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The Future of Inflation Targeting*

CARL E. WALSH

Department of Economics, University of California, Santa Cruz, CA, USA

By the end of the Great Moderation, over two dozen central banks were formal inflation targeters, and others, such as the Federal Reserve, the European Central Bank and the Swiss National Bank, behaved essentially as inflation targeters even though they were resistant to identifying themselves as such. However, the past 3 years have seen central banks faced with new challenges, and these have raised questions about the future of inflation targeting as a framework for the conduct of monetary policy. I consider three suggested modifications to this policy framework: incorporating additional goals among a central bank's objectives; raising the average target for inflation; and switching to price level targeting.

I Introduction

Twenty years ago, the Reserve Bank of New Zealand Act of 1989 came into effect, restructuring the relationship between New Zealand's central bank and its elected government. This change heralded the emergence of inflation targeting as a means of achieving low and stable inflation. Australia was one of the earlier adopters of inflation targeting, announcing its first inflation target in 1993. From these early adopters, inflation targeting spread so that, at the onset of the recent financial crisis, over two dozen central banks were formal inflation targeters, and others, such as the Federal Reserve, the European Central Bank and the Swiss National Bank, behaved essentially as inflation targeters even though they were resistant to identifying themselves as such.

In the years immediately leading up to the crisis in financial markets and the most severe global recession since the 1930s, policy-makers and academic economists shared a broad consensus about monetary policy (Svensson, 2002; Goodfriend, 2007). As part of this consensus, the notion that inflation targeting represented best practice among central banks was widespread, but most discussions of monetary policy emphasised the dual objectives of stabilising inflation around a low level and stabilising some measure of real economic activity. Financial stability was also mentioned as desirable, but by and large, discussions of monetary policy took financial stability for granted, and models used for policy analysis almost always assumed financial frictions were irrelevant for policy design.

During the past three years, key aspects of this consensus have been called into question

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Correspondence: Carl E. Walsh, Department of Economics, University of California, 1156 High St., Santa Cruz, CA 95064, USA. Email: walshc@ucsc.edu

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and have lead to a re-examination of inflation targeting. I consider three suggested modifications to this policy framework. The first modification calls for incorporating additional objectives into the mandates of central banks. The second two, raising the average target for inflation and, more radically, switching to price level targeting, have gained adherents as ways of overcoming the constraint the zero lower bound on nominal interest rates poses for monetary policy. Conclusions are summarised in the final section.[1]

II Inflation Targeting as a Policy Framework

Flexible inflation targeting is generally modelled by assuming the central bank implements policy to minimise a quadratic loss function of the form

$$\mathrm{E}_t \sum_{i=0}^{\infty} \beta^i [(\pi_{t+i} - \pi^*)^2 + \lambda x_{t+i}^2], \qquad (1)$$

where π_t is inflation, π^* is the inflation target, and x_t is the output gap. The inflation targeting in the name reflected the primacy of inflation as the ultimate objective of monetary policy; the flexibility reflected the short-run trade-off between inflation control and real economic stability that would make strict inflation targeting – an exclusive focus on stabilising inflation – too costly to be socially desirable. Equation (1) can represent the objectives of formal inflation targeters as well as those of central banks such as the Federal Reserve that emphasise the role of real objectives in addition to inflation. While many central banks have also become more transparent in recent years, an important distinction between formal and informal inflation targeters is that formal targeters make public the value of the target π^*.

III Should Inflation Targeting Become More Flexible?

Inflation targeting has frequently been criticised as focusing too much on inflation stability, or it has been argued that central banks should focus on more objectives than just inflation and output gap stability. So should central banks add to their list of policy objectives? That is, should they become more flexible in pursuing their inflation goals?

The theoretical rationale for flexible inflation targeting was based on models in which stabilising the inflation gap and the output gap succeeded in minimising economic distortions.[2] When additional distortions are present, such as those associated with credit market or labour market frictions, then a policy aimed at minimising the welfare costs of economic fluctuations will need to expand the list of objectives beyond the minimisation of inflation and output gaps.[3] With more distortions than policy instruments, we are in the world of the second best and an exclusive focus on eliminating a single distortion, by stabilising inflation for example, is unlikely to be optimal.

(i) Credit Market Frictions

Much recent research has focused on improving our understanding of credit frictions and the distortions these frictions may generate. Unfortunately, we do not yet have a clear understanding of the nature of financial market distortions that might be addressed by monetary policy, how to measure the financial market distortions to which monetary policy might respond, or even what that response should be. For example, Faia and Monacelli (2007) derive the optimal monetary policy in the context of a model with a financial accelerator and find that the central bank should actually cut interest rates in response to a rise in asset prices. In their model, financial frictions limit the response of investment to productivity shocks. Essentially, these frictions act as a procyclical tax on investment, and the central bank should offset this tax by cutting interest rates in a boom and raising them in a bust. As this example illustrates, the policy implications of financial market frictions are not always straightforward and depend heavily on the sources of economic fluctuations and the nature of the frictions.

[1] The longer version of this article presented at the 2010 Australian Conference of Economists also reviews the performance of inflation targeting countries during the crisis. See also Rose (2007), Walsh (2009a) and Roger (2010).

[2] This is not quite right. These models generally assume a fiscal subsidy is used to address the average distortion created by monopolistic competition. Consistent with that literature, I will continue to focus on the distortions that can be ameliorated by monetary policy.

[3] For example, when nominal wages are sticky, optimal policy needs to consider a wage inflation gap as well as an inflation gap.

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Of course, the mere existence of distortions in financial markets does not necessarily call for a monetary policy response. Presumably, the first best policy involves establishing an adequate system of financial market regulation. As an analogy, consider a baseline new Keynesian model with monopolistic competition and sticky prices. The presence of imperfect competition implies that even with flexible prices, the equilibrium output level would be too low. But the solution is to use taxes and subsidies, not monetary policy, to deal with the distortion caused by imperfect competition. This leaves monetary policy free to address the distortions created by nominal rigidities.

But even with the best designed financial regulation, credit markets may be subject to frictions that interact with the nominal rigidities that give monetary policy leverage to affect the real economy. In this case, the central bank cannot ignore the effect it may have on financial markets. Hence, the key issues involve identifying what the distortions are, measuring them, deciding whether they present trade-offs in that achieving inflation, output and financial market objectives conflict, and determining whether there are other policies better designed to deal with these other distortions.

(ii) Labour Market Frictions

A large literature has studied the implications of two types of frictions that characterise labour markets. First, since the original work of Erceg *et al.* (2000), it has become common to incorporate nominal wage rigidities. The staggered adjustment of wages generates an inefficient dispersion of relative wages whenever nominal wage inflation deviates from zero. Optimal policy balances the resulting welfare cost against the welfare costs of relative price dispersion that is generated when price inflation deviates from zero. If, as a result of real shocks, real wages need to adjust, the goals of price stability and of wage stability clash.

Second, an alternative literature has worked to embed unemployment into DSGE models, and much of this literature has explored the consequences of labour market frictions within the Mortensen–Pissarides search and matching model (e.g. Walsh, 2005; Blanchard & Galí, 2010; Ravenna & Walsh, 2011). In this class of search models, the initial employment level (the number of matches) is a critical state variable that affects the dynamics of economic adjustment, and the evolution of employment depends on both the incentives firms have to create jobs and the frictions that prevent unmatched vacancies and unemployment workers from quickly matching.

Ravenna and Walsh (2011) show that in a basic model with labour search frictions the welfare-consistent quadratic loss function depends on inflation, the output gap and deviation of labour market tightness (vacancies relative to unemployment) around its efficient level. That is, it is appropriate to stabilise inflation, the output gap and a labour market gap.[4] Price inflation is costly because it generates an inefficient dispersion of relative prices. This reduces welfare because, conditional on total consumption, it leads the economy to produce an inefficient bundle of goods. Similarly, when market production is subject to frictions in matching workers and firms, deviations of labour market tightness from its efficient level lead, for a given level of utility, to an inefficient combination of market production (which incurs search costs) and nonmarket activities (which do not incur search costs). Hence, frictions in the labour market can make labour market conditions and variables such as the unemployment rate appropriate objectives for monetary policy.

(iii) Summary on Policy Objectives

Most of the recent research has focused on how labour market and financial frictions affect the transmission process of monetary policy. Distortions originating in either labour or financial markets that generate real effects of monetary policy may require making trade-offs with the goals of inflation stability and stability of real economic activity. However, measuring these distortions is a difficult task. While measures such as credit spreads may provide one measure of the type of inefficient fluctuations that would call for a policy response, we still do not fully understand the factors that generate movements in spreads, or the degree to which these movements reflect inefficient fluctuations that call for policy responses. Similarly, just as measuring the output gap raises significant issues, the same issues apply to measuring the labour market tightness gap.

[4] As Ravenna and Walsh show, labour market tightness can be equivalently expressed in terms of a measure of unemployment.

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In models with multiple distortions, eliminating any one distortion, such as by focusing solely on price stability, may lead to suboptimal outcomes by worsening other economic distortions. Despite this, a common result in much of the literature to date has been that price stability is often a close approximation to the optimal policy even in the face of other distortions.[5]

IV The ZLB and Raising the Inflation Target

Over the past three years, many central banks have had to cut their policy rate to zero as they strove to counteract the massive contraction associated with the financial crises. Given the constraint posed by the zero lower bound (ZLB) on nominal interest rates, Blanchard *et al.* (2010) have recently proposed raising average inflation targets, and when Japan was confronted with the ZLB, Krugman (1998), McCallum (2000) and Svensson (2001, 2003) all proposed that the Bank of Japan commit to policies that promised higher future inflation. These proposals for higher inflation are relevant for two separate questions. First, how can the chances of hitting the ZLB be reduced? And second, how can a central bank expand the economy when its policy rate is already at zero?

(i) Reducing the Chances of Hitting the ZLB

Raising the average inflation target would lead to a higher average level of nominal interest rates. This would give the central bank more room to cut rates in the face of a contractionary shock to the economy before hitting the zero lower bound. This point was first made by Summers (1991).

Prior to the crisis, a consensus existed among high income inflation targeters that a target within the range of 1–3 per cent represented an appropriate goal for average inflation. Central banks that have not formally adopted inflation targeting also seem to have implicit targets that fall in the 1–3 per cent range. For example, it is reasonable to interpret the long-term inflation forecast of members of the Federal Reserve's Federal Open Market Committee (FOMC) as equivalent to an implicit inflation target. This central tendency forecast for inflation in the longer term, measured by the price index for personal consumption expenditures, ranges between 1.5 and 2 per cent. The ECB has stated publicly that inflation should remain at or below 2 per cent.

Using the FRB/US model and a Taylor rule to represent monetary policy, Williams (2009) finds that the ZLB has proven to be a hindrance to economic recovery in the aftermath of the recent financial crisis and concludes that 'The analysis in this paper argues that an inflation target of between 2 and 4 per cent will, on average, be sufficient to avoid the ZLB causing sizable costs in terms of macroeconomic stabilisation even in a much more adverse macroeconomic climate' (p. 26).

Not all authors have found low inflation to lead to frequent encounters with the ZLB. For example, Schmitt-Grohe and Uribe (2010) argue that even with a quite low average inflation rate, the ZLB binds infrequently. In fact, in many of the variants of the model they analyse, the optimal rate of inflation is negative and still the ZLB occurs infrequently. Of course, this result is dependent on the level of the average real return and variances of the underlying exogenous shocks, with the ZLB encountered more frequently if the economy is subject to larger shocks.

Blanchard *et al.* (2010) are perhaps the most prominent proponents of raising the inflation target, and they have argued that a 4 per cent average inflation rate would constitute a safer target by providing more room for interest rate cuts when the economy faces an adverse shock. While accepting that higher inflation is distortionary, they suggest that many of these distortions could be eliminated if tax systems were corrected to allow for higher average inflation. Higher inflation might also induce more widespread wage indexation which would then hinder the ability of the economy to adjust to shocks requiring adjustment of real wages. Blanchard *et al.* also recognise that we do not really know whether inflation expectations would be more difficult to anchor if average inflation rates were to rise.

Determining whether average inflation targets should be raised requires an analysis of the costs and benefits of higher inflation. Of course, a long literature has addressed the issue of the optimal rate of inflation. Much of this literature focused on the steady state and so ignored the role of monetary policy as a tool for stabilising

[5] For example, this is the finding of Faia and Monacelli (2007) in a model with credit frictions and of Ravenna and Walsh (2011) in a model with labour market frictions.

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the economy in the face of shocks, but it provides a useful starting point for a discussion of inflation targets.

The optimal rate of inflation: the traditional analysis

Bailey (1956) and Friedman (1969) identified a key inefficiency that arises when nominal interest rates are positive: private agents will inefficiently economise on their money holdings. An increase in the average rate of inflation would increase this efficiency cost. However, the size of this cost if average inflation rose from 2 to 4 per cent is likely to be small. Ireland (2009) finds that, using a measure of the money stock that accounts for some of the changes due to financial market deregulation, the traditional welfare cost of 2 per cent inflation is less than 0.04 per cent of income.

Even that small cost can be avoided, as higher inflation need not raise the opportunity cost of holding money if money pays an own return that also rises with inflation. While there may be technical difficulties in paying interest on cash, many countries, including now the United States, pay interest on bank reserves. With interest paid only on reserves, the demand for currency remains distorted by a positive nominal interest rate, but if it becomes feasible to pay explicit interest on money, then the Friedman welfare costs of moving from an average inflation rate of 2 per cent to one of 4 per cent are likely to be tiny.

Paying interest on money does have fiscal implications; other sources of fiscal revenue must be used to finance interest on money, and this will require increases in other potentially distorting taxes. If the welfare costs of the Friedman distortion are small, however, the fiscal implication of eliminating them is also likely to be small.

Other costs of inflation

The more recent literature on wage and price stickiness has emphasised a second distortion that would be worsened by a rise in inflation. When the adjustment of wages and prices is staggered across firms and not fully indexed, higher inflation generates an increase in relative wage and price dispersion. Because this dispersion is not generated by fundamental shifts in the demand or supply of individual products or labour types, economic efficiency is reduced. In calibrated models, this efficiency loss arising from relative price dispersion is significantly larger than the costs Friedman identified.

If firms indexed prices to the average rate of inflation, as is commonly assumed in many of the empirically estimated models employed for policy analysis, then a move from say 2 to 4 per cent average inflation would not affect the dispersion of relative prices. However, since micro data provide no evidence of this type of indexation, an increase in the average rate of inflation is likely to reduce the ability of the price system to efficiently guide the allocation of resources.

In fact, Coibion *et al.* (2010) and Lago Alves (2010) show that the effect of trend inflation on welfare can be quite significant, and standard approximations to welfare that are correct for a zero-trend inflation rate can be quite misleading if used to estimate the welfare costs when average inflation is positive. In particular, the standard approximation suggests that welfare is little affected by an increase of average inflation from 1 to 6 per cent. Yet when the correct approximation is employed, welfare falls sharply as inflation rises past around 2 per cent. With their calibration, Coibion *et al.* find the optimal inflation rate is equal to approximately 1 per cent per year. Coibion *et al.* also account explicitly for the ZLB in their analysis of the optimal rate of inflation and examine the robustness of their estimate of the optimal inflation rate to various changes in the model parameters. In general, they find that the optimal rate is positive but quite low, usually on the order of 1–2 per cent per year, a figure actually on the low side of most target ranges employed by central banks.

Benefits of higher inflation

Two benefits of inflation are relevant in considering whether to raise inflation targets. First, positive nominal interest rates provide revenue for the government – seigniorage. Second, Akerlof *et al.* (1996) have suggested that, due to the resistance to nominal wage cuts, the long-run (unemployment) Phillips Curve is not vertical but has a negative slope at low rates of inflation. Hence, higher average inflation would lower the average rate of unemployment.[6]

[6] This issues has recently been revisited by Benigno and Ricci (2010) who show how the Phillips Curve flattens at low rates of inflation and shifts with changes in macro volatility.

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However, the evidence on downward nominal wage stickiness is mixed. Haefke *et al.* (2007) and Pissarides (2009) conclude that wage stickiness does not explain the observed volatility of unemployment, and Kudlyak (2009) finds that the real user cost of labour is fairly cyclically sensitive. The evidence suggests that wages for new hirers display much greater flexibility than wages for existing workers. Hence, at the margin relevant for hiring decisions, wage stickiness may be less important.

Summary on raising the inflation target

In considering whether average inflation targets should be raised, it is relevant to consider whether other policies might reduce macro volatility and thereby reduce the chances of hitting the ZLB. Better financial sector regulation, for example, might insulate the economy from large shocks without necessitating a rise in the average inflation rate. And it is important to recall that central banks have spent the past 25 years striving to reduce inflation and to gain the credibility necessary to maintain inflation at low and stable rates. The stability of inflation expectations has been a characteristic of the recent crisis, a stability that might have been less likely during earlier periods in which the commitment of central banks to low and stable inflation was less clear. This credibility may be put at risk if inflation targets are increased.

(ii) The ZLB as a Constraint on Monetary Policy

How much does the ZLB actually restrict the ability of central banks to ensure macroeconomics stability? To address this question, it is useful to start with a conventional model.

Conventional policy at the ZLB

In recent years, monetary policy analysis has been dominated by the new Keynesian framework (e.g. Clarida *et al.*, 1999; Woodford, 2003). This framework consists of an expectational IS relationship given by

$$x_t = \mathrm{E}_t x_{t+1} - \left(\frac{1}{\sigma}\right)\left(i_t - \mathrm{E}_t \pi_{t+1} - r_t^n\right), \qquad (2)$$

and an inflation adjustment equation given by

$$\pi_t = \beta \mathrm{E}_t \pi_{t+1} + \kappa x_t + e_t, \qquad (3)$$

where x_t is the output gap, π_t is inflation, r_t^n is the equilibrium real interest rate when the output gap is zero, e_t is a cost shock and i_t is the nominal interest rate. These equations can be derived by log-linearising the equilibrium conditions of a model consisting of a representative household and firms operating in goods markets characterised by monopolistic competition using time-dependent price-adjustment strategies.[7] The conventional policy instrument is taken to be the current policy interest rate. However, the expectational IS curve given in (2) can be solved forward to obtain

$$x_t = -\left(\frac{1}{\sigma}\right)\left[(i_t - \mathrm{E}_t \pi_{t+1}) + \mathrm{E}_t \sum_{i=1}^{\infty}(i_{t+i} - \pi_{t+1+i}) - \mathrm{E}_t \sum_{i=0}^{\infty} r_{t+i}^n\right], \qquad (4)$$

Equation (4) makes clear that both the current policy rate and expectations about its future path are important.

The idea that it is both current policy and expectations of the future policy path that matter has played an important role in discussions of monetary policy at the ZLB (Eggertsson & Woodford, 2003). Even when the current policy rate is at zero, the central bank still has the potential to influence real spending if it can affect expectations of future real interest rates. If $i_t = 0$ and is expected to remain at zero until $t + T$, then (4) becomes

$$x_t = \left(\frac{1}{\sigma}\right)\left[\sum_{i=0}^{T} \mathrm{E}_t \pi_{t+1+i} - \mathrm{E}_t \sum_{i=T+1}^{\infty}(i_{t+i} - \pi_{t+1+i}) + \mathrm{E}_t \sum_{i=0}^{\infty} r_{t+i}^n\right].$$

Therefore, output can be stimulated by raising expected inflation, by lowering expected future real interest rates or by raising the natural real rate, either now or in the future. If the central bank is able to commit to future policies, it can stimulate current output by committing to keep rates low for an 'extended period of time'. This would involve keeping the policy rate at zero even when the natural rate has risen to levels that would normally call for the policy rate to move back into positive territory. That is, the

[7] For a textbook derivation, see Walsh (2010a, Chapter 8). The discussion in this section and the following one borrows from Walsh (2009b).

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central bank commits to maintaining a zero-rate policy even when the ZLB is no longer a binding constraint (Eggertsson & Woodford, 2003). If the central bank is able to do this, most research suggests that the costs of the ZLB are quite small (e.g. Eggertsson & Woodford, 2003; Adams & Billi, 2006; Nakov, 2008).[8]

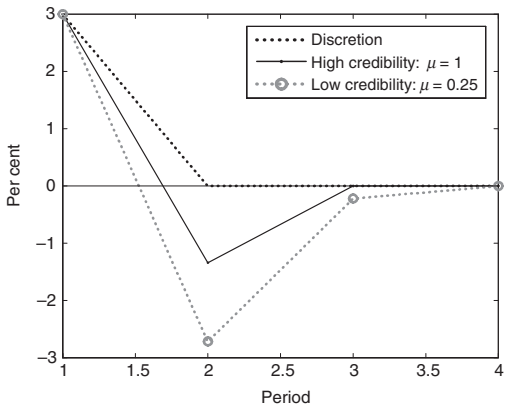
Committing to lower interest rates in the future is consistent with the strategies to generate higher inflation expectations that were proposed for Japan when it faced the ZLB. Raising inflation expectations and committing to keeping the policy interest rate low in the future are not really separate policy options. It is by committing to lower future policy rates that the central bank affects future inflation at the ZLB.

To further expand on this point, consider the following very simple four-period example.[9] The economy is characterised by (2) and (3); policy objectives are given by

$$\mathrm{E}_0 \sum_{i=0}^{\infty} \beta^i \left(\pi_i^2 + \lambda x_i^2\right).$$

Assume r_t^n is the only disturbance (i.e. $e_t \equiv 0$ for all t). This means that the central bank can achieve $\pi_t = x_t = 0$ as long as the ZLB is not encountered. Now suppose that in period 1, r_1^n takes a large enough negative value that the economy is pushed to the zero lower bound, so $i_1 = 0$. After one period, the natural real interest rate returns to its steady-state level r^n (assumed to be 4 per cent in the numerical example) so that $x_i = \pi_i = 0$ for $i \geq 2$ is a feasible outcome. I assume (and this is the simplification) that $\pi_4 = x_4 = 0$ and $i_4 = r^n$.[10] The issue is what happens in periods 2 and 3, and how does this affect the output gap and inflation in period 1.

FIGURE 1
Nominal Interest Rate Under Discretion, Full Commitment and Imperfect Credibility When the Zero Lower Bound (ZLB) is Binding Only in Period 1



Following Bodenstein *et al.* (2010), suppose the public assigns a probability μ to the likelihood the central bank will fulfil its promises. Full credibility corresponds to $\mu = 1$; discretion corresponds to $\mu = 0$. Figure 1 shows the paths of the interest rate relative to the equilibrium real rate under the optimal policy with full credibility (solid line) and discretion (dashed line).[11] Under discretion, the central bank sets $i_2 = r_2^n > 0$ to ensure $x_2 = \pi_2 = 0$ (and similarly in periods 3 and 4). Under commitment, $i_2 < r_2^n$. As shown in Figure 2, this causes inflation to rise about zero in period 2 and leads expected inflation in period 1 to be positive. This lowers the actual real interest rate in period 1: $r_1 = i_t - \mathrm{E}_1\pi_2 = -\mathrm{E}_1\pi_2 < 0$. For the calibrated parameters of the example, the fully credible policy is actually able to prevent any deflation and limit the decline in the output gap in period 1. With full credibility, the interest rate gap $i - r^n$, inflation, and the output gap return to zero in periods 3 and 4 .[12]

[8] Most of the research on the ZLB has relied on models based on linear approximations to the structural equations. Levin *et al.* (2010) show that nonlinearities can become very important when simulating a large 'Great Recession' shock as opposed to a typical 'Great Moderation' shock. They find that even a credible central bank that can affect expectations about the future path of policy rates may have limited ability to stabilise the economy when a large negative shock occurs.

[9] The details of this four-period model can be found in the appendix of the longer version of this article, available at http://people.ucsc.edu/~walshc/MyPapers/walsh_ace_20100927.pdf/.

[10] While this is feasible, and $x_{t+j} = \pi_{t+j} = 0$ is optimal for some $j \geq 2$, the fully optimal policy will delay the return to a zero output gap and inflation rate more than the two periods assumed in this example.

[11] Parameter values used for this example are $\beta = 0.99$, $\lambda = 0.25$ and $\kappa = 0.25$.

[12] The return to zero output gap in period 4 is by assumption; the return in period 3 depends on the choice of parameters employed in the example.

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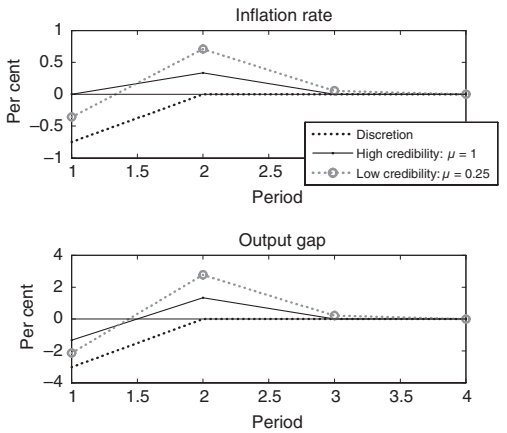
FIGURE 2
Inflation and the Output Gap Under Discretion, Full Commitment and Imperfect Credibility When the Zero Lower Bound (ZLB) is Binding only in Period 1



Outcomes under imperfect credibility are also shown in the figures by the dashed line with circles for the case $\mu = 0.25$. Consistent with the results obtained by Bodenstein *et al.* (2010), a central bank that lacks credibility must promise to keep interest rates even lower and for longer than a credible central bank would find optimal (see Figure 1). Rather than falling between the cases of pure discretion and full credibility, partial credibility leads to more extreme promises. By weakening the central bank's ability to affect future expectations, the central bank is forced to promise to keep interest rates low for an extended period of time relative to the policy under full commitment. As a consequence, if the central bank actually carries out its announced policies, inflation and the output gap are much higher in period 2. Of course, the high inflation under the promised path increases the temptation to revert to the discretionary policy in period 2, potentially further eroding credibility.

Old-school conventional policy at the ZLB

In addition to conventional interest rate tools, central banks have employed unconventional policy instruments as well. At the ZLB, central banks can still expand the supply of bank reserves, a policy commonly referred to as *quantitative easing*. Quantitative easing plays no role in the standard new Keynesian model for the simple reason that the real equilibrium in that model is independent of the quantity of money and the demand for money. To discuss quantitative easing requires a different theoretical framework.

Models common during the debates between monetarists and Keynesians in the 1960s and 1970s emphasised portfolio balance effects as the mechanism through which monetary policy affected interest rates, asset prices and the real economy. The portfolio balance approach started with the assumption that assets, both real and financial, were imperfect substitutes. Therefore, changes in the relative supplies of the different assets would set off a process of rebalancing that would affect asset prices and interest rates across a broad range of assets (Tobin, 1969; Meltzer, 1995). Disagreement focused on the set of assets that were potential substitutes for money in private portfolios. Monetarists emphasised that portfolio rebalancing could affect real asset holdings, not just financial holdings (see Meltzer, 1995). Hence, the reduction in the liquidity yield of money that occurs when its quantity is increased causes a substitution into both financial and real assets. Because the private sector must, ultimately, hold the larger stock of money, this attempt at rebalancing portfolios raises the prices of both financial and real assets, creating incentives for capital goods producers to expand production.[13]

In this framework, open market operations in short-term Treasuries, in long-term Treasuries, or in private sector assets (credit easing) can be effective in moving long-term interest rates and asset prices if different assets are imperfect substitutes. If, at a zero short-term nominal rate, bank reserves and short-term government debt are perfect substitutes, open market purchases of long-term government debt reduces the quantity of long-term government debt in the hands of the public, raising the price of long-term debt and lowering long-term yields. In a similar manner, central bank purchases of private sector assets will generate portfolio adjustments that raise the price of these assets and lower their yields and the yields of close substitutes.

During the past two years, the size of the Fed's asset holdings and their composition have changed dramatically.[14] The initial expansion

[13] Recent articles employing this perspective include Andrés *et al.* (2004) and Goodfriend (2011).

[14] Carlson *et al.* (2009) provide a nice discussion of the asset side of the Fed's balance sheet.

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of the Fed's asset holdings occurred through its programs to extend credit and liquidity to financial institutions. After averaging $30.5 billion from January 2007 until the end of July 2007, they rose to a peak of $1,988 billion in December 2008. Since then, this category of asset holdings has declined significantly, so that by the middle of September 2010, they totalled $223 billion. This pattern is consistent with the behaviour of a lender of last resort, providing temporary liquidity to markets during a crisis and then allowing this credit extension to shrink as markets return to more normal conditions.

However, while lending to financial institutions and the provision of liquidity have returned to something approaching pre-crisis levels, the size of the Fed's balance sheet has not. As lending and liquidity programs have shrunk, the Fed has purchased longer-term securities representing direct obligations of Fannie Mae, Freddie Mac and Federal Home Loan Banks as well as mortgage-backed securities. As of the middle of September 2010, the Fed held $1,600 billion of these securities.

Whether alterations in the private sector's portfolio of assets are effective is an empirical issue, and an issue that has, at least in the United States, long been debated. Modigliani and Sutch (1967) found little evidence that Operation Twist mattered in the 1960s, though this probably reflected the small scale of the operation relative to offsetting operations by the Treasury. Prior to the current crisis, many argued that it would require extremely large open market operations in non-standard assets to have a significant impact on yields (e.g. Clouse *et al.*, 2003). Bernanke *et al.* (2004) offer one of the most extensive attempts to employ event studies and term structure models to determine if non-standard central bank open market operations have affected yields. Their general conclusion is that shifts in relative asset supplies, or the expectations of such shifts, do affect yields. However, it is not clear from their analysis whether these shifts lead to the sustained movements in relative yields that would be needed to successfully stabilise real economic activity. Gagnon *et al.* (2011) discuss some of the more recent evidence and conclude that announcements of the Fed's asset purchases have lowered yields, though, as they note, using an announcement approach (as did Bernanke *et al.*, 2004) to capture the effects relies on the assumption that financial markets are efficient in processing information. This assumption might be suspect as the rationale for credit-easing policies is that financial markets are not operating efficiently.

Gagnon *et al.* (2011) also provide some time series evidence on the impact on yields of the net supply of long-term debt held by the private sector. Using monthly data from 1985 until June 2008, just prior to the start of the Fed's purchases, they find that an increase in the debt stock held by the public lowered prices and raised yields by a statistically significant amount.[15] They conclude that the size of the Fed's purchases reduced yields by between roughly 40 and 80 basis points, depending on their empirical specification. However, because of the large Federal deficit, total debt (as a percent of GDP) held by the public has risen dramatically. While the Fed purchases may have reduced rates relative to the increase that might have been observed, it is less clear what the net impact of the debt stock on rates has been. Similarly, Joyce *et al.* (2010) find evidence that the unconventional policies of the Bank of England succeeded in lowering long-term interest rates.

(iii) Summary on the ZLB

Raising average inflation targets to avoid the zero lower bound is a form of insurance. The permanent distortionary costs of higher average inflation would need to be balanced against the low probability of another negative shock of the magnitude the global economy experienced in 2008. A more effective strategy for avoiding the ZLB would be to reduce the risks of another major negative shock to aggregate demand. Better financial market regulation, as well as a more active policy response to emerging financial imbalances could lower the chances of returning to the ZLB.

In principle, a central bank with high credibility should not find the ZLB a serious constraint because it can promise higher future inflation. However, central bankers seem well aware of the dangers of sacrificing the gains that have

[15] Their point estimates implied that an increase in longer-term debt supply equal to 1 per cent of GDP (around $140 billion at 2008 GDP) would raise the 10-year term premium by between 4.4 and 6.4 basis points.

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been achieved by keeping inflation low and stable. As Ben Bernanke stated at the 2010 Jackson Hole Symposium, '…such a strategy is inappropriate for the United States in current circumstances. …raising the inflation objective would likely entail much greater costs than benefits. Inflation would be higher and probably more volatile under such a policy, undermining confidence and the ability of firms and households to make longer-term plans, while squandering the Fed's hard-won inflation credibility'.

Absent promises of future inflation, central banks still have the tools of quantitative and credit easing. The effectiveness of these tools depends on portfolio balance models that were, until recently, rejected by most of the profession. At a minimum, this means we lack the knowledge to accurately assess the likely effectiveness of these policies.

V Price Level Targeting

If the constraint posed by the zero lower bound on the nominal policy interest rate is costly, and raising the average inflation target carries more costs than benefits, what other monetary policy strategies could help reduce the problems created by the zero lower bound and contribute to macro stability? The search for new strategies has led to renewed interest in price-level targeting (PLT) as an alternative to inflation targeting.[16]

(i) Expectations as Automatic Stabilisers

Consider an environment in which a central bank can commit to objectives – an inflation target or a price level target – but in which actual policy decisions are characterised by discretion. Then price-level targeting produces outcomes that mimic the optimal commitment policy (Svensson, 1999; Vestin, 2006). This improvement occurs even though welfare ultimately depends on inflation. When the public believes prices will return to a target level, their expectations about future inflation help to stabilise current inflation when price setting behaviour is forward looking.[17]

This role for expectations can be particularly important in a deflationary situation at the zero lower bound. As the price level falls, the gap widens between the actual price level and the path for prices implied by the target path. The more severe the deflation, the greater must be the subsequent inflation to return prices to their intended path. Hence, a credible commitment to PLT would cause expected inflation to rise, lower the real interest rate, and help boost nominal interest rates above the ZLB. That is, under PLT, expectations serve as an automatic stabiliser.

In practice, most discussions of PLT combine it with a positive trend or average rate of inflation so that the target path evolves according to $p_t^T = p_{t-1}^T + \pi^T$, where π^T is the average rate of inflation and with the initial value of the target path pinned down at some initial level $p_0^T = p_0$. In contrast, under inflation targeting, the implicit target for the price level evolves as $p_t^T = p_{t-1} + \pi^T$. Essentially, inflation targeting allows for base drift in the target path of prices, while price-level targeting makes p_t^T a trend stationary variable. As a consequence, the subsequent inflation needed after a deviation of prices below the target path rises with π^T. A positive trend to the price path strengthens the way expectations act as an automatic stabiliser after deflationary shocks, because with the target path rising over time, the gap between it and the actual price level grows over time and amplifies the rise in expected inflation (if the path is credible). At the same time, a positive trend means that inflation shocks that push inflation above the target rate temporarily do not necessarily require actual deflation to return prices to the target path, only a period of below average inflation.

The credibility of price-level targeting is critical to its success, because expectations will not serve as automatic stabilisers if the public doubts the central bank's commitment to return prices to the target path. Kryvstov *et al.* (2008) show that the gains from imperfectly credible price-level targeting in a calibrated model are fairly small, and the gains may not be sufficient to dominate inflation targeting if credibility is obtained slowly.[18] However, repeating this exercise using the Bank of Canada's policy model ToTEM, Cateau *et al.* (2008) found the ultimate

[16] This discussion draws from Walsh (2009b, 2010b).

[17] Not surprisingly, therefore, Walsh (2003) found that price level targeting performed less satisfactorily in a discretionary environment when the inflation process displays inertia.

[18] They ignore the ZLB in their analysis.

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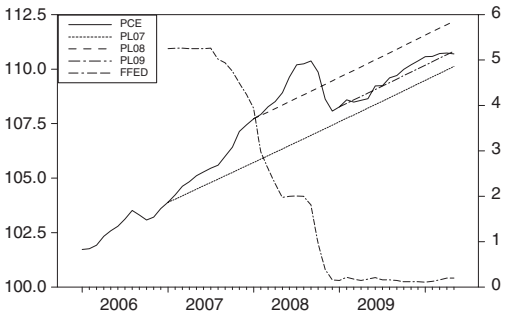
FIGURE 3
The PCE Index and Hypothetical Price Cones Beginning January 2007, 2008 and 2009



Notes: Lower paths correspond to 1.5 per cent inflation, the upper paths to 2.0 per cent inflation.

gains from price-level targeting to be more significant.[19]

The effect on inflation expectations of adopting PLT depends on when it is adopted. Figure 3 shows the price level in the U.S., measured by the PCE chained index together with hypothetical π^T of 1.75 per cent using different starting dates. One path begins in January 2007, one in January 2008 and one in January 2009. Also shown is the Federal funds rate (right scale). If the Fed had adopted such a price path target in January 2007, the movement of the PCE index above the target path during 2007 would have called for a tighter monetary policy throughout 2007 and 2008 and would have generated expectations of deflation over this period. Hence, it is not evident that adopting PLT prior to the crisis would have contributed a stabilising influence, nor would it have generated increases in expected inflation that might have reduced real interest rates at the ZLB.[20]

[19] Batini and Yates (2003) consider what they describe as hybrid inflation and price-level targeting in which the central bank is assigned an objective that combines both inflation and the price level. They argue that much of the benefit of price-level targeting is obtained when only a small weight is placed on the price level target. See also Adams and Billi (2007) and Billi (2008).

[20] Of course, this analysis ignores the fact that the price level might have evolved differently during 2007 and 2008 if the Federal Reserve had adopted price-level targeting.

The case for PLT is stronger if the target price path had been adopted in January 2008. While the actual level of prices rose above target in 2008, they subsequently fell below target just at the time the Federal funds rate was cut to zero. A credible promise to return to the target price path might have contributed to a rise in expected inflation during the past 2 years.

(ii) Should Central Banks Adopt PLT at the ZLB?

There are several reasons for questioning the efficacy of adopting price-level targeting when an economy is at the ZLB. First, the stabilising adjustment of expectations arises only if the public understands the implications of price-level targeting and believes the central bank is committed to this new policy. The experience with inflation targeting was that credibility followed experience, and the gain in anchoring expectations was not something that was achieved immediately. Gaining credibility for PLT in the midst of a liquidity trap may be particularly challenging. Adopting a new, untested targeting regime while in a crisis seems inadvisable.

Commitment to a price-level target, to the extent to which it was successful in generating expectations of future inflation, would lead to a rise in long-term nominal interest rates. This rise in long-term rates may easily lead some to question the central bank's commitment to economic expansion.

The impact on expectations depends importantly on the speed with which the public expects the central bank to regain the target path. This may be hard for the public to forecast because there would be no past experience to draw upon. Similarly, it may be difficult for the central bank to assess the impact of the regime change on the public's expectations. If expectations are for an extended recession, the public may doubt whether the target path will be achieved very quickly. This would reduce the effect PLT would have in raising inflation expectations.

Finally, commitment to a price path is time inconsistent. PLT is a means of implementing the optimal commitment policy, and this policy is itself time inconsistent. Once the economy recovers from the ZLB, the optimal policy is not to create the inflation required to restore the price level to the promised target path. Optimal commitment means doing what you had previously promised to do, even if it is not the optimal thing to do at the moment. Many central

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banks have committed to inflation targeting. They have developed credibility by delivering low and stable inflation. The optimal strategy at the ZLB is to change the policy regime to one of price-level targeting, and of course to promise never to change the policy framework again. Changing the policy regime in a crisis is exactly what discretion would call for.

VI Conclusions

So where does this discussion leave us in assessing the future of inflation targeting? Flexible inflation targeting seems to have worked well during the crisis, or at least no worse than other policy frameworks. One consequence of the financial crisis should be to remind us that in the presence of multiple economic distortions, central banks face more complex trade-offs than suggested by standard models of flexible inflation targeting. This is true because of financial frictions as well as labour market frictions. Understanding these trade-offs, and how to construct useful measures of the distortions that generate them, must be high on the research agenda. But nothing suggests that inflation should not remain the primary objective of monetary policy.

The constraints associated with the zero lower bound on nominal interest rates have led to proposals to raise average inflation targets. When macro volatility is at the levels seen during the Great Moderation, occurrences of the ZLB may be sufficiently rare that raising average inflation is unnecessary. But if macroeconomic shocks are likely to be larger in the future, the benefits of higher average inflation increase, though these must be balanced against the costs of higher inflation. Better regulation of financial markets, rather than raising the inflation target, is clearly the place to focus in creating a more stable macro environment.

Central banks typically argue that interest rate policy is too blunt an instrument to deal with financial stability and asset price bubbles, and that these problems are best dealt with through well-designed and well-implemented regulatory policies. However, even in the presence of adequate financial sector regulation, imperfect information and the resulting moral hazard and adverse selection problems in financial markets remain a source of economic distortions that affect the appropriate objectives of monetary policy.

Price-level targeting is a viable alternative to inflation targeting and may lead inflation expectations to move in a stabilising fashion, particularly in helping to avoid the ZLB. However, the date PLT is adopted, its credibility, the public's understanding of it and the speed with which price level deviations from the target path are expected to be reversed are all important for determining whether PLT would be a desirable policy regime.

Even at the ZLB, central banks are not without policy instruments, but the effectiveness of unconventional policies such as credit easing depend on the extent to which assets are imperfect substitutes or financial markets are segmented. These are both aspects of financial markets that we do not yet fully understand. Clearly, the next generation of models will incorporate credit frictions, but in the models developed to date, these frictions often do not seem to generate big differences in the transmission mechanism. The sources of financial shocks and how best to respond to them is still an open issue on which no consensus has developed. The same is true of labour market frictions, whether arising from sticky nominal wages or from search and matching frictions. None of these issues, though, suggests a need for major reform of flexible inflation targeting as the basic framework for monetary policy.

REFERENCES

Adams, K. and Billi, R.M. (2006), 'Optimal Monetary Policy under Commitment with a Zero Bound on Nominal Interest Rates', *Journal of Money, Credit, and Banking*, **39**, 1877–905.

Adams, K. and Billi, R.M. (2007), 'Discretionary Monetary Policy and the Zero Lower Bound on Nominal Interest Rates', *Journal of Monetary Economics*, **54**, 728–52.

Akerlof, G.A., Dickens, W.R. and Perry, G.L. (1996), 'The Macroeconomics of Low Inflation', *Brookings Papers on Economic Activity*, (1), 1–76.

Andrés, J., López-Salido, D. and Nelson, E. (2004), 'Tobin's Imperfect Asset Substitution in General Equilibrium', *Journal of Money, Credit, and Banking*, **36**, 665–90.

Bailey, M.J. (1956), 'The Welfare Costs of Inflationary Finance', *Journal of Political Economy*, **64**, 93–110.

Batini, N. and Yates, A. (2003), 'Hybrid Inflation and Price Level Targeting', *Journal of Money, Credit, and Banking*, **35**, 283–300.

Benigno, P. and Ricci, L.A. (2010), 'The Inflation-Output Trade-Off with Downward Wage Rigidities', NBER Working Paper 15762.

Bernanke, B.S. (2010), 'The Economic Outlook and Inflation', in *Macroeconomic Challenges: The*

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Decade Ahead. Federal Reserve Bank of Kansas City Symposium, 27–28 August, Jackson Hole, Wyoming. Available from: http://www.federalreserve.gov/newsevents/speech/bernanke20100827a.htm

Bernanke, B.S., Reinhart, V.R. and Sack, B.P. (2004), 'Monetary Policy Alternatives at the Zero Bound: An Empirical Assessment', *Brookings Papers on Economic Activity*, (2), 1–78.

Billi, R.M. (2008) 'Price-Level Targeting and Risk Management in a Low-Inflation Economy', Economic Research Working Paper RWP 08-09, Federal Reserve Bank of Kansas City, Kansas City, MO.

Blanchard, O.J. and Galí, J. (2010), 'Labor Markets and Monetary Policy: A NK Model with Unemployment', *American Economic Journals: Macroeconomics*, **2**, 1–30.

Blanchard, O., Dell'Ariccia, G. and Mauro, P. (2010), 'Rethinking Macroeconomic Policy', *Journal of Money, Credit, and Banking*, **42** (S1), 199–215.

Bodenstein, M., Hebden, J. and Nunes, R. (2010), 'Imperfect Credibility and the Zero Lower Bound on the Nominal Intrest Rate', International Finance Discussion Paper No. 1001, Board of Governors of the Federal Reserve System.

Carlson, J., Haubrich, J.G., Cherny, K. and Wakefield, S. (2009), 'Credit Easing: A Policy for a Time of Financial Crisis', *Economic Trends*, 11 February. Available from: http://www.clevelandfed.org/research/trends/2009/0209/02monpol.cfm.

Cateau, G., Kryvstov, O., Shukayev, M. and Ueberfeldt, A. (2008), 'Adopting Price-Level Targeting Under Imperfect Credibility in ToTEM', Bank of Canada Working Paper 2009-17.

Clarida, R., Galí, J. and Gertler, M. (1999), 'The Science of Monetary Policy: A New Keynesian Perspective', *Journal of Economic Perspectives*, **37**, 1661–707.

Clouse, J., Henderson, D., Orphanides, A., Small, D.H. and Tinsley, P.A. (2003), 'Monetary Policy When the Nominal Short-Term Interest Rate is Zero', *Topics in Macroeconomics*, **3** (1), Article 12.

Coibion, O., Gorodichenko, Y. and Wieland, J.F. (2010), 'The Optimal Inflation Rate in New Keynesian Models', NBER Working Paper No. 16093.

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

Erceg, C.J., Henderson, D. and Levin, A.T. (2000), 'Optimal Monetary Policy with Staggered Wage and Price Contracts', *Journal of Monetary Economics*, **46**, 281–313.

Faia, E. and Monacelli, T. (2007), 'Optimal Interest Rate Rules, Asset Prices, and Credit Frictions', *Journal of Economic Dynamics and Control*, **31**, 3228–54.

Friedman, M. (1969), 'The Optimum Quantity of Money', in Friedman, M. (ed), *The Optimum Quantity of Money and Other Essays*. Aldine Publishing Co., Chicago; 1–50.

Gagnon, J., Raskin, M., Remarche, J. and Sack, B. (2011), 'Large-Scale Asset Pruchases by the Federal Reserve', *International Journal of Central Banking*, **7**, 3–43.

Goodfriend, M. (2007), 'How the World Achieved Consensus on Monetary Policy', *Journal of Economic Perspectives*, **21**, 47–68.

Goodfriend, M. (2011), 'Central Banking in the Credit Turmoil An Assessment of Federal Reserve Practice', *Journal of Monetary Economics*, **58**, 1–12.

Haefke, C., Sonntag, M. and van Rens, T. (2007), 'Wage Rigidity and Job Creation', IZA Discussion Paper 3714.

Ireland, P.N. (2009), 'On the Welfare Cost of Inflation and the Recent Behavior of Money Demand', *American Economics Review*, **99**, 1040–52.

Joyce, M., Lasaosa, A., Stevens, I. and Tong, M. (2010), 'The Financial Market Impact of Quantitative Easing in the United Kingdom', *International Journal of Central Banking*, (forthcoming).

Krugman, P.R. (1998), 'It's Baaack: Japan's Slump and the Return of the Liquidity Trap', *Brookings Papers on Economic Activity*, (2), 137–205.

Kryvstov, O., Shukayev, M. and Ueberfeldt, A. (2008), 'Adopting Price-Level Targeting under Imperfect Credibility', Bank of Canada Working Paper 2008-37.

Kudlyak, M. (2009), 'The Cyclicality of the User Cost of Labor with Search and Matching', FRB of Richmond WP No. 09–12.

Lago Alves, S. (2010), 'Optimal Policy When the Inflation Targeting is Not Optimal', University of California, Santa Cruz, mimeo.

Levin, A., López-Salido, D., Nelson, E. and Yun, T. (2010), 'Limitations on the E ectiveness of Forward Guidance at the Zero Lower Bound', *International Journal of Central Banking*, **6**, 143–89.

McCallum, B.T. (2000), 'Theoretical Analysis Regarding a Zero Lower Bound on Nominal Interest Rates', *Journal of Money, Credit, and Banking*, **32**, 870–904.

Meltzer, A.H. (1995), 'Monetary Credit and (Other) Transmission Processes: A Monetarist Perspective', *Journal of Economic Perspectives*, **9**, 49–72.

Modigliani, F. and Sutch, R. (1967), 'Debt Management and the Term Structure of Interest Rates: An Empirical Analysis of Recent Experience', *Journal of Political Economy*, **75**, 569–89.

Nakov, A. (2008), 'Optimal and Simple Monetary Policy Rules with Zero Floor on the Nominal Interest Rate', *International Journal of Central Banking*, **4**, 73–128.

Pissarides, C.A. (2009), 'The Unemployment Volatility Puzzle: Is Wage Stickiness the Answer?', *Econometrica*, **77**, 1339–69.

Ravenna, F. and Walsh, C.E. (2011), 'Welfare-based Optimal Monetary Policy with Unemployment and Sticky Prices: A Linear-quadratic Framework', *American Economic Journals: Macroeconomics*, **3**, 130–62.

© 2011 The Economic Society of Australia

Roger, S. (2010), 'Inflation Targeting Turns 20', *Finance and Development*, **47**, 46–9.
Rose, A.K. (2007), 'A Stable International Monetary System Emerges: Bretton Woods, Reversed', *Journal of International Money and Finance*, **26**, 663–81.
Schmitt-Grohe, S. and Uribe, M. (2010), 'The Optimal Rate of Inflation', NBER Working Paper No. 16054.
Summers, L. (1991), 'Panel Discussion: How Should Long-Term Monetary Policy Be Determined?', *Journal of Money, Credit, and Banking*, **23** (3 Pt 2), 625–31.
Svensson, L.E.O. (1999), 'Price Level Targeting vs. Inflation Targeting', *Journal of Money, Credit, and Banking*, **31**, 277–95.
Svensson, L.E.O. (2001), 'The Zero Bound in an Open Economy: A Foolproof Way of Escaping from a Liquidity Trap', *Monetary and Economic Studies*, **19** (S-1), 277–312.
Svensson, L.E.O. (2002), 'Monetary Policy and Real Stabilization', in *Rethinking Stabilization Policy*. Federal Reserve Bank of Kansas City Symposium, 29–31 August, Jackson Hole, Wyoming. Available from: http://www.kansascityfed.org/publicat/sympos/2002/pdf/SymposiumProceedings2002.pdf.
Svensson, L.E.O. (2003), 'Escaping from a Liquidity Trap and Deflation: The Foolproof Way and Others', *Journal of Economic Perspectives*, **17**, 145–66.
Tobin, J. (1969), 'A General Equilibrium Approach to Monetary Theory', *Journal of Money, Credit, and Banking*, **1**, 15–29.
Vestin, D. (2006), 'Price-Level Targeting versus Inflation Targeting', *Journal of Monetary Economics*, **53**, 1361–76.
Walsh, C.E. (2003), 'Speed Limit Policies: The Output Gap and Optimal Monetary Policy', *American Economic Review*, **93**, 265–78.
Walsh, C.E. (2005), 'Labor Market Search, Sticky Prices, and Interest Rate Policies', *Review of Economic Dynamics*, **8**, 829–49.
Walsh, C.E. (2009a), 'Inflation Targeting: What Have We Learned', the John Kuszczak Memorial Lecture, the Bank of Canada, *International Finance*, **12**, 195–233.
Walsh, C.E. (2009b), 'Using Monetary Policy to Stabilize Economic Activity', in *Financial Stability and Macroeconomic Policy*. Federal Reserve Bank of Kansas City Symposium, Jackson Hole, WY. Federal Reserve Bank of Kansas City, Kansas City, MO; 245–96.
Walsh, C.E. (2010a), *Monetary Theory and Policy*, 3rd edn. The MIT Press, Cambridge, MA.
Walsh, C.E. (2010b), 'Implementing Monetary Policy', prepared for the 2010 Bank of Korea International Conference, June.
Williams, J.C. (2009), 'Heeding Daedalus: Optimal Inflation and the Zero Lower Bound', *Brookings Papers on Economic Activity*, (Fall), 1–37.
Woodford, M. (2003), *Money, Interest, and Prices*. Princeton University Press, Princeton.

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