suggesting that prime would be unlikely to fall below 5 per cent. Cozier and Lavoie posit that if this spread represented a normal profit rate for banks, then there might be a resistance level for the prime between 4 and 5 per cent. To the extent that lending rates have more impact on consumer and business demand than do market rates, the resistance floor (or nominal interest rate bound) might be higher than zero, although not necessarily as high as Cozier and Lavoie found, given the institutional changes in the financial markets and a low inflation environment.

Johnson, Small, and Tryon (1999) examine data on nominal interest rates in the United States from 1920, and they also examine data on the recent performance of Japan. Clouse et al. (2000) take an even longer look at history, reviewing nominal interest rates in the United States from 1856 to the present for evidence that the zero bound has constrained policy. In addition, they examine the yield curves during the Great Depression in the United States and currently in Japan. Given the similarities between Johnson, Small, and Tryon (1999) and Clouse et al. (2000) in this part of

their papers, only the main observations in the latter paper, arising from the authors' review of history and comparison with Japan's current situation, are reported here.

Clouse et al. report that for the period 1860 to 1930, short-term interest rates did not approach zero in the United States, despite a series of inflationary and deflationary cycles and an average inflation rate similar to that over the 1930s and 1940s. Short-term nominal interest rates fell to zero by 1932 with the deflation that began in 1929 (a 25 per cent decline in the price level over three years), and from 1932 to 1948 they were under 1 per cent, with weekly data showing occasional negative nominal yields on treasury bills from late 1938 to early 1941. Since 1950, nominal interest rates have been well above zero. Clouse et al. comment that the steepness of the treasury yield curve during the early part of the 1930s implied that near-term expectations were for short-term interest rates to rise. They construct a proxy for the "policy buffer," the amount of room available for reducing nominal rates in response to shocks. The Great Depression is said to stand out "not because of relatively little room for easing at the outset of the downturn in 1929 but for ultimately running out of room despite the initial room to ease" (p. 14). With the rapid decline in the rate of inflation, real rates actually rose when nominal rates were falling. They make an interesting assessment of the 1950s and early 1960s, when CPI inflation averaged about 1.5 per cent in the United States. Even when policy buffers were not large in this period the Federal Reserve did not experience difficulty contributing to a turnaround in the recessions of 1953, 1957, and 1960.

Clouse et al. state that Japan in the 1990s had a delayed decline in long-term yields that was similar to the experience of the United States in the 1930s. At the end of 1991, when the economy was slowing, the term structure of interest rates was relatively flat, in the 5 to 6 per cent range. By the end of 1995, the slope of the yield curve steepened as the short rate had moved towards zero, but the 10-year rate was 3 per cent. Around mid-1998, the term structure was flat, at close to zero per cent for maturities up to three years; Clouse et al. suggest that the financial market expected the zero bound to remain relevant for some time.

The International Monetary Fund (IMF) (1999) proposes that evidence on the likelihood of a zero nominal bound could be gathered by observing the incidence of negative real interest rates during past economic cycles. They use a graph to show the level of policy-determined nominal and (ex post) real interest rates during past economic cycles over the period 1957 to 1999Q2 for several major economies. The shared experiences of many of the countries with negative real rates at the beginning and in the latter half of the 1970s were mentioned. The IMF attributes these episodes to countries trying to overcome the slowdown induced by the oil price shock. However, the main observation was that limited experience and the dubious relevance of the periods of negative real

short-term interest rates for other periods made it difficult to derive firm, empirically based conclusions on the importance of the zero bound on nominal interest rates as a constraint on monetary policy.

Analysis

In interpreting historical data, researchers who have examined the data closely conclude that, historically, there seems to have been a relatively low probability of the zero bound for nominal interest rates acting as a constraint on monetary policy in an industrial country. Further, they would probably agree that the likelihood of such an event occurring across a group of countries at the same time is even lower, particularly with flexible exchange rates.[4,5] This latter statement is supported by what seems to be the emerging consensus view that where the zero bound can be said to have acted as a constraint on monetary policy, aggressive and pre-emptive action by monetary authorities would have avoided some, if not all, of the more egregious effects.

Great care must be taken in using the historical record of ex post real rates to suggest that the monetary authority requires the option of generating negative real interest rates via inflation. For example, few people would argue that the negative ex post real rates experienced in a number of countries in the 1970s was the deliberate objective of the monetary authorities. As for Canada in the 1970s, Konieczny (1994, p. 8) says “So, it can be argued that the negative rates are an indication of unexpected expansionary policy.” This observation implies that the 1970s should be excluded when using averages over a period of time to choose the appropriate long-term real interest rate to use in models.

Regarding implications for the definition of price stability, most researchers who have relied on introspection or causal empiricism seem to feel that an inflation target of 2 to 3 per cent is high enough to substantially reduce the risk of encountering a zero bound. Suggestions range from a zero rate of inflation through a vague argument for a positive rate of inflation to specific suggestions clustered mainly around an inflation target of 2 per cent. Konieczny (1994) concludes that the

4. The ability of Asian countries to continue to exhibit solid growth before the Asian crisis while the largest country, in economic terms, stagnated might be taken as evidence for this viewpoint. In part, though, this result may stem from the largeness of some of the countries and from the extent of their links with countries other than Japan. Given Canada’s strong links with the United States, there might be more of a spillover effect if the United States was to encounter a zero bound situation despite the flexible exchange rate.
5. Laxton and Prasad (2000) report on simulation experiments to explore international spillovers of macroeconomic shocks among the major industrial countries. In the set of experiments where the inflation target is reduced to 1 per cent, there are significantly increased short-run output costs of a composite shock to the United States. The authors attribute these results to the effect of the zero bound on nominal interest rates.

optimal target rate of inflation for Canada is zero because of his emphasis on the unit-of-value role of money and his interpretation that the negative real rates in the 1970s in Canada reflects expectational shocks. Phelps (1972, p. 210) suggests that long-run inflation should be kept above zero "to provide insurance against economic instability" from the perspective that "at low rates of inflation the trials of the stabilizers are made harder and their tools made blunter and less reliable." Summers (1991 and 1996), Fischer (1996), and Svensson (2000) suggest that an inflation target of around 2 per cent would provide sufficient room to take account of measurement error in the price measure, nominal wage rigidities, and the zero bound on the nominal interest rate.[6]

The conclusions that arise from this type of analysis are from different, unspecified underlying models applied to data from various historical or country situations. As a result, a lot of uncertainty remains about their applicability in a low-inflation world under a coherent monetary order (Laidler 1999). A more disciplined way to evaluate the importance of the zero bound as a constraint on monetary policy requires a macroeconomic model and a way to assess its importance.

3.2 What are some of the results from macroeconomic models?

The importance of the zero bound on nominal interest rates as a constraint on monetary policy has been analyzed using a range of models. To give an overview of the different models, we organize them from the more theoretically based to the more empirically based. When we describe their main features—the experiments and conclusions—we cluster them by major common features or focus.

Some research interprets available data on the Japanese economy using stylized versions of various theoretical models (Krugman 1998). Other research is based on small, quantitative macro models in which the agents are depicted as solving dynamic optimization problems, but with some type of price stickiness that allows monetary policy to have real effects (Rotemberg and Woodford 1997, Wolman 1998 and 2000). Some research uses small dynamic estimated models with rational expectations and staggered price settings for a closed economy (Fuhrer and Madigan 1997,

6. Other authors give other reasons for their choice of an inflation target around 2 per cent. Bernanke et al. (1999, p. 30) argue that persistent deflation can lead to liquidity and solvency problems that could exacerbate contractions, and they therefore propose a target range for inflation of 1 to 3 per cent. Taylor (Solow and Taylor 1998, pp. 33–34, 45) posits that an inflation target of zero (but not lower) likely poses no serious stability problems, but suggests that a 2 per cent target for measured inflation is consistent with zero per cent "true" inflation, given the upward bias to measured inflation. However, recent improvements in measuring the CPI and other price measures in the United States have reduced the bias there. In Canada, the estimate of the bias in the year-to-year change in CPI inflation is for a mean of 0.5 percentage points and a maximum of 0.7 percentage points (Crawford et al. 1998, pp. 68–69).

Orphanides and Wieland 1998) and for an open economy (Cozier and Lavoie 1994, Lavoie 1995). Another approach uses larger models designed for projection and policy analysis, such as the Federal Reserve Board's econometric model of the United States economy (Reifschneider and Williams 2000), the Bank of Canada's Quarterly Projection Model (QPM) (Black, Coletti, and Monnier 1998), and the IMF's multicountry simulation model (MULTIMOD) (International Monetary Fund 1998).

Rotemberg and Woodford (1997) analyze the properties of optimal monetary policy for the United States in a dynamic framework with lags in price adjustment, but, conditional on those lags, there is optimizing behaviour by consumers, workers, and firms. Reaction functions of the Taylor-rule form are used for the base model and in simulations to identify the optimal monetary policy. There is no role for money in their model. Rotemberg and Woodford account for the zero bound indirectly, since they linearize their model to simplify the analysis, and they do this by assuming that the variability of the interest rate instrument is constrained by the average level of interest rates—that is, by the inflation target. They show that the model can mimic observed responses of output, inflation, and the federal funds rate to monetary policy shocks derived from a vector autoregression. Their experiments focus on how monetary policy should respond to disturbances to spending and aggregate supply. Because policy-makers are assumed to observe disturbances affecting private decisions only with a lag, a policy of completely stabilizing inflation leads to large swings in interest rates. Combined with a non-negative nominal interest rate, this result suggests that inflation can only be completely stabilized at a relatively high positive inflation rate. However, allowing for the likelihood that the monetary authorities would trade off inflation and interest rate variability, Rotemberg and Woodford derive that target inflation would be 0.14 per cent a year and argue that it would be even lower if other costs of inflation, such as economizing money balances, are taken into account.

Wolman (1998 and 2000) uses an explicit optimizing sticky-price model. He follows Fuhrer and Madigan (1997) and Orphanides and Wieland (1998) in imposing the zero bound directly, but extends the analysis by explicitly modeling money demand (using a shopping-time technology) to include a channel working in favour of zero nominal interest rates. He does this because monetary theory indicates that one benefit of zero nominal interest rates is the elimination of inefficiencies associated with holding too little money. However, monetary policy is assumed to be characterized by a feedback rule for the nominal interest rate, structured like a Taylor rule but with the price level on the right-hand side. Money demand is an integral part of the model in that the quantity of money enters other equations of the model in addition to the money demand equation. Wolman solves the model using a technique that gives an approximate non-linear solution as opposed to linearizing the model's equations around a steady state. The experiment comprises simulating the

model at moderate inflation and moderate deflation and comparing the results in three ways: (i) simulating the model for several periods with the same shocks at high and low inflation, and informally comparing the results; (ii) examining the variances of inflation and output; and (iii) examining the two regimes in terms of welfare. Wolman (1998a) concludes that, in the context of labour supply shocks, the zero bound is not an important factor affecting the real economy if firms set their prices to maximize expected profits, and the monetary policy rule works to keep the price level stationary. Wolman (2000) extends this research to show that, even if both consumption and labour supply shocks are considered, the zero bound is unlikely to have significant real effects if prices are set to maximize expected present discounted profits and the policy rule is focused on keeping the price level stationary.

Fuhrer and Madigan (1997) and Orphanides and Wieland (1998) explore the implications of the zero bound using models that are similar to one another and are based on United States data. Fuhrer and Madigan's model contains: (i) a backward-looking IS curve, (ii) an overlapping price-contracting specification, and (iii) a monetary policy reaction function. Orphanides and Wieland's model has the same contracting specification, but the IS curve is disaggregated into its components of consumption, fixed investment, inventory investment, net exports, and government spending. Monetary policy operates in both models by changing the short-term nominal interest rate; money is not included in either model. Spending is affected by long-term real interest rates. With sticky inflation arising from the contracting specification, changes in the short-term nominal interest rate generate changes in the long-term real rate. Hence, monetary policy can affect real spending and output. Neither model derives their equations for private-sector behaviour from explicit optimization, raising the question of their stability in the face of policy experiments that are outside the historical experience over which each model is estimated. As to the design of the experiments, Fuhrer and Madigan evaluate the zero bound's importance by comparing the response of their model to IS curve shocks at inflation targets of zero and 4 per cent, while Orphanides and Wieland use estimated shock processes and compare the variance of output at different inflation targets. They find a significant detrimental effect on economic performance if policy-makers target inflation below 1 per cent. Both sets of researchers conclude that, at a zero inflation target, monetary policy is significantly constrained in that the zero bound occurs regularly and, as a result, output is more variable than at a moderate inflation target (2 to 3 per cent). Output is at potential on average when the target for inflation is high enough to prevent interest rates from hitting the lower bound, but below it otherwise.

Cozier and Lavoie (1994) construct a calibrated four-equation reduced-form macro model, which has a reduced-form aggregate demand relationship to determine the output gap, an expectations-augmented price Phillips curve, a nominal exchange rate equation, and a forward-looking monetary

policy rule with an inflation target. The experiment comprises stochastic exogenous shocks drawn from nine sources applied to five scenarios for inflation rates (zero to four per cent). Cozier and Lavoie find that the probability of falling into a trap increases as the target inflation rate declines. For example, this probability is 3.5 per cent at a 1 per cent inflation rate and 5 per cent at a zero inflation rate. However, they conclude that an inflation target in the 1 to 3 per cent range is unlikely to cause major problems for monetary policy in terms of the constraint arising from the zero bound on nominal interest rates.

Reifschneider and Williams (2000) use the Federal Reserve Board's econometric model of the United States economy to quantify the effects of the zero nominal interest rate bound on macroeconomic stabilization, and to explore how policy can be designed to minimize those effects. They note that the basic dynamic properties of this model differ significantly from both the sticky-price model used by Wolman and the sticky-inflation model used by Fuhrer and Madigan, and Orphanides and Wieland. Specifically, the persistence of inflation is said by Reifschneider and Williams to be between that in a Taylor staggered wage-contracting model (with little inflation persistence) and that in the Fuhrer and Madigan, and Orphanides and Wieland models. The persistence of output is said to be between that in the models used by Fuhrer and Madigan, and Orphanides and Wieland, respectively. Reifschneider and Williams design their experiments to explore how the effect of the zero bound varies under alternative monetary policies, considering the effects of various modifications to the standard Taylor rule and how efficient rules change as the non-negativity constraint begins to bind. They draw three broad conclusions. First, during particularly severe contractions, open-market operations alone may be insufficient to restore equilibrium; some other stimulus is needed. Second, in very low inflation environments where policy follows a Taylor rule, the zero bound could be a significant constraint on policy, given that their simulations show the funds rate to be stuck at zero over 10 per cent of the time, and that they also show a significant increase in the variability of output but not inflation. Third, they report that with perfect credibility and a Taylor rule augmented to incorporate a response to past constraints on policy, there is a dramatic reduction in the detrimental effects of the zero bound.

Black, Coletti, and Monnier (1998) use the Bank of Canada's QPM to gauge the costs of an interest rate floor. QPM is a calibrated, almost small open economy model designed for projection and policy analysis (described in detail in a series of Bank technical reports beginning in November 1994). A forward-looking monetary policy reaction function has the monetary authority adjusting its policy instrument (the short-term interest rate) to bring inflation into line with the inflation target. Stochastic simulations were performed to build up a distribution of output and consumption, and interest, inflation, and exchange rates under different target inflation

rates and varying assumptions about the level of the interest rate floor (as suggested by the work of Cozier and Lavoie 1994). In the experiment, QPM was subjected to random demand shocks, which directly affect both consumption and investment. The variance of the shocks was calibrated so that the standard deviation of output relative to its trend, as measured using the extended multivariate filter, is close to its historical average over the 1961 to 1992 period.[7] When the equilibrium real interest rate is assumed to be 4 per cent, one of the results is that for an inflation target of 2 per cent and a zero nominal interest rate bound "the floor has a negligible effect" (Black, Coletti, and Monnier 1998, p. 323). For this equilibrium real interest rate, the experiments with other combinations of the inflation target (0, 1, and 2 per cent) and the assumed floor on nominal interest rates (0, 0.5, 1.0, 1.5, and 2.0 per cent) indicate that it is the difference between the target rate of inflation and the level of the interest rate floor that is most important, with the effect of the interest rate floor being "quite non-linear" (p. 323). The authors state that the policymaker should be wary of targeting an inflation rate more than 1 percentage point below the interest rate floor. If a lower equilibrium real interest rate (3 per cent) is assumed, the authors suggest that "the policymaker should be wary when targeting a rate of inflation equal to or below any interest rate floor" (p. 325).

The IMF (1998, Box 4.1) reports on two simulations with a Japan-specific version of its multicountry simulation model, MULTIMOD. The important feature of MULTIMOD for these simulations is its incorporation of forward-looking behaviour in financial and goods markets so that expectations of future values of the endogenous variables can affect prices and activity in the current period. In the first simulation, Japanese monetary authorities are assumed to aim at stabilizing inflation at zero. In the second simulation, they are assumed to credibly commit to achieving a longer-term inflation rate of 1.5 per cent per year; that is, they resist inflationary pressures only after inflation reaches this threshold. In both cases, nominal short-term interest rates are constrained by the floor of zero. The zero bound in the zero inflation target scenario results in higher long-term real interest rates initially, a greater appreciation of the real exchange

7. It is clear that if these experiments were to be redone today, reducing the output variance in the base case scenario would have to be seriously considered (see Debs 2001). The inflation variance in the base case of the model was already well below that in history and close to that in the 1990s (see Black, Coletti, and Monnier 1998, p. 322, Table 1). The latter, and the resultant lower variance of nominal interest rates relative to history, occurred because the reaction function worked to contain deviations from the midpoint. The real interest rate assumption, especially given the sensitivity analysis, would not necessarily have to be changed, although the term premium may have to be revisited because of the reduced supply of long government bonds. More recent work suggests that if an element of price-level targeting was introduced into the inflation-based, forward-looking reaction function, there would be a reduction in the variability of inflation relative to its target, output relative to potential, and the nominal interest rate (see Maclean and Pioro 2001). Such changes might further reduce the probability of encountering the zero bound constraint.

rate, and a larger decline in output than in the 1.5 per cent inflation scenario. These differences occur because when the objective for inflation is 1.5 per cent over the long term, deflationary forces are less strong, since agents in the model base their expectation on the authorities successfully achieving their higher inflation target. The IMF stress that their results underscore the important influence that inflation expectations have on real interest rates and aggregate demand in a liquidity trap, and this includes an indication of how a “deflationary spiral” can emerge.

In another study of the recent experience of Japan, Krugman (1998) presents a series of stylized theoretical models to demonstrate the elements of a liquidity trap. The models are explicitly intertemporal, assume rational expectations, and allow for foreign trade, capital mobility, and financial intermediation (providing for a distinction between currency and reserves and broader measures of money and credit). He demonstrates policy ineffectiveness when the nominal interest rate is zero, taking future money growth as given. However, Krugman stresses that in these models only temporary monetary expansions are ineffective, and that a central bank can get the economy out of a trap if it can credibly promise a future rise in prices, since this would be a way of lowering ex ante real interest rates. Specifically, he suggests a commitment to 4 per cent inflation for a period of fifteen years by the monetary authority in Japan.

Analysis

The evidence from the models is that an inflation target of 2 per cent would be “high enough to greatly reduce the effect of the zero bound on the effectiveness of monetary policy in all but the most extreme shocks” (Johnson, Small, and Tryon 1999, p. 27). In most cases, these conclusions assume that the key real interest rate is consistent with its recent long-run average. While some of the modelers (Orphanides and Wieland, for example) find that the simulation results show the greatest deterioration when inflation is targeted at 1 per cent or lower, they recommend an inflation target of 2 per cent, to have a cushion.

An obvious question is whether there would be significant problems if the inflation target were 1 per cent instead of 2 per cent. In the context of lessons to be drawn from the models, complementary questions are: which macroeconomic models show that there would be problems and what are the key assumptions? Are there models that do not show a problem and how do they differ from those that do? And how relevant are simulation results from models to implications of a low-inflation or stable price-level world? On the one hand, changes in policy or economic relationships may mean that the shocks being examined will not apply in the future. Several recent studies, discussed later, have shown that the volatility of real output has declined considerably in the United States and in Canada. Furthermore, other studies find evidence of

changes in monetary policy regime. Finally, there is the question of whether evidence from some types of models should be given more weight than evidence from other types of models.

Wolman (2000) and Reifschneider and Williams (2000) suggest that a lower target might be possible without having a negative effect on inflation and output stabilization. As reported above, Wolman uses a price-level reaction function and relies on the effect of the credibility of the monetary authorities on inflation expectations to lead to the appropriate ex ante real rates for stabilization purposes. Reifschneider and Williams consider the effects of different inflation targets on output and inflation volatility using a Taylor rule that allows for expectational effects via the monetary authority's commitment to a weaker interest rate relative to that from a basic Taylor rule whenever the economy is—or is anticipated to be—weak. They argue that "Confidence that policy will be easier in the future than would normally be the case could lower bond rates today and raise current expectations of future inflation" (p. 32). Rotemberg and Woodford argue that "On theoretical grounds, one might be tempted to discount the possibility of sticky inflation and thus accept Wolman's finding that the zero bound is of little concern. However, such a step may not be prudent, given the ongoing debate over whether the high degree of persistence displayed by inflation historically is evidence of intrinsic inertia, irrespective of theoretical arguments" (p. 4). Conversely, Dittmar and Gavin (2000, p. 21) state that "price-level targeting should be preferable in a sticky-price world where prices are costly to adjust . . . a policy that reduces price fluctuations would seem to be appropriate." As noted in the description of the models, particularly for the United States, different assumptions are made about the type and degree of inertia in inflation (the price level in Wolman's case).

An obvious risk of using models to infer what is likely to happen in a low-inflation world is that models estimated or calibrated to historical data would be subject to the Lucas critique. This point is sharpened somewhat given recent work that shows a decline in the volatility of real output in the United States after 1984 (McConnell and Perez Quiros 2000, Taylor 2000b, Watson 2000, and Nelson 2000).[8] For Canada, the decline in the volatility of real output is much more evident after 1991 than earlier (see Debs 2001) and there is evidence of a change in the inflation regime (Laxton, Ricketts, and Rose 1994, Ricketts and Rose 1995, and Fillion and Léonard 1997). Given that the stochastic shocks imposed on these models are drawn from an average over history, it is important that the researchers be clear about their views on the change in output volatility in choosing the representative set of shocks. Similarly, assumed expectations processes play a major

8. While Brainard and Perry (1999) suggest that the breakpoint in the United States occurred in the early 1990s, Taylor (2000b) argues that the weight of the evidence (economic and statistical) indicates that the real change occurred in the early 1980s.

role in determining the results of the models under stochastic simulations, so the processes in the model should reflect the regime consistent with the question being asked.

The Lucas critique might be thought to be less of a problem where models are based on equations derived from explicit objective functions for firms and individuals, assuming that the objective functions reasonably represent those of agents in the economy. It can also be argued that models that incorporate forward-looking specifications of some of the structural relations, and use rational (or model-consistent) expectations in analyzing alternative policies, respond to the Lucas critique to some extent. In this vein, slightly more weight might be given to the Rotemberg and Woodford, and Wolman results because the models on which they are based are derived from explicit objective functions, and to the Reifschneider and Williams results because model-consistent expectations are used in analyzing alternative policies. However, there are still issues of whether the variances have been appropriately calibrated and whether the expectations process assumed for inflation is consistent with a low-inflation regime.

Most of the models explore only the interest rate channel of monetary policy, except for that of Wolman. If money is excluded from the model, then the model results do not reflect any welfare cost of positive nominal interest rates. Wolman (1998) argues that while the behaviour of real and nominal variables may be invariant to incorporating money in an additively separable way, the welfare implications of different monetary policies are not invariant to this modification.

None of the studies allow for the possibility that low and stable inflation makes it easier for businesses to plan, leading to higher investment, productivity, and growth, as seems to have happened in the United States in the mid-to-late 1990s. The result could be less of a boom/bust cycle than in the past, with a higher average output level and a higher equilibrium real interest rate, other things being equal.

4. What Role does the Policy and Economic Framework Play in Determining the Likelihood that a Zero Bound will Occur?

Some of the literature suggests that the monetary policy framework could change the likelihood of encountering the zero bound for any given inflation target, whether it is explicit or implicit. Another important conditioning factor seems to be the economic context.

4.1 How does the monetary policy regime influence the probability of the zero bound occurring?

Benhabib, Schmitt-Grohé, and Uribe (2000, p. 1), hereafter BSGU, indicate that "a growing body of theoretical work has argued that Taylor rules contribute to macroeconomic stability." While this conclusion results from methodologically diverse work, two common elements suggest to BSGU that the conclusion is not necessarily robust: (i) a focus on local dynamics or small fluctuations around a target level of inflation, and (ii) inattention to the zero bound on nominal interest rates. BSGU (2001) argue that when account is taken of the zero bound on the nominal interest rate, there can be unexpected consequences from active interest rate feedback rules. In particular, they show that even if there is a locally unique equilibrium at which monetary policy is active, an infinite number of equilibrium trajectories originating arbitrarily close to that steady state exist that converge to a liquidity trap—a steady state in which the nominal interest rate is near zero and inflation is possibly negative. In addition to BSGU, Krugman (1998) and Reifschneider and Williams (2000) suggest that the recognition of the existence of a zero lower bound has drastic effects on the dynamic properties of models that include interest rate policy rules such as the Taylor rule.

On the other hand, McCallum (2000, p. 34) argues that "these particular effects represent theoretical curiosa that are not relevant to practical policy analysis, even granting the possibility of a ZLB-induced liquidity trap," but acknowledges that many theorists would disagree with his views. He does not believe that some of the theoretical possibilities would ever come into play, especially in an economy with a clearly enunciated target and a history of meeting that target. He sketches a simple model to show why. It could be argued that the main contribution of this debate is to underscore the importance of a central bank having a coherent monetary order (Laidler 1999) to condition expectations and to ensure consistency in the formulation and implementation of monetary policy.[9] Since we believe that there is a coherent monetary order in place in Canada, we lean toward McCallum's view.

Bernanke and Gertler (2000) consider the question of the appropriate policy framework for large industrial economies when there are both price stability and financial stability issues. As part of their analysis they present simulations using a standard dynamic new Keynesian model, modified to allow for financial accelerator effects and for exogenous bubbles in asset prices. Their model

9. Laidler (1999) defines a coherent monetary order "as a set of arrangements whereby: (i) monetary policy has a well-defined goal; (ii) the authorities charged with achieving that goal have the powers needed to achieve it; and, too often overlooked, but crucial, (iii) private sector agents, or at least a representative majority of them, understand that goal, expect it to be pursued, and base their own actions on that expectation."

allows for the possibility of a sharp market correction leading to adverse effects on economic activity, compounded by the effects of weakened balance sheets on financial positions. They conclude that the best policy framework for attaining both price and financial stability is a regime of flexible inflation targeting, whether implicit or explicit, although they indicate a preference for an explicit target. Elaborating on this, they note that the inflation-targeting approach requires central banks to adjust monetary policy in a pre-emptive manner to offset incipient inflationary or deflationary pressures, but that policy should not respond to changes in asset prices unless they are signalling a change in inflation expectations. According to them, adopting a flexible inflation targeting approach for the monetary policy framework would reduce the probability of a zero bound occurring, because it forces policy-makers to adjust interest rates in a stabilizing direction. However, they do not argue for any particular inflation target.

To the extent that there is still variability in inflation in a low-inflation monetary regime, there is a greater risk of experiencing a zero nominal bound for at least short periods of time. A policy framework that reduces uncertainty could help to avoid this risk. Dittmar, Gavin, and Kydland (1999) report that, with a simple neoclassical Phillips curve model and realistic assumptions about the persistence in output gaps, a price-level-targeting regime would likely result in a better inflation-output variability trade-off than an inflation-targeting regime. In response to a criticism by Kiley (1998) that the neoclassical specification is inconsistent with U.S. data, Dittmar and Gavin (2000) use a new Keynesian Phillips curve and reach the same conclusion.[10,11] While it is possible to question how consistent either model is with U.S. data, the intent of this research is to show that there seems to be some robustness to the idea that a long-term price-level target used in an error-correction framework to modify the short-run inflation target could be helpful to achieving the objectives of monetary policy.

As stated above, using an explicit optimizing sticky-price model, Wolman (2000) finds that policy rules that make the price level stationary lead to only small real distortions when the zero bound is encountered. He notes that the intuition for why this is so is similar to that given by Duguay (1994)

10. See Dittmar and Gavin (2000) for more details on the main differences between a neoclassical and new Keynesian Phillips curve.

11. Dittmar and Gavin (2000) argue that the different results reported in simulations of econometric models that indicate that targeting the price level leads to more inflation and output variability depends critically on the expectations process assumed. Simulation results using econometric models with forward-looking inflation expectations (Black, Macklem, and Rose 1998 and Williams 1999) find that combining a long-term price-level target with a short-term inflation-targeting rule or having price-level targeting either shows an improvement or little additional cost in terms of output and inflation variability relative to an inflation-targeting rule. On the other hand, simulation exercises that assume an adaptive expectations process show that price-level targeting results in higher short-run variability for both inflation and output. Dittmar and Gavin point out that these types of simulation exercises are where the Lucas critique is likely to be most relevant.

and Coulombe (1998): "by promising to return the price level to a fixed path, policy automatically generates expected inflation in situations where the nominal interest rate hits the zero bound and the real rate needs to be negative" (Wolman 2000, p. 16). To examine price-level and inflation targeting, Svensson (1999) derives endogenous decision rules and equilibrium price-level or inflation processes when the central bank is assumed to act under discretion in the face of persistent output movements. He finds that price-level targeting dominates inflation targeting for realistic assumptions about persistence in output. As to non-negative nominal interest rates, Svensson states that, "For a given average inflation rate, the reduced inflation variability under price-level targeting once more seems to speak in favor of price-level targeting" (p. 290).

4.2 How does the economic context affect the probability of a zero bound occurring?

A higher "equilibrium" real interest rate for a given inflation rate would decrease the likelihood of encountering the zero bound,[12] because via the Fisher equation it would imply a higher "equilibrium" nominal interest rate and hence leave more room for inflation to move before the nominal interest rate becomes zero. The "equilibrium" real interest rate depends on such factors as the growth of the labour force and rate of technical progress (which, added together, give the "natural" rate of growth of the economy) and the propensity to save (determined by the rate of time preference, the risk-aversion of economic agents, the level of government debt, and distortionary tax regimes). So a country with a higher "natural" growth rate might be expected to be less susceptible to the zero bound, other things being equal.

The monetary authority's ability to use the interest rate may be constrained when the long real rate is an important channel for affecting economic activity if there is a term premium in long rates. One reason this premium could emerge is a high level of government debt funded more at the long end of the market. With a term premium, the ability to ease in response to an adverse spending shock would be more constrained, because the equilibrium short real rate would be lower than the equilibrium long rate by the amount of the term premium. Fuhrer and Madigan (1997) consider this possibility; they show that there is an important negative effect of this on output in the zero inflation case relative to the 4 per cent inflation case. Their simulation incorporated both long and short rates in the IS equation, as opposed to just using long rates, and it did not affect their conclusions.

12. "Equilibrium" is used here in the sense most widely accepted by economic agents, to denote the long-run average applicable in the economy for the time frame under consideration.

5. How does Credibility Affect the Zero Lower Bound?

Under a regime that is ambiguous about its target (for example, a credible argument can be made that Japan has at times gone back and forth between a price stability and an exchange rate target), a monetary authority is unlikely to have achieved much credibility. The absence of a clear nominal anchor or of past success would make it difficult for the monetary authority to rely on expectations to adjust endogenously or in response to its pronouncements.

Under a credible inflation-targeting regime, the probability of the nominal interest rate hitting the zero bound should be lower than under an ambiguous regime, in that the monetary authorities should be symmetrically proactive in responding to demand shocks. Furthermore, the economy may have a better output performance on average that would lead to a higher equilibrium real interest rate, leaving more room for the monetary authority to stimulate the economy by moving the ex ante real rate further below its equilibrium value. If a negative shock was a complete surprise or large enough, or both, to require the monetary authority to reduce nominal interest rates to zero, it might have enough credibility that economic agents would respond to commitments by the authority to bring inflation back towards the inflation target. (Svensson 2000 and others have shown how high credibility makes an inflation target easy to achieve.)

If a monetary policy regime where a price-level target played a role was credible, then that might be the best outcome. Logical arguments and various simulation experiments indicate that under such a regime price expectations adjust endogenously to allow ex ante real interest rates to be consistent with what is needed to move back to the target (Coulombe 1998, Duguay 1994, Black, Macklem, and Rose 1998, and Wolman 2000).

6. How can Monetary Policy be Effective at the Zero Lower Bound?

Alternatives to the interest rate channel for implementing monetary policy have been proposed in the literature.[13] For the discussion here, these alternatives have been categorized into three groups, having to do with increasing liquidity; affecting expectations; and taxing currency holdings. Table 1 outlines some of the advantages, disadvantages, and evidence pertaining to each policy proposal in a group, to supplement the brief discussion that follows.

13. Mishkin (1996) provides a useful list of all potential channels and discusses their potential importance. He highlights alternatives to the interest rate channel and states that asset prices other than short-term debt contain information about the stance of monetary policy and are therefore important channels of monetary policy transmission.

Table 1: Alternatives to the interest rate channel when the interest rate is bounded at zero[a]

Proposal	Advantage	Disadvantage	Evidence
POLICY ALTERNATIVES (GROUP #1): Expand real money balances by providing additional liquidity			
Increasing the monetary base via **open-market purchases of Treasury bills** (Clouse et al. 2000)	-May increase credibility that central bank (hereafter, C.B.) will keep short-term rates at zero for a prolonged period of time. -Increases liquidity but unlikely to affect desired holdings of loans nor provide additional benefits through money demand equations. -May increase inflation expectations and hence lower ex ante real interest rates (Mishkin 1996, Wolman 1998, Krugman 1998). -Possibility of stimulus through the credit channel à la Bernanke and Gertler (1995), who see two main channels: balance sheet channel and bank lending channel. May be most effective for open-market operations in assets other than Treasury bills.	-May waste time and effort. -At zero nominal interest rate, agents have no reason to reconsider their portfolio allocations or their spending decisions (open-market operation in two perfect substitutes). -Expectations may not be altered because of sluggishness of wages and prices, and inability to convince public that C.B. will be able to deliver. -Hard to see how balance sheet would be improved, since can't decrease interest expenses or increase asset prices. Also, with zero nominal rates, seems hard to lower costs of financial intermediation to improve the bank lending channel.	-Studies by Koenig (1990) and Meltzer (1998 or 1999) report a statistically significant impact of real money balances on major demand components as well as on aggregate output, independent of (and in addition to) the explanatory power of the real interest rate. IMF (1999) reports that Tamin Bayoumi and James Morsink failed to detect any independent impact on aggregate demand in Japan from changes in the monetary base when controlling for the impact of changes in interest rates.
Purchasing government bonds. Using standard notions of how their prices are determined suggests the possibility of two channels: expectations of future short-term interest rates and term premiums. (Clouse et al. 2000, and Bernanke 2000)	-May be able to lower interest rates, hence increase collateral values by buying large amounts of these bonds and therefore increase economic activity.	-Risk of future declines in prices of long-term bonds may limit credit channel effect. -C.B. determines the market, as opposed to working with it.	-Experience with "Operation Twist" in the United States in 1961 does not support the idea that this will work.

(continued)

Table 1 (continued): Alternatives to the interest rate channel when the interest rate is bounded at zero[a]

Proposal	Advantage	Disadvantage	Evidence
Purchasing foreign exchange. (Bernanke 2000, Clouse et al. 2000, McCallum 2000, and Meltzer 1999)	-Provides a signal that C.B. will lower interest rates in the future to profit from the purchase of foreign assets via a greater-than-expected future dollar depreciation. -Could allow a portfolio reallocation between domestic and foreign assets that would affect relative rates of return.	-If monetary policy is ineffective because of the liquidity trap, such an action would be equivalent to sterilized intervention. -May harm relations with other countries whose currencies would have to appreciate.	-Bernanke (2000) states that he is not aware of any previous historical episode in which a C.B. has been unable to devalue its currency; but empirical evidence suggests that sterilized interventions cannot create sustained changes in exchange rates. -Empirical literature provides limited support for existence of signalling effects (Johnson, Small, and Tryon 1999). -The consensus in the empirical literature is that relative supply effects have little or no lasting impact on exchange rates.
Purchasing private sector securities. (Clouse et al. 2000, and Bernanke 2000).	-Reduces credit-risk premiums that might have risen in the face of zero short-term treasury rates and a floundering economy. C.B. would facilitate this by taking the credit risk onto its balance sheet via purchases of private sector securities.	-May require changes in statutory authority. The Bank of Canada has the power to purchase commercial paper under section 18.g.1 of the Bank of Canada Act. -What credit risk and how much should the C.B. take onto its balance sheet?	-Unavailable?
Lending by the central bank (Clouse et al. 2000)	-May be able to accept a broad range of securities as collateral and to make loans to a wide variety of economic agents.	-Need to make sure that credit risk is off the C.B.'s balance sheet at a time when such risks may be elevated already.	-Unavailable?

(continued)

Table 1 (concluded): Alternatives to the interest rate channel when the interest rate is bounded at zero[a]

Proposal	Advantage	Disadvantage	Evidence
"Money rains" (Clouse et al. 2000 and Bernanke 2000). -This option requires coordination with the fiscal authority in that the central bank needs an asset (government bonds) to match its liability (currency used for "money rain").	-Provides a way to have wealth effects when interest rates cannot be used to generate higher asset prices.	-Economic agents may anticipate a future lump-sum tax on wealth equal to the per capita money transfer and hence would hold on to the funds. -Need to make decisions on how to distribute in equitable fashion. May not be legal.	-Unavailable? However, any evidence supporting Ricardian equivalence would work against this proposal.
POLICY ALTERNATIVES (GROUP #2): Reduce private risk by committing central bank to future policy			
Explicit commitment to inflation target for several years into the future (Krugman 1998 and Bernanke 2000). - Other forms of explicit commitments include money-growth targets (Hetzel 1999) and commitments to stay at zero (Okina 1999)	-Gives private decision-makers more information about monetary policy and therefore reduces uncertainty. -Signals intent to make up some of the price-level gap. -Committing to stay at zero reduces the option value of longer-term bonds.	-May further endanger C.B.'s credibility if targets are not achieved.	-Bernanke (2000) finds evidence of yield curve effects from the Bank of Japan's commitment to run a zero-rate policy until deflationary expectations subside.
Writing Options. (Clouse et al. 2000 borrowed from Tinsley 1999.)	-Allows the C.B. to specify its ceiling for a particular interest rate over a specified future period and to monitor, via the day-to-day changes in the price of the option, the credibility of the interest rate ceiling.	-The more options that are written by the C.B., the more money would be left on the table if the C.B. walked away from its policy of lowering near-term interest rates.	-Credible version of keeping inflation at zero for longer periods of time. Maybe refer to Japanese experience.
POLICY ALTERNATIVES (GROUP #3): Create conditions in which nominal interest rates can become negative			
Imposition of a carry tax on monetary liabilities of the C.B. - a Gesell tax (Goodfriend 2000, and Buiter and Panigirtzoglou 1999)	-Would allow open-market operations to make nominal interest rates negative.	-Likely to be significant costs in producing a magnetic bank note and monitoring system.	-The Bank has done some tests with different substrates in the $5 bill. It is very expensive to track cash.

a. References given in the table do not indicate priority or all of the researchers who have made the same type of recommendation.

The most common policy alternatives attempt to increase real money balances by providing additional liquidity to the economy. While the mechanisms by which liquidity is provided differ slightly, the idea in all cases is straightforward: by purchasing assets the central bank increases the monetary base. These policy actions might include purchases of treasury bills via open-market operations, purchases of government bonds, foreign exchange and private sector securities, lending by the central bank, and "money rains."

A second set of policy alternatives attempts to alter or influence private expectations about future inflation, and thereby influence ex ante real interest rates, by committing the central bank to a course of action or an outcome (either implicitly or explicitly). For example, the Bank of Japan's February 1999 adoption of a zero interest rate policy is an example of an explicit announcement aimed at altering expectations. Commitments to explicit inflation targets or explicit money-growth targets also fall under this category. A commitment can also be implied. A central bank may undertake to write options on the treasury bond rate that will prevail at some point in the future. The price of that option would reflect the implied future policy and allow the holder to exercise the option if and when the central bank fails to deliver on its commitment.

The third alternative (the final one outlined in Table 1) is to create a mechanism whereby nominal interest rates can become negative if need be. A tax on money holdings has been proposed as a means of implementing such a policy. Advocates of this tax find it compelling: it would remove the zero bound as a problem for monetary policy; varying the carry tax would enable interest rate policy to be made exactly as it is today; long-term bond rates could move closer to or below zero; and the carry tax would allow a central bank to deal directly with deflation scares by making the nominal interest rates negative.[14]

The main criticisms of a tax on cash and currency (a Gesell tax, see Buiter and Panigirtzoglou 1999) or a carry tax on electronic reserves (see Goodfriend 2000) have focused on the difficulty of implementing and administering the tax.[15,16] Opponents contend that the ongoing resources required to administer the carry tax system (which would be idle much of the time) are

14. These reasons are taken from Goodfriend (2000).
15. A more fundamental criticism is that such a tax is analogous to "radioactive decay" of the value of money, a situation which would erode the very raison d'être of having money as a stable unit of account or medium of exchange. Reportedly, Wallace (2000) made this point in an intervention from the floor at a conference on monetary policy in a low-inflation environment.
16. As Buiter and Panigirtzoglou (1999) note, the Gesell tax involves paying negative interest on government "bearer bonds"—coin and currency (that is, "taxing money"). Taxing currency amounts to having periodic "currency reforms"; that is, compulsory conversions of "old" currency into "new" currency, say by stamping currency. The terms of the conversion can be set to achieve any positive or negative interest rate on currency. There are likely to be significant shoe-leather costs associated with such schemes. The policy question then becomes how much shoe leather it takes to fill an output gap. For electronic reserves, a daily tax on electronic reserve balances would be imposed to make the interbank rate negative (see Goodfriend 2000 for more details).

prohibitively costly (see Freedman 2000). Based on its impracticalities, this alternative is unlikely to be more than an academic curiosity. Our discussion of it ends here, to focus on the two more practical approaches introduced earlier.

Economists remain divided on the effectiveness of all six proposals for increasing liquidity in the economy when nominal interest rates are at zero. The division of opinion centres on how much emphasis is given to all assets being close substitutes. As stated earlier, when the nominal interest rate is zero, short-term treasury bills are perfect substitutes for base money or bank reserves, so exchanging one for the other has no effect on economic activity. Advocates of the policy-impotence view rely heavily on the standard assumption that bonds and real capital are perfect substitutes. Coupled with the perfect substitutability of treasury bills and base money or bank reserves at a zero nominal interest rate, the implication is that all assets are perfect substitutes. As a result, purchasing domestic or foreign long-term bonds, equities, or commodities, or purchasing foreign money, cannot change relative prices and real wealth. Some of the researchers who seem to hold this view to a greater or lesser extent are: Clouse et al. 2000, Freedman 2000, and Johnson, Small, and Tryon 1999. However, there are indications that many of these researchers would modify their conclusions in the face of extremely large changes in relative supplies of assets to the private sector.

Meltzer (1999) is perhaps the strongest advocate of assets other than bills and money not being perfect substitutes for money. He suggests that we need money because some transaction and information costs mean that all assets are not perfect substitutes. If the latter is assumed, then a zero interest rate means that only one row and one column in the matrix of asset returns has been eliminated. While other returns may remain near zero, the fact that they are not zero means that monetary policy remains effective if the central bank buys (or sells) any asset that does not have a zero yield. Meltzer notes that changing the assumption about which assets are not perfect substitutes removes the theoretical basis for the liquidity trap. This is the case whether it is bonds and real capital (as in Brunner and Meltzer 1968) or foreign assets (as in McCallum 2000) that are not perfect substitutes for domestic assets.

To support his analytic argument, Meltzer (1999, p. 13) examines three recession periods in the United States economy (1920–21, 1937–38, and 1947–48) and interprets the evidence as showing that expansion of the monetary base in real terms was “consistent with recovery in each of these cases, despite high and, at times, rising real rates of interest and, in some cases, a zero nominal interest rate.” Meltzer favours the relative-price-adjustment view of the role of money during these episodes to the money-gap view. According to this latter view, the gap between actual and desired real balances is a measure of the relative price adjustments across different assets that is

required to restore full equilibrium. While, in full equilibrium, these relative prices might be summarized by a single interest rate, this is not the case in transition.

Orphanides and Wieland (1999) report on the use of a calibrated, open-economy model to consider the possibility that the quantity of base money may affect output and inflation when the nominal interest rate is constrained by zero. Small, pure quantity effects, and uncertainty about them, are incorporated into the analyses. Emphasis is given to the portfolio balance channel whereby changes in relative money supplies might influence the exchange rate. If the policy multipliers and the monetary transmission mechanism for these quantity effects were well-understood, then Orphanides and Wieland would not see the zero bound as a significant concern for monetary policy. However, their analysis indicates that once uncertainty about these effects is considered, there may be a substantial increase in the costs of stabilization policy near price stability. They feel that the optimal policy in the presence of the zero bound exhibits two complementary elements to moderate the risk of deflationary crises: (i) an asymmetrically quick and strong stimulative response as inflation declines towards zero, and, because of this response, (ii) an upward bias in inflation and a different stochastic distribution of economic outcomes than if the target for inflation was achieved more precisely on average.

Some novel policy alternatives for overcoming the zero nominal bound, many suggested in response to the recent Japanese experience, involve commitments about future central bank policy (see Policy Alternative Group #2 in Table 1). Explicit inflation targets are the most widely discussed policy measure of this type. The debate focuses on whether the benefit of providing more direction to economic agents outweighs the cost of a potential erosion of credibility. Those who support the idea (Bernanke 1999 and Krugman 1998) stress that explicit targets would give private decision-makers more information about the objectives of monetary policy and encourage them to act in a way that would help the target to be realized.

In an interesting twist on this idea—which combines it with another idea discussed above—Svensson (2001) proposes establishing, for a period of time, a price-level target path corresponding to positive inflation (inflation expectations) reinforced by a devaluation of the yen that would be held for a sufficient period of time (a temporary peg) by intervention of whatever magnitudes were required. Since the proposal provides the means—the temporary exchange rate peg—for the Bank of Japan to achieve its inflation objective, its major concern is addressed (see the discussion of Okina 1999 below). As for the Ministry of Finance being responsible for foreign-exchange intervention, Svensson expects that it would do what is required for the welfare of the country. Note that once the price-level target is reached (the price-level gap is removed), the peg would be

abandoned and monetary policy would shift to whatever target (price-level or inflation) had been previously announced.

Those who oppose the idea of inflation targets (Okina 1999 and Okina and Oda 2000 consider the Japanese situation) stress the loss-of-credibility risk if the central bank announces an explicit target but has not formulated a way to implement it. Inflation targets may help implement a disinflationary policy for which a clear policy path (higher nominal interest rates) can be planned, but implementing an inflationary policy (without the nominal interest rate channel) is a different thing altogether. Okina's point stresses that there is no upper bound on nominal interest rates. Okina and Oda (2000) seem to suggest that making the central bank accountable for an inflation target, especially in a situation like that in Japan, can lead it to take risks that it might not have taken otherwise.

Analysis

Each policy alternative to the usual interest rate channel at the zero bound has its merits and shortcomings. While accepting the possibility of monetary policy being ineffective for the reasons discussed above, it is hard to believe that if the monetary authority was to intervene in a massive way, including implementing a Svensson (2001) type of proposal, that there would be no stabilizing response in the economy. In particular, economic agents could not ignore a substantial excess of real money balances and, as a result, would try to reduce those balances, leading to higher inflation and more activity. However, this approach may not be the best one, because of the many uncertainties involved (e.g., how much? how long? what response? is it the desired one? when to unwind?). On the other hand, an extreme situation may require more creative responses.

Given the lack of consensus about how effective monetary policy can be at the zero bound, one approach in a situation perceived to have an increased probability of encountering the zero bound is to have a contingency plan requiring joint action by the fiscal and monetary authority (as in Svensson's 2001 proposal) when certain pre-specified conditions arise. It could be made clear that most, if not all, studies suggest that there is a very low risk of encountering a zero bound, and even less of a risk of it resulting in a liquidity crisis, particularly if the financial authorities have been following prudent policies (Cargill 2000). The contingency plan would be in place to aid in the stabilization of the economy in the face of unexpected negative shocks outside of the usual range of historical experience.

The cornerstone of this contingency plan would be the central bank's ongoing commitment to an inflation, price-level, or combined target. If the commitment is credible, then returning to the target should be easier (see Svensson 1999). All other non-interest rate channel alternatives

outlined in Table 1 would exist only to support a return to the inflation target and should be utilized in that context. Evidence from Japan suggests that a commitment to “stay at zero” until central bank forecasts see inflation returning into the target band flattens the yield at longer maturities. This would be a useful second step. Beyond this, large unsterilized interventions and writing options may be necessary.

Such a contingency plan should be flexible enough to take into account the nature of the shock that causes nominal interest rates to fall to zero; e.g., is the shock purely a national one or is it the result of spillover effects from another country? For example, if the United States was to encounter a zero bound situation, expectations and economic activity in Canada would likely be negatively affected. In such a case, the contingency plan might need to be coordinated with other nations, particularly since the exchange rate channel may no longer be available.

7. What are the Lessons from Other Times and Other Places?

As stated earlier, history is an obvious place from which to seek insights into the implications for the economic activity and policy of the zero bound on nominal interest rates. In this vein, we provide brief observations based on our reading of the literature on the experience of the United States during the Great Depression and that of Japan in the 1990s.

7.1 What can we learn from the experience of the Great Depression?

Despite the many changes in economic institutions and industrial structures since the Great Depression, the research literature on what happened during the Great Depression is still an obvious place from which to seek insights into what might occur if a zero bound situation were to arise. In the early 1930s, prices plunged more quickly than nominal interest rates fell, so real rates rose, and, at least in the United States—where financial markets were a bit more developed—for a time the term structure suggested an expectation that nominal short-term rates would shortly rebound (Clouse et al. 2000).

Much work has been done to analyze the lessons from the Great Depression. Recent work by Bordo, Choudhri, and Schwartz (1999) seems to reflect the evolving view. Their main point is that the United States was not constrained from using an expansionary policy to offset banking panics, deflation, and declining economic activity at the time of the Great Depression. Bordo, Choudhri, and Schwartz report that simulations based on a model of a large open economy indicate that expansionary open-market operations by the Federal Reserve at two critical junctures (October 1930 to February 1931, and September 1931 to January 1932) would have successfully averted the

banking panics that occurred without endangering convertibility. They assert that if the expansionary open-market purchases had been conducted in 1930, the contraction would not have led to the international crises that followed.

Meltzer (1999) comes to the same conclusion from a different perspective. As stated earlier, he tries to demonstrate from various episodes in history that monetary policy remains effective at low inflation rates when assets are not perfect substitutes. He specifically indicates that he did not consider the 1929–33 period to contradict his results because "the price level continued to fall, and the economy continued to contract as money and real balances fell. . . . The policy actions, not the responses, were perverse" (p. 13). Cargill (2000) comes to a similar conclusion.

Incorrect policy actions and a large negative shock can interact to create a downward spiral that becomes very difficult to reverse. In the worst case there might be a liquidity trap.[17]

7.2 What can we learn from the Japanese experience?

Various authors have drawn parallels between the experience of the United States in the early years of the Great Depression and that of Japan in the early 1990s.[18] For example, in both cases there was a delayed decline in long-term yields and there were questions about whether monetary policy could have been better. It is perhaps not surprising that the conclusions about the most important lessons are similar. There appear to be two specific lessons: (i) monetary policy should consistently focus its efforts on one clearly defined policy target, and (ii) because credibility is so important to a monetary authority, concerns about the implications of any particular policy choice can narrow the choices perceived to be available, especially in a situation where credibility is already low.

There are various assessments of the Japanese monetary authority's degree of culpability, although there is certainly a view that things might have been done better at points in time. For

17. However, the IMF (1999, p. 34, footnote 32) notes that:
"The existence of a liquidity trap is inconsistent with the quantity theory of money (or—equivalently—a stable money demand function with a finite interest elasticity) and has been rejected by leading monetarists. It is interesting to note that Keynes himself considered an infinitely interest-elastic money demand a theoretical curiosity of little practical relevance. In the original Keynesian framework (*The General Theory*), the ineffectiveness of monetary policy was linked to a low and unstable interest elasticity of aggregate demand (business investment in particular), rather than to an infinitely interest-elastic demand for money, labelled the "liquidity trap" by Keynes and his followers; see Karl Brunner and Allan Meltzer, "Liquidity Traps for Money, Bank Credit, and Interest Rates," *Journal of Political Economy*, January–February 1968, (pp. 1–38)."

18. Radelet and Sachs (1999) draw some parallels between "mistaken" policy actions in the early years of the Great Depression in the United States and the tightening of policies demanded of East Asian countries by the international community in response to the Asian Crisis.

example, Bernanke (1999) points to three "mistakes" that the Bank of Japan made in the late 1980s and early 1990s: (i) their failure to tighten from 1987 to 1989, which led to the asset-price bubble of the late 1980s; (ii) their attempt to prick that bubble; and (iii) their failure to ease when asset prices did decline from 1991 to 1994. Bernanke attributes these mistakes to the Bank of Japan's obsession with the yen/dollar exchange rate and asset prices, rather than inflation and aggregate demand. Given that other evidence suggests that the United States Federal Reserve policy had aimed to bring down equity prices in February 1929, there might be a lesson to learn from the resultant poor outcomes in each case. One potential lesson seems to be "that if central bankers allow the fluctuations in asset prices to affect their decisions it may distract them from concentrating on some combination of output growth and inflation" (Cecchetti 1998, p. 179).

Posen (1998, p. 2) argues that the economic stagnation of Japan in the 1990s resulted from bad macroeconomic policy more broadly. He says:

> . . . the stagnation of Japan in the 1990s was anything but inevitable, and it was misguided macroeconomic austerity and financial laissez-faire—not lack of return on investment or political deadlock—that caused it. In the 1990s, Japanese economic policymakers were presented with the opportunity to fight the last war, the demand-shock-caused depression of the 1930s, and they chose to adopt the strategy that lost the war.

Regarding the most fundamental aspect of monetary policy, Meltzer (2000, p. 32) argues that the government and the Bank of Japan should decide on a single goal for monetary policy and that "an adaptive policy rule for price stability meets the objective expressed in the Bank of Japan law." Taylor (2000c, p. 15) states that "it is hard for me to see how modern policy analysis can be done without an inflation target," but that it is not the same as adopting an "inflation policy" whereby the central bank chooses a high inflation rate to stimulate the economy (see Krugman 1998). Introducing an "inflation policy" in the current situation has been criticized by some researchers as being naive, not because of theoretical problems with the idea, but because of practical considerations. To some extent the criticism demonstrates the points made earlier about the need to work consistently to gain and maintain credibility when the economy is performing well. The job is doubly difficult if the monetary authority starts only when the economy is in a precarious situation.

Okina (1999) seems to be dismissive of introducing either inflation targeting or an "inflation policy" in Japan. He acknowledges the important role inflation targeting has had in several countries implementing disinflation. However, he argues that with nominal interest rates already near zero, the Bank of Japan has lost its main instrument and would need to turn to "innovative measures beyond the current policy framework" (p. 165) to create additional monetary easing. The introduction of alternative and untried policy options without prior evidence or knowledge of

their effectiveness might further impair the Bank of Japan's credibility. For any central bank caught in this scenario there are two types of credibility: (i) that they will do what they say, and (ii) that they can deliver on the promise. For the first one, the Bank of Japan has likely lost credibility over the past decade and a half. For the second, there is no precedent to allow the Bank of Japan (and the Japanese public) to be confident that whatever is announced could be achieved.

7.3 What can we not learn from the experience of Japan in the 1990s?

Japan's role in both the Asian and global economy makes its experience less applicable to the Canadian context, particularly in issues related to the exchange rate. Japan is the world's second-largest economy and the cornerstone of the Asian economy. Canada, on the other hand, is a relatively small economy both locally and globally. One might expect large economies to have a tougher time getting out of a liquidity trap for several reasons. For one, if a large economy falls into a trap, the economic effects could spill over onto its trade partners, thereby unleashing second-round effects, such as weakened export markets or perhaps exporting those deflationary expectations. Correspondingly, that country may not be able to export its way out of its slump. Smaller countries (like Canada) may be able to rely on trade to reinvigorate their economy. Goodfriend (2000) and Stevens (2000) allude to this possibility. Of course, there is a risk that, if the small country had strong links with a large trading partner and the latter encountered the zero bound problem, there could be negative effects for the small country from weaker exports and an erosion of expectations about future economic activity.

For example, it is unlikely that a concerted effort by the Bank of Canada to depreciate the dollar would motivate depreciations in other currencies. It seems plausible that a Canadian dollar depreciation when the economy is in large excess supply would be tolerated. In addition, it can be argued that Canada faces few of the "structural" factors that have worked against Japanese policy-makers and their desire for a lower yen exchange rate when nominal interest rates are near zero.[19] Nevertheless, even without these factors working against the Bank of Canada, it is still possible that intervening to bring down the value of the dollar would fail in Canada.

Svensson (2000, p. 28) remarks that:

> To the extent that the exchange rate is determined by an interest-rate parity condition involving the interest rate differential relative to foreign interest rates, once domestic interest rates are zero, the domestic currency is expected to appreciate over time and the current exchange rate varies with the expected future exchange rate. . . . If deflationary expectations do not change, non sterilized foreign-exchange interventions are then unlikely to affect the current exchange rate (not to speak of sterilized foreign-exchange interventions).

19. See McKinnon, Ohno, and Shirono (1999) for a discussion of the "syndrome of the ever-higher yen."

Freedman (2000) also questions the efficacy of foreign exchange interventions and their likelihood of success. He does suggest that the "psychological reaction" of the market to a non-sterilized intervention might stand a small chance of changing expectations. Expectations play a huge role in liquidity traps. Unless the central banker can change expectations, foreign exchange interventions are futile.

Analysis

Perhaps the most important lesson for central banks from the experience of the United States during the Great Depression and of Japan in the 1990s is that conducting monetary policy with a strong focus on fundamentals (low inflation and stable output growth) is a good way to avoid the problems brought about by the zero bound on nominal interest rates. While this strategy will not guarantee complete removal of all risks, there seems to be more and more agreement that the evidence from Japan in the 1990s and the United States during the Great Depression suggests that a better performance on policy would have moderated the worst aspects.

While conventional wisdom suggests that central banks have nothing to gain and much to lose by focusing too much attention on asset prices, a very recent report suggests that this approach should be revisited (Cecchetti et al. 2000). The authors argue that inflation-targeting central banks can smooth the path of inflation by taking asset prices (in particular, housing prices) into account when formulating monetary policy.[20] Other reports do not go so far. For example, Bernanke and Gertler (2000, p. 46) conclude that "given a strong commitment to stabilizing expected inflation (by using targets), it is neither necessary nor desirable for monetary policy to respond to changes in asset prices, except to the extent that they help to forecast inflationary or deflationary pressures." The role of monetary policy in responding to an asset-price bubble remains an unresolved issue. It is true that asset prices may play a role in deflationary shocks large enough to create a zero bound on nominal interest rates. DeLong (2000) has argued that asset prices, more than general consumer prices, are a likely source of deflationary shocks in a modern economy. Research on the Great Depression and the recent stagnation in Japan (see Ito and Iwaisako 1995, and Bayoumi 1999) suggests that asset prices played an important role in these events. Nevertheless, how a central bank should explicitly take into account movements in asset prices remains unclear.

20. In Canada, housing-price movements are captured to some extent in the consumer price index.

8. Conclusions

This paper has surveyed the literature on the zero bound on the nominal interest rate. A range of questions have been considered. How likely is it that the zero bound on the nominal interest rate will be encountered for specific inflation targets, whether explicit or implicit? Are there circumstances (the policy framework, the economic context, etc.) that would lead to somewhat different conclusions? Are alternatives to the usual interest rate channel available to the monetary authority for stabilization purposes in a zero bound situation? What does the experience of the United States during the Great Depression and that of Japan in the 1990s imply for how cautious the monetary authority should be in choosing its policy target?

Various approaches, ranging from analyses of historical data to stochastic simulations of models, suggest that the probability of encountering the zero bound is relatively low. Most researchers would see this probability as essentially zero for an inflation target of 2 per cent with only a slight increase down to a 1 per cent inflation target, assuming an equilibrium real interest rate in line with recent long-run averages in the industrial countries (other than Japan). However, the model simulation work indicates that the relationship is a non-linear one, such that as inflation approaches zero, the likelihood of encountering the zero bound increases at an increasing rate. There is a major caveat to relying on inferences based on historical data, whether they are used for statistical analyses or for estimating or calibrating models: they come from different monetary regimes and, hence, may lead to mistaken inferences for a regime of price stability.

Some researchers have used analytic or simulation work to argue that the situation is different if the price level is a key element of the monetary authority’s loss function, as opposed to an inflation target alone. Their work notes that the commitment by the monetary authority to bring the price level back to its targeted path encourages stabilizing-inflation expectations. For example, if a negative demand shock pushes the price level below its targeted value, then forward-looking economic agents will anticipate higher-than-normal inflation to bring the price level back to where it should be. Such inflation expectations mean that the ex ante real interest rate is lower than otherwise, thus contributing to stabilizing adjustments in the economy. Other researchers have suggested that a similar result could be obtained with an inflation target and a commitment by the monetary authority to keep interest rates lower than otherwise after a period when the zero bound on the nominal interest rate has kept them higher than otherwise.

An important conditioning element for these conclusions is credibility. In that area, the objective of the monetary authority is well known, as is its reaction function. With the knowledge and belief that the monetary authority will do what it commits to do, economic agents respond in a stabilizing

manner. In reality, this state can be approached only in an economy with a coherent monetary order (see Laidler 1999). Another context element is that the equilibrium real interest rate in most credibility work is taken to be equal to the long-run average over some recent period, placing it at around 2 per cent (Treasury bill rate) for the United States and between 3 and 4 per cent (90-day commercial paper rate) for Canada.[21] Other things being equal, the higher the real interest rate the more room there is before the zero bound on nominal interest rates is encountered for a given low-inflation rate. The higher the natural growth rate of the economy the higher is its equilibrium real interest rate. For a number of reasons, any particular country may have an average real rate over a period of time that differs from that for the world over the same period.

Even if an economy has a coherent monetary order, good fiscal and structural policies, and all of its other economic and institutional elements as they should be, it could still be hit unexpectedly by an unprecedented negative shock. In such a situation, the zero bound on the nominal interest rate may act as a constraint on the stabilization activities of the monetary authority. In terms of the potential alternative channels for monetary policy to contribute to stabilization—such as providing more liquidity to the economy, directly affecting expectations, or taxing money holdings—there is no clear-cut consensus in the literature. On increasing liquidity, the tension is between those who believe that the usual interest rate channel is crucial and those who believe that there is sufficient substitutability among assets that portfolio balance and credit channels can play a role. To affect expectations, the monetary authority must have credibility that it will adhere to what it proposes and the credibility that it can deliver on its proposal, both of which may be hard to achieve in an unprecedented economic situation. With respect to taxing money holdings, the main tension is between those who see it as a viable option and those who see it as unlikely because of high administrative costs.

An undercurrent in the relevant literature suggests that if the action by the monetary authority were massive enough, it would be able to move the economy away from the zero bound. Since the amount of intervention required will be known only after the fact, there is a risk to credibility both from not doing enough and from doing too much. However, it must be acknowledged that extreme situations may require creative actions. One possibility for low-inflation economies is to have a joint agreement between the fiscal and monetary authorities to a contingency plan to be implemented immediately if a zero bound situation were to occur. The importance of a prompt response by the fiscal authority was specifically noted in one study that used stochastic

21. As a point of reference, researchers in the United States tend to use the Treasury bill rate and researchers in Canada the 90-day commercial paper rate. When like is compared to like—for example, real 90-day commercial paper rates—the equilibrium real rate in Canada is likely to be about 50 basis points higher than that in the United States.

simulations to assess the implications of the zero bound for an economy with a low inflation target. What was achievable for an inflation target seemed to be premised on the possibility of coordinated fiscal action.

An example of the need for such coordination is given in the elements of a recent proposal by Svensson (2001) to aid the transition to a sustainable environment. The monetary authority (perhaps jointly with the government) adopts a price-level target, the implication of which is a path for inflation. The fiscal authority supports its achievement and maintenance by agreeing to intervene to depreciate the exchange rate to the requisite level and to hold it there for a period of time (a temporary peg). The idea is to remove whatever price-level gap has emerged. Once the price-level target is reached, the peg would be abandoned and monetary policy would shift to targeting its usual objective (one example is an inflation target).

The main lessons to be drawn from the experiences of the United States during the Great Depression and Japan in the 1990s, according to the literature that we have read, are threefold and interrelated: (i) confusion about the goal and/or poor implementation of monetary policy should be avoided, (ii) the monetary authority when confronted with a zero bound situation may be too cautious in taking stabilizing action for fear of eroding any remaining credibility, and (iii) a prolonged period of economic stagnation may occur, weakening confidence in the ability of the monetary authority to influence economic activity, even over the short term.

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