Price-Level Targeting

by Agathe Côté

Price-Level Targeting

by

Agathe Côté

Research Department
Bank of Canada
Ottawa, Ontario, Canada K1A 0G9
acôté@bankofcanada.ca

Acknowledgements

Abstract

In November 2006, the Bank of Canada announced its intention to lead a concerted research program over the next few years on the type of monetary policy framework that would best contribute to the economic well-being of Canadians in the decades ahead. The research will focus on two broad questions: whether economic welfare might be improved by targeting a rate of inflation lower than 2 per cent, and whether economic welfare might be improved by moving from an inflation-targeting (IT) framework to some form of price-level targeting (PLT). This paper focuses on the second question. The author provides an overview of the main conclusions in the literature on the relative merits of replacing IT with PLT, identifies some key outstanding questions, and outlines the Bank's research program. The author concludes that, compared with the conventional wisdom that prevailed a decade ago, recent analysis is more promising for PLT. Nevertheless, the models that have been used so far often ignore some of the key potential benefits, or some of the key potential costs, associated with PLT. More research is needed before one can draw strong conclusions.

JEL classification: E52, E58
Bank classification: Monetary policy framework

Résumé

En novembre 2006, la Banque du Canada a annoncé son intention de mener un programme de recherche concerté au cours des années à venir en vue de déterminer quel cadre de conduite de la politique monétaire serait le plus propre à favoriser la prospérité économique des Canadiens durant les prochaines décennies. On tentera en particulier de répondre à deux questions. La réduction de la cible d'inflation en deçà de 2 % permettrait-elle des gains au chapitre de la prospérité? Le remplacement de la cible d'inflation par une cible fondée sur le niveau des prix se traduirait-il par une amélioration du bien-être dans l'économie? L'auteure s'attache à la deuxième de ces questions. Elle présente un survol des principales conclusions dégagées dans la littérature au sujet des mérites respectifs des régimes de cibles basées sur le niveau des prix et des régimes de cibles d'inflation, dresse une liste de questions qui restent à résoudre et expose les grandes lignes du programme de recherche de la Banque. L'auteure conclut que les travaux récents sont plus encourageants que ceux effectués il y a dix ans concernant le potentiel des cibles de niveau des prix. Elle note par ailleurs que les modèles employés ne tiennent pas souvent compte de certains avantages ou coûts potentiels importants de l'adoption de cibles de niveau des prix. Il faudra pousser les recherches dans ce domaine avant d'être en mesure de tirer des conclusions solides.

Classification JEL : E52, E58
Classification de la Banque : Cadre de la politique monétaire

1 Introduction

In November 2006, the Government and the Bank of Canada renewed Canada's inflation-control framework for a further five-year period, maintaining the target at the 2 per cent midpoint of a 1 to 3 per cent control range. In its background document (Bank of Canada 2006), the Bank indicates the need for further research on the type of policy framework that would best contribute to the economic well-being of Canadians in the decades ahead. In particular, the Bank plans to lead over the next few years a concerted research effort focused on two broad questions: whether economic welfare might be improved by targeting a rate of inflation lower than 2 per cent, and whether economic welfare might be improved by moving from an inflation-targeting (IT) framework to some form of price-level targeting (PLT). In this paper, we focus on the second question.

The main difference between PLT and IT, as currently practiced, is that the latter ignores past deviations from the target – that is, bygones are bygones. Under IT, the average rate of inflation should converge towards the target rate over the long run, provided that the shocks hitting the economy are random and the central bank consistently aims for the target. But uncertainty about the future price level will, nevertheless, rise without limit as the planning horizon is lengthened. In contrast, under PLT (which is defined here to include the possibility of a price-level target that rises over time), policy would aim to unwind any cumulative deviations of the price level that had occurred; the average rate of inflation would converge faster to its target and uncertainty about the future price level would converge to some limit.

This paper provides an overview of some of the main conclusions in the literature on the relative merits of replacing IT with PLT, identifies some key outstanding questions, and outlines the Bank's research program. Part of the motivation for this paper is to solicit feedback on what the key outstanding questions are, and the best approaches to address them. The Bank is hoping that others will join this research program.

2 An Overview of Some Key Conclusions in the Literature

2.1 Methodology

Several countries are currently pursuing explicit or implicit IT, but there are no countries with explicit or implicit PLT. Sweden during the 1930s may be the only country in history with explicit PLT. For this reason, very little empirical evidence can be used to examine the merits of PLT relative to IT.[1] This leaves two main approaches in the literature: theoretical modelling and simula-

---

1. It may be possible, however, to draw lessons about expectations formation and credibility issues from countries' experiences during the gold-standard era and under fixed exchange rate regimes.

tions analysis. Typically, a researcher sets up a relatively simple model. The central bank is assumed to choose a policy that minimizes a loss function that is either assumed or derived as an approximation of agents' utility function. Within this framework, the researcher can derive the optimal policy rule and evaluate alternative policy proposals. When the models are too large or complex to solve analytically, alternative policies are ranked on the basis of stochastic simulation results.

2.2 Welfare benefits from reduced long-run price-level uncertainty

In theory, a decline in long-run price-level uncertainty should be beneficial to intertemporal decisions and long-term nominal contracts. This could prove particularly important for the increasing number of retirees on fixed income.

Konieczny (1994, 2001) focuses on the role of money as a stable unit of account. A constant price level is particularly appealing because nominal values become real values. This reduces calculation costs, minimizes the risk of costly errors, and improves the role of prices in allocating resources. Konieczny argues that these errors may lead to a suboptimal consumption structure.[2] Coulombe (1998) also emphasizes the benefits of targeting a fixed price level, which is the only way to fully restore the intertemporal information conveyed by prices.

For people who enter into long-term nominal contracts, a policy that reduces future price-level uncertainty should be welfare improving. In the absence of perfectly indexed nominal debt contracts, and with some persistence in the price-level process, it is expected that the default risk premium for long-term debt will be higher than for short-term debt. Under a PLT regime, the default risk premium on long-term debt would be lower, making it relatively more attractive to borrowers. Another aspect to consider is the redistribution impact of unanticipated price-level movements. For example, an unanticipated price-level increase (or inflation) will lower the real value of nominal assets and liabilities, and thereby redistribute wealth from lenders (typically older people) to borrowers (typically young people who are making labour supply decisions). This can have consequences on labour supply, investment, output, and welfare. Prescott (2005) and Doepke and Schneider (2006) argue that the effects can be large and depend on demographics and the monetary policy regime. With the aging population, the redistribution of wealth and the resulting macroeconomic effects could become significantly higher than in the past. The extent of the redistribution should be smaller under PLT than under IT.[3]

---

2. For example, overestimating the increase in price level since the last house purchase means that households would spend too much on a new one.
3. Results of work in progress at the Bank support this conclusion.

Although, in theory, a policy regime that reduces long-term price-level uncertainty should be welfare enhancing, very little work has been done to try to evaluate the magnitude of the potential gains. Howitt (2001, 261) advocates more research in this area and expresses the view that "long-term price-level uncertainty is one of the most serious consequences of inflation, because of its ruinous effects on long-term contracting."[4] Others, however, doubt that welfare can be improved much by a trend-stationary price level relative to a low inflation target. For example, McCallum (1999) argues that the amount of price-level uncertainty in current low-inflation regimes may not be all that large. Eichenbaum contends that the costs of inflation are likely to be small in current regimes and that there is little social value in reducing inflation substantially below 1 per cent to 2 per cent (Fisher and Krane 2006). Fischer (1994) argues that the benefits of more stable long-term contracting are unlikely to be substantial, given that other means (indexed bonds, contingent contracts) exist to mitigate long-run price uncertainty. As noted by Beaudry (2006), the attractiveness of PLT for retirement planning will depend in part on the degree of sophistication of investors and the availability of financial instruments. The gains should be larger if investors are less sophisticated, or if there are substantial fees on complicated financial assets.

In theory, then, a reduction in long-run price-level uncertainty should improve welfare. However, the literature in this area is very limited and priors differ markedly as to whether, in practice, the magnitude of these welfare gains would be significant.

2.3 Short-run stabilization properties with standard loss function

In much of the literature comparing PLT with IT, modellers use a loss function that depends only on inflation and output variability.[5] It has been demonstrated that such a loss function can be derived from a general-equilibrium model with optimizing consumers and monopolistically competitive firms.[6] But these models abstract from the mechanisms noted above, suggesting that their results are not general. In this section, we discuss some of the main results obtained under the assumption that price-level volatility is not included in the social loss function.

2.3.1 Conventional wisdom

The conventional wisdom, as Svensson (1999, 278) states, is that "the choice between price-level targeting and inflation targeting involves a trade-off between low-frequency price-level variability

---

4. See also Ragan (2006).
5. Sometimes, the variability of interest rates is also included. It can enter for several reasons, most importantly to capture the revealed preference of central bankers for smoothing interest rates.
6. See, for example, Rotemberg and Woodford (1997). In these models, inflation variability enters the loss function because it creates relative price dispersion (distortions between firms that can adjust their prices and those that cannot).

on one hand and high-frequency inflation and output variability on the other hand." The intuition is as follows. In order to stabilize the price level under PLT, higher-than-average inflation must be succeeded by lower-than-average inflation. This should result in higher inflation variability than under IT, since, in the latter case, base drift is accepted and higher-than average inflation need only be succeeded by average inflation. With nominal rigidities, the higher inflation variability would also lead to higher output variability.

The conventional wisdom does not take into account the possibility that the inflation process might change as a result of a change in monetary policy.[7] Allowing for the fact that, under PLT, rational forward-looking agents will perceive shocks to the price level as being temporary, the new intuition became that, with PLT, the response of inflation expectations to price shocks would be dampened, which in turn would lead to lower inflation variability. But output variability would still increase, because of the policy response to supply shocks.[8]

Even when society is assumed to care only about inflation and output variability, a number of recent papers conclude that PLT may still be preferred, therefore calling into question the conventional trade-off view. The relative performance of PLT compared with IT depends on a number of assumptions, most importantly the extent to which expectations are forward looking and the central bank credible. Results also vary depending on whether the central bank is assumed to commit to policy or to operate under discretion. Starting with a seminal paper by Svensson (1999), many studies have drawn comparisons between results obtained under each of these assumptions.

2.3.2 "Free lunch" under discretion

Svensson argues that the conventional trade-off between low-frequency price-level variability and high-frequency inflation and output variability depends on a comparison of exogenously imposed policy rules under commitment. He shows that if rules are chosen endogenously without commitment, PLT can result in lower price-level and inflation variability than does IT and at the same time deliver identical output variability. Thus, there is a "free lunch."

Svensson starts with the assumption that the true social loss function depends only on the variance of output and inflation. In each period, the central bank, which operates with discretion, chooses output and inflation to minimize this loss function, subject to a Lucas short-run supply curve with output gap persistence (in which current inflation surprises affect the output gap). With this type

---

7. This view is supported by simulation results of models in which inflation expectations are backward looking and unaffected by the monetary policy regime. See, for instance, Lebow, Roberts, and Stockton (1992) and Haldane and Salmon (1995).
8. Fillion and Tetlow (1994) obtain simulation results supporting this alternative intuition. See Duguay (1994) for a comprehensive review of the earlier work on PLT.

of model, monetary policy is neutral under rational expectations and real output always equals potential output. The optimal policy would be to aim at the inflation target each period. However, the central bank will attempt to offset the supply shocks and, therefore, persistence in potential output will translate into persistent deviations of inflation from target. This will cause extra variability in inflation without reducing the variability of output. Svensson shows that one way to partially correct for this stabilization bias is to assign the central bank a loss function that depends on output and price-level volatility.

Svensson demonstrates that, when there is enough persistence in output, the variability of inflation under PLT will be less than under IT.[9] In effect, the central bank will worry too much about cumulative price-level errors to allow the persistent fluctuations in inflation not to be undone quickly. The central bank will react more aggressively, which ends up lowering the volatility of inflation. The assumption that the central bank operates under discretion is critical to the results. Under commitment, the conventional wisdom that PLT results in higher inflation variability is true in this model.

Vestin (2006) examines the same question as Svensson, but in a forward-looking model with Calvo-Taylor style price-stickiness. He shows that Svensson's free lunch holds in this framework without the need for persistent shocks in the Phillips curve. If the central bank operates under discretion, PLT can move the monetary authority closer to the commitment solution. Intuitively, PLT introduces some history dependence and a stationary level of prices, both of which are prominent features of the commitment solution (as discussed further in the next section). The more gradual response associated with PLT is not a feature of discretionary IT. Under discretion with IT, the central bank has to do all the stabilization in the current period, and ends up overreacting compared with the commitment case. Vestin shows that, without persistence in the cost-push shock, the commitment solution can be fully implemented with PLT. With persistence, PLT can outperform IT as long as the relative weight on output variance in the loss function is allowed to vary appropriately.[10]

9. Svensson's result also depends on the assumption that preference weights on output are the same across the IT and PLT objective loss functions. Dittmar, Gavin, and Kydland (1999) and Parkin (2001) generalize the analysis to different weights in loss functions as long as output persistence is sufficiently high.

10. For a given value of the relative preference on output variance, PLT generates more variability in the output gap than IT. This is what led Kiley (1998) to reject the free-lunch result of Svensson. Smets (2003) draws a link between the weight on output variability in the loss function and the optimal policy horizon for maintaining price stability. Smets finds that the optimal horizon for a PLT objective is generally longer than for an IT objective. He also finds that, by choosing a longer horizon for PLT, society's overall loss under PLT can be lower than under IT if the economy is forward looking.

PLT, therefore, can deliver a free lunch when the central bank cannot commit to future policy. If expectations are forward looking, as in the New Keynesian Phillips curve (NKPC), the free-lunch result holds, whatever the degree of output persistence. With a neoclassical Phillips curve (NCPC), the free-lunch result holds provided the degree of endogenous output persistence is high enough. As Barnett and Engineer (2001) explain, in this case the free-lunch result works because the current choice of output affects the next period's Phillips curve through the lagged output term. With exogenous output persistence, the central bank can do nothing to affect the current output-inflation trade-off.[11]

Vestin's conclusion above depends on the assumptions that agents are fully rational and that the central bank enjoys perfect credibility. Using a framework similar to Vestin, Nessén and Vestin (2005) demonstrate that the relative performance of PLT deteriorates as the degree of forward-looking behaviour in the Phillips curve falls. Yetman (2005) also shows that Vestin's free lunch can disappear if the assumptions of rational expectations and perfect credibility are relaxed. He concludes that an IT regime is more robust to alternative assumptions about expectations and central bank credibility than a PLT regime.

The above results suggest that PLT can outperform IT under discretion if expectations are sufficiently forward looking, or if expectations are predetermined but there is substantial endogenous output persistence.

There is considerable debate as to whether central banks are best described as operating under commitment or discretion. Svensson's view is that social welfare is too complex to be an operational objective for monetary policy. Successful monetary policy has often consisted in assigning simple and verifiable objectives for central banks. Others consider Svensson's approach to be unrealistic. For example, Howitt (2001) argues that central banks are rarely tempted to produce surprises and should be treated as if they have the power to commit. This should be particularly true in current IT regimes that are typically endorsed by the government and have clear accountability mechanisms.[12]

2.3.3 Results under commitment

The ranking of alternative policy regimes under commitment also depends importantly on the behaviour of expectations. Barnett and Engineer (2001) conclude that the strongest case for PLT

---

11. Interestingly, a recent study by Kryvtsov, Shukayev, and Ueberfeldt (2007), using a very different approach (an overlapping-generations model), also finds that the efficacy of PLT or IT is a function of output persistence. In their case, however, PLT dominates IT when persistence is low.
12. Mankiw (2005) also expresses skepticism with Svensson's approach. McCallum (1997) favours commitment and argues that, in practice, central banks can "just do it."

is when the central bank can commit and expectations are forward looking, as in the NKPC. Then, price-level-trend stationary policy is optimal, using a standard loss function defined on inflation and output.[13] When the economy is faced with a one-time positive inflation (cost-push) shock, the optimal response is gradual: the central bank maintains the output gap below its steady-state value as long as the price level remains above its steady-state value, even when no further shocks hit the economy. The reason is that, with forward-looking price-setters, having a policy that induces expectations of future low marginal-cost pressures spills over directly into lower prices set by the firms that are allowed to change prices in the current period. Thus, the expectations term in the Phillips curve shifts downward, creating a better short-run trade-off between inflation and the output gap.[14] In contrast, if expectations are predetermined, as in the NCPC, the policy response to current shocks does not feed through the current Phillips curve trade-off. Thus, there is nothing to be gained by moving to PLT. In this case, the central bank should target inflation.

Barnett and Engineer (2001) consider the case of a hybrid Phillips curve; that is, an equation that has a mixture of backward- and forward-looking expectations. They conclude that, unless expectations are completely forward looking, an IT regime will be optimal under commitment.[15] However, the optimal policy involves undoing some of the price-level impact of the shock in subsequent periods. As the weight on the forward-looking component increases, the optimal policy displays less drift.

In contrast, Ball, Mankiw, and Reis (2005) consider a different model from Vestin and Svensson and conclude that PLT may be superior to IT under commitment even if price expectations are predetermined. They use a behavioural model of output-inflation trade-off based on the hypothesis that agents are slow to incorporate information about macroeconomic conditions, even when such information is publicly available. In effect, Ball, Mankiw, and Reis use a sticky-information Phillips curve in which past expectations of current inflation enter the equation.[16] With such a model, they find that pure PLT is optimal when the economy faces only demand shocks. The intuition underlying this result is as follows. Suppose that the economy is in steady state and all prices are set at, say, one. Then suppose that a demand shock occurs that raises output. The price level will also increase, since firms who received the information in the current period raise their price.

---

13. See, for example, Clarida, Galí, and Gertler (1999) and Vestin (2006). Yun (2005) shows, however, that allowing for initial price dispersion can alter the nature of optimal monetary policy in this class of models.

14. This conclusion depends on the assumption that the central bank can control current variables. If prices are predetermined, then, even with an NKPC, PLT will not be optimal.

15. As noted by Boivin (2001), Barnett and Engineer use a very general definition of IT; that is, a regime that includes hybrid policies that target the inflation rate as well as, partially, the price level.

16. Ball, Mankiw, and Reis argue that such a model better captures inflation dynamics than either the NKPC or the NCPC.

Under PLT, these effects disappear in subsequent periods, since the prices set by the uninformed firms are fixed at one, and the informed firms also set their prices at one, owing to PLT. Hence, relative variability is eliminated as informed and uninformed firms set the same price after the initial shock. In contrast, IT allows the price level to rise permanently after the shock. Since the uninformed firms are unaware of the new price level, they still choose a price of one in subsequent periods. In order to support the new higher price level, the central bank under IT must induce the informed firms to set a price greater than one, leading to relative price variability and a misallocation of resources. When the economy also faces markup shocks, optimal policy is more complicated and reflects a trade-off between the goal of stabilizing relative prices and that of stabilizing output.[17]

In a recent paper, Cover and Pecorino (2005) emphasize another channel through which forward-looking expectations may have a stabilizing influence under PLT. They start with Svensson's framework under commitment and change the central bank's information set so that it does not see contemporaneous shocks when setting interest rates. With this assumption, Cover and Pecorino find that PLT is superior to IT via the aggregate demand channel. When the price level is above its expected value in the future period, expected future inflation declines. This raises real interest rates and reduces aggregate demand. As a result, the variations in output and the price level are both dampened.[18]

In sum, by providing a firm nominal anchor for expectations, PLT may outperform IT in forward-looking models under commitment. If price expectations are mixed, pure PLT may not be optimal.

2.4 Hybrid regimes

The studies reviewed in the previous section show that, even if society's loss function does not include price-level stabilization, it may still be optimal to choose PLT rather than IT under certain

---

17. Policy-makers must make accommodations that will depend on the serial correlation of shocks. The optimal policy can also be described in terms of endogenous variables. The expected price level should deviate from its target path only if output is expected to deviate from its natural rate. Ball, Mankiw, and Reis note that this result closely resembles the monetary policy rule proposed by Hall (1984), dubbed as an "elastic price standard." One difference is that Hall advocates a constant target, while in their model a rising target for the price level would do equally well.
18. The stabilizing impact of PLT on aggregate demand is also emphasized by Duguay (1994) and Coulombe (1998). The real consequence of that dampening effect on aggregate demand is not to dampen the variability of output (which depends on the Phillips curve), but to lower the variability of nominal interest rates (i.e., a smaller change in interest rates is needed to achieve the desired result). As discussed in section 2.5, this implies a lesser risk of hitting the zero interest floor for any given targeted inflation rate.

model specifications. Of course, the case for PLT would be much stronger if society put some weight on price-level uncertainty.

A number of recent papers conclude that if the social loss function includes the variance of the price level in addition to that of inflation and output, then optimal policy will be a hybrid targeting regime; that is, some amount of price-level shocks will be reversed, but less than under strict PLT. The optimal level of drift will depend on the underlying model parameters, such as the degree of output persistence or the degree to which expectations are forward looking. A hybrid targeting regime can also be interpreted as a statement about the optimal horizon over which the price level is brought back to the desired path.

Cecchetti and Kim (2005) use a framework similar to Svensson (1999) and show that, for a given degree of output persistence, there is an optimal hybrid targeting policy that is a weighted average of IT and PLT. Batini and Yates (2003) investigate policy regimes that combine PLT and IT in a variety of models, and conclude that their relative merits depend on several assumptions, in a non-monotonic fashion when moving from one regime to another. For example, under some specifications, Batini and Yates find that most of the reduction in price-level variability occurs in the first few increments along the spectrum from IT towards PLT. In general, combining regimes is good when policy is set optimally or in a forward-looking manner, but is inefficient when policy follows simple contemporaneous Taylor rules.

Nessén and Vestin (2005) examine the merits of average IT (i.e., targeting a *j* period average of one-period inflation rates) compared with pure IT and PLT regimes in a discretionary framework similar to Vestin (2006).[19] Average IT is modelled as an intermediate regime between the extremes of IT and PLT. Nessén and Vestin show that, in a purely forward-looking model, average IT is more efficient than conventional one-period IT because it introduces some history dependence and causes inflation expectations to change in such a way that the short-run trade-off faced by policy-makers is improved. Average IT is, however, still dominated by pure PLT. As the economy becomes less forward looking, average IT provides more efficient outcomes than either IT or PLT. [20]

The above discussion illustrates again the critical role of expectations in the relative ranking of regimes, which is also confirmed by simulation results of larger macroeconomic models (e.g., Black, Macklem, and Rose 1998; Maclean and Pioro 2001; Williams 1999).

---

19. King (1999) also focuses on average IT. He argues that it is in many ways equivalent to PLT.
20. This result may appear counterintuitive. One might argue that average IT would lead to a worse outcome than either IT or PLT, because its selective history dependence would introduce persistent cycles.

If price-level variability is included in the loss function and expectations are mixed, then optimal policy may be some weighted average of IT and PLT.

2.5 Risks of deflation and the zero-bound problem

Returning to the conventional wisdom, one of the strongest arguments against PLT, which was forcefully articulated by Fischer (1994), is that if there has been a large enough overshoot of the price level, returning to the target might require a period of deflation that could promote financial instability and be quite harmful. The fear of deflation has been stressed by a number of analysts over time, with Mishkin (2001), in particular, emphasizing the possibility of financial crises. Others, however, such as Ragan (2006), argue that the kind of sustained deflation that could pose significant threats to the financial system is not likely in a credible PLT regime with drift.

In fact, Duguay (1994) argues that a benefit of PLT is that it would exert a stabilizing influence on aggregate demand, by raising real interest rates when the price level moves above target and lowering them when the price level falls below target. Therefore, real interest rates can fall below zero even when the economy has reached the zero lower bound. Duguay concludes that Fischer's argument has more merit in a zero inflation rate regime than in a PLT regime. Coulombe (1998) also shows that a credible PLT can help alleviate the zero-bound problem, because it reduces the need to move nominal interest rates. Berg and Jonung (1999, 548) provide supporting evidence for this claim, stating that "An important lesson from the early Swedish experience is that a price stability target can be used to raise inflation expectations when there are widespread fears of deflation."

In recent years, the argument that PLT can help circumvent the zero-bound problem and move the economy away from a deflation trap has gained broader acceptance.[21] Reviewing some of the main findings in this area, Mishkin (2006) concludes that the case for PLT when an economy is in a deflationary environment is quite strong. He identifies two main reasons for this. First, there is the expectations channel described above. Second, if an economy has experienced a prolonged period of deflation with severe balance-sheet problems that prevent the financial system from working properly, a PLT may help restore financial and non-financial balance sheets, and it would help the financial system to start working again to allocate capital. Mishkin (2006, 211) states that "A price-level target, which encourages an expansionary monetary policy, is thus more sensibly viewed as a complement to restructuring rather than an impediment."

---

21. See, for instance, Eggertsson and Woodford (2003) and Wolman (2005). For Canada, empirical simulations conducted in a DSGE model by Lavoie and Pioro (2007) suggest that adopting a PLT rule can reduce the costs associated with the zero bound of lowering the inflation target closer to zero.

Some analysts, however, continue to emphasize the greater probability of hitting the zero bound, and the potential risks of deflation associated with a PLT. For example, in commenting on Eggertsson and Woodford's (2003) paper, Friedman (Friedman and Gertler 2003, 215) notes that "Many historical episodes suggest that deflation is not a desirable outcome for an economy arranged as ours is, and much economic analysis has explained why. . . . Having the central bank deliberately create a deflation therefore usually seems like a bad idea." Friedman argues that Eggertsson and Woodford's analysis is not that convincing because their model includes none of the mechanisms that make deflation harmful (such as debt defaults), and it is based on the assumption of perfect central bank credibility.

Recent evidence suggests that PLT may help circumvent the zero-bound problem. If there is a strong enough case to be made in favour of a lower inflation target, then PLT might be better than IT to protect against this problem.

3   Outstanding Questions

Compared with the conventional wisdom that prevailed a decade ago, recent analysis appears more promising for PLT. In addition to providing the benefits of reduced price-level uncertainty over a long horizon, PLT may also lead to smaller business cycles and may help alleviate the problems arising from the zero bound on nominal interest rates. The latter conclusions are nevertheless model dependent. The one result that is very conclusive in the literature is that the case for PLT is much stronger if private sector expectations are purely forward looking and monetary policy is perfectly credible. But PLT may still outperform IT when expectations are predetermined under certain model specifications. Some form of hybrid regime may be optimal if expectations are mixed and/or if society puts at least some weight on price-level variability in the loss function. A hybrid price-level target is, however, often dismissed on the ground that it would create difficult communication issues.

Clearly, more research is needed to further our understanding of the properties of a PLT regime. The models that have been used so far ignore either some of the key potential benefits of PLT or some of the key potential costs (and sometimes both). Unless these benefits and costs are explicitly included in the analysis, it is difficult to draw strong conclusions about the relative merits of PLT compared with IT.

In particular, almost all of the analysis is based on models that abstract from some of the key features of the economy that may give rise to welfare benefits from reduced price-level variance. In order to quantify these benefits, one must develop models that explicitly incorporate long-term nominal contracts, or a more efficient operation of the price system.   Because the models typi-

11

cally used do not incorporate these channels, conclusions in the literature seem to be tilted against PLT.

On the other hand, almost all theoretical examinations have been done in the context of simple models in which there is only one price or cost. In particular, the labour market is rarely considered explicitly. Even in the empirical work using larger models, the shocks considered often do not include (persistent) wage shocks or permanent shocks to the real exchange rate, real commodity prices, or the level of productivity. As discussed by Longworth (2001), if the central bank targets the total CPI under PLT, there is no price-level and nominal exchange rate adjustment that can ease the adjustment in the labour market over the longer run in response to these shocks. All of the adjustment must come from the level of nominal wages. If nominal wages are more rigid than goods prices, then the adjustment process could be slower and costlier under PLT. At this point, we still know very little about the effectiveness of PLT in the face of persistent relative price movements or supply shocks. To address this question, stochastic simulations in multiple prices/ sector models are required.[22] As noted by Duguay (2006), the trade-off between output and price stabilization in the face of supply shocks, which has disappeared under credible IT (since relative price shocks have only a temporary effect on measured inflation), may re-emerge under PLT. Because the literature has typically ignored these complications, conclusions seem to be tilted in favour of PLT.

Another question that is of interest to a small open economy like Canada is whether the choice of policy regime in other countries should affect its own choice of regime. For instance, Srour (2001) argues that, since alternative monetary policy arrangements in the large foreign country lead to significantly different behaviour of real variables in the foreign economy, exchange rate adjustment will not completely insulate the small home country from the consequences of the foreign regime choice. Therefore, the question arises as to whether the optimal policy rule in the small country is affected by the choice of policy regime in the large country. This is another question that has received little attention in the literature.

More generally, one is forced to admit that our understanding of the inflation-output dynamics is still limited. Although the stronger policy framework is surely a key factor, there are no definitive answers to the questions as to why inflation expectations have become better anchored and why inflation has become less persistent. Most of the recent work on optimal policy uses either an

---

22. To our knowledge, only Ortega and Rebei (2006) have addressed the issue in a multi-sector framework. They calibrate a small open-economy DSGE model for Canada featuring traded and non-traded sectors as well as imperfect competition and staggered prices in labour and product markets. They conclude that welfare gains of moving from IT to PLT, or a combination of both, are negligible. Their model is, however, quite complicated and the intuition behind the results is not straightforward.

12

NCPC or an NKPC based on a Calvo pricing model. Both of these approaches are subject to criticism. In the end, the belief that at least a component of inflation is backward looking appears to raise concerns about adopting a simple PLT rule. Because there is still considerable uncertainty about the inflation-output dynamics as well as other features of the economy, one important avenue for research is to examine the robustness of conclusions to model uncertainty.

Finally, because the zero bound on nominal interest rates is often identified as the main reason for not targeting a lower rate of inflation, additional research needs to be conducted to assess whether PLT helps address the zero-bound problem in an important way.

4   Bank of Canada Research Program

As noted in the introduction, the Bank of Canada will lead a research program over the next few years to examine the merits of a PLT regime relative to an IT regime. This research will focus on addressing some of the main questions discussed in the previous section.

A first line of research will have more of a microeconomic focus, and concentrate on the welfare benefits that might accrue from greater price-level certainty and greater willingness to enter into long-term contracts under a regime of PLT. A first project, by Meh, Quadrini (of NBER and the University of Southern California), and Terajima, will study the effects on output and investment of nominal price-level volatility in the presence of short-term and long-term nominal contracts. Preliminary results suggest that a reduction in price-level uncertainty can lead to an increase in the fraction of agents entering into long-term contracts, increase aggregate output, and reduce the probability of default. But, given the difficulty of solving the model with long-term nominal debt contracts, the results were obtained with a few simplifying assumptions that need to be relaxed in order for the results to be truly informative. In particular, the authors need to introduce endogenous nominal price-level changes and incorporate some of the potential costs of PLT. A second project will focus on the redistribution effects of price-level shocks under IT and PLT when taking into account different demographic structures. Meh, Rios-Rull (University of Pennsylvania), and Terajima will use an overlapping-generations model to examine the aggregate and welfare implications of alternative monetary policy regimes. The analysis will follow the framework used in Doepke and Schneider (2006), but the authors plan to extend the model in several dimensions. A third project currently under way by Crawford aims to quantify, using various techniques (for instance, survey data and a regime-switching model), the amount of long-run price-level uncertainty that remains in Canada under the current IT regime. Preliminary results indicate that uncertainty has declined quite sharply in the 1980s and the first part of the 1990s and has since levelled off, but still appears significant.

A second line of research will take more of a macroeconomic orientation, looking at the implications of PLT for the variability of output growth and inflation under different economic assumptions. The question as to whether PLT would cause undue variability in the domestic economy when it is subject to persistent relative price movements will be examined in a variety of models. Amano, Kryvtsov, and Murray will develop a two-sector economic model, where one sector is subject to exogenous persistent price movements and the other sector experiences aggregate price adjustment driven by monetary policy. The same question will be addressed by Mendes in the context of ToTEM, the Bank of Canada's multi-sector Canadian macro model, and by Coletti, Lalonde, and Muir (forthcoming), who will use the Bank's version of the Global Economy Model (GEM) developed at the IMF. These projects will also evaluate the merits of targeting alternative measures of the price level (e.g., traded goods prices, non-traded goods prices, core CPI, total CPI, wages).[23] Under PLT, the choice of price index potentially becomes a more crucial issue, since there may not be cointegration among the various price measures.[24]

Regarding open-economy considerations, Coletti, Lalonde, and Muir (forthcoming) will also investigate the impact of the choice of monetary policy framework on Canada's major trading partner, and the relative merits of PLT versus IT for Canada. Coletti and Bordo will study the behaviour of inflation and inflation expectations in the classical gold-standard era in order to draw some lessons about what might be expected from PLT currently.[25]

As discussed earlier, one concern with PLT is its ability to stabilize the economy in the face of supply shocks. Amano, Ambler (UQAM), and Ireland (Boston College) will examine this issue in a dynamic general-equilibrium model where the degree of wage indexation depends on the monetary regime. The lower degree of optimal indexation associated with a PLT regime (relative to an IT regime) leads to a greater degree of real wage flexibility in response to technology shocks, and therefore significant improvements in welfare. The Bank also intends to conduct a survey of businesses' wage-setting behaviour. The Bank conducted a similar survey on price-setting behaviour a few years ago. This work may help shed some light on some of the key questions regarding the behaviour of labour markets relative to that of goods markets (such as the relative degree of rigid-

---

23. This could cause significant communication issues, since the general public is familiar only with the total CPI. And even if the target was for the total CPI, one would presumably want to abstract from indirect tax changes.
24. A study by Crawford, Fillion, and Laflèche (1998) using Canadian data from the mid-1950s suggests that there is a common trend among the CPI, the GDP deflator, and unit labour costs. However, the inflation rates based on these three measures diverged significantly for extended periods of time.
25. Examining the gold-standard era could also be useful to address issues related to returning the price level to its target following a major shock (for instance, how costly it would be and the extent to which the credibility of the whole regime might be affected).

ity and forward-lookingness), which should lead to a better calibration of the models used to assess the relative merits of PLT compared with IT.

Another assumption that is important to the relative ranking of regimes is that of perfect central bank credibility. Kryvtsov, Shukayev, and Ueberfeldt are planning to address this issue in the context of an overlapping-generations model. In particular, they will explore whether IT and PLT are credible policies under extreme circumstances (i.e., large shocks), and whether one policy is better than the other when credibility issues are taken into account.

Finally, given the importance of dealing with model uncertainty, Cateau will compare the properties of PLT versus IT under the assumption that the central bank's model of the economy is misspecified. The analysis will be conducted with ToTEM. Cateau will consider a policy-maker that views ToTEM as a good model of the Canadian economy but wants to allow for the possibility that it is misspecified. The policy-maker will use robust control to construct different versions of the model corresponding to different degrees of misspecification. Cateau will also examine how PLT and IT rules perform the more one allows for the "alternative" version of ToTEM to deviate from the "reference" version that the policy-maker starts from. Based on this exercise, Cateau will then determine which rule can withstand higher degrees of misspecification (that is, offer more robust performance).

References

Ball, L., N.G. Mankiw, and R. Reis. 2005. "Monetary Policy for Inattentive Economies." *Journal of Monetary Economics* 52: 703–25.

Bank of Canada. 2006. *Renewal of the Inflation-Control Target, Background Information— November 2006.* Ottawa: Bank of Canada.

Barnett, R. and M. Engineer. 2001. "When is Price-Level Targeting a Good Idea?" In *Price Stability and the Long-Run Target for Monetary Policy*, 101–43. Proceedings of a seminar held by the Bank of Canada, June 2000. Ottawa: Bank of Canada.

Batini, N. and A. Yates. 2003. "Hybrid Inflation and Price-Level Targeting." *Journal of Money, Credit and Banking* 35(3): 283–300.

Beaudry, P. 2006. "Panel Discussion 1." In *Issues in Inflation Targeting*, 345–351. Proceedings of a conference held by the Bank of Canada, April 2005. Ottawa: Bank of Canada.

Berg, C. and L. Jonung. 1999. "Pioneering Price Level Targeting: The Swedish Experience 1931-1937." *Journal of Monetary Economics* 43: 525–51.

Black, R., T. Macklem, and D. Rose. 1998. "On Policy Rules for Price Stability." In *Price Stability, Inflation Targets, and Monetary Policy*, 411–61. Proceedings of a conference held by the Bank of Canada, May 1997. Ottawa: Bank of Canada.

Boivin, J. 2001. "Discussion: 'When is Price-Level Targeting a Good Idea?' by R. Barnett and M. Engineer." In *Price Stability and the Long-Run Target for Monetary Policy*, 144–49. Proceedings of a seminar held by the Bank of Canada, June 2000. Ottawa: Bank of Canada.

Cecchetti, S.G. and J. Kim. 2005. "Inflation Targeting, Price-Path Targeting, and Output Variability." In *The Inflation-Targeting Debate*, edited by B.S. Bernanke and M. Woodford, 173–95. Chicago: University of Chicago Press.

Clarida, R., J. Galí, and M. Gertler. 1999. "The Science of Monetary Policy: A New Keynesian Perspective." *Journal of Economic Literature* 37: 1661–1707.

Coletti, D., R. Lalonde, and D. Muir. Forthcoming. "Inflation-Targeting (IT) and Price-Level-Path Targeting (PLPT) in a DSGE Model: Some Open-Economy Considerations." Draft. Bank of Canada.

Coulombe, S. 1998. "The Intertemporal Nature of Information Conveyed by the Price System." In *Price Stability, Inflation Targets, and Monetary Policy*, 3–28. Proceedings of a conference held by the Bank of Canada, May 1997. Ottawa: Bank of Canada.

Cover, J.P. and P. Pecorino. 2005. "Price and Output Stability under Price-Level Targeting." *Southern Economic Journal* 72(1): 152–66.

Crawford, A., J.F. Fillion, and T. Laflèche. 1998. "Is the CPI a Suitable Measure for Defining Price Stability?" In *Price Stability, Inflation Targets, and Monetary Policy*, 39–73. Proceedings of a conference held by the Bank of Canada, May 1997. Ottawa: Bank of Canada.

Dittmar, R., W.T. Gavin, and F.E. Kydland. 1999. "The Inflation-Output Variability Tradeoff and Price-Level Targets." *Federal Reserve Bank of St. Louis Review* 81(1): 23–31.

Doepke, M. and M. Schneider. 2006. "Inflation and the Redistribution of Nominal Wealth." *Journal of Political Economy* 114(6): 1069–97.

Duguay, P. 1994. "Some Thoughts on Price Stability versus Zero Inflation." Draft. Bank of Canada.

———. 2006. "Panel Discussion 2." In *Issues in Inflation Targeting*, 353–57. Proceedings of a conference held by the Bank of Canada, April 2005. Ottawa: Bank of Canada.

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

Fillion, J.-F. and R. Tetlow. 1994. "Zero-Inflation or Price-Level Targeting? Some Answers from Stochastic Simulations on a Small Open-Economy Macro Model." In *Economic Behaviour and Policy Choice under Price Stability*, 129–66. Proceedings of a conference held by the Bank of Canada, October 1993. Ottawa: Bank of Canada.

Fischer, S. 1994. "Modern Central Banking." In *The Future of Central Banking: The Tercentenary Symposium of the Bank of England*, 262–308, edited by F. Capie, C. Goodhart, S. Fisher, and S. Schnadt. Cambridge: Cambridge University Press.

Fisher, J.D.M. and S.D. Krane. 2006. "2005 Conference on Price Stability: A Summary." In *Chicago Fed Letter*, Number 233a, The Federal Reserve Bank of Chicago.

Friedman, B.M. and M. Gertler. 2003. "Comments and Discussion: 'The Zero Bound on Interest Rates and Optimal Monetary Policy' by G.B. Eggertsson and M. Woodford." *Brookings Papers on Economic Activity* 1: 212–33.

Haldane, A.G. and C.K. Salmon. 1995. "Three Issues on Inflation Targets." In *Targeting Inflation*, edited by A. Haldane, 170–201. A conference of central banks on the use of inflation targets organized by the Bank of England, March 1995. London: Bank of England.

Hall, R.E. 1984. "Monetary Strategy with an Elastic Price Standard." In *Price Stability and Public Policy*, 137–59. Kansas City: Federal Reserve Bank of Kansas City.

Howitt, P. 2001. "Discussion: 'What Have We Learned About Price Stability?' by M. Parkin." In *Price Stability and the Long-Run Target for Monetary Policy*, 260–65. Proceedings of a seminar held by the Bank of Canada, June 2000. Ottawa: Bank of Canada.

Kiley, M.T. 1998. "Monetary Policy under Neoclassical and New-Keynesian Phillips Curves, with an Application to Price Level and Inflation Targeting." Finance and Economics Discussion Series 1998–27. Board of Governors of the Federal Reserve.

King, M. 1999. "Challenges for Monetary Policy: New and Old." In *New Challenges for Monetary Policy*, 11–57. A symposium sponsored by the Federal Reserve Bank of Kansas City, 1999.

Konieczny, J.D. 1994. "The Optimal Rate of Inflation: Competing Theories and Their Relevance to Canada." In *Economic Behaviour and Policy Choice Under Price Stability*, 1–35. Proceedings of a conference held by the Bank of Canada, October 1993. Ottawa: Bank of Canada.

———. 2001. "Discussion: 'Price Level Targeting—The Role of Credibility' by D. Maclean and H. Pioro." In *Price Stability and the Long-Run Target for Monetary Policy*, 186–97. Proceedings of a seminar held by the Bank of Canada, June 2000. Ottawa: Bank of Canada.

Kryvtsov, O., M. Shukayev, and A. Ueberfeldt. 2007. "Optimal Monetary Policy and Price Stability Over the Long-Run." Bank of Canada Working Paper No. 2007-26.

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

Lebow, D.E., J.M. Roberts, and D.J. Stockton. 1992. "Economic Performance under Price Stability." Working Paper No. 125. Board of Governors of the Federal Reserve System.

Longworth, D. 2001. "Notes on Price-Level Targeting." Draft. Bank of Canada.

Maclean, D. and H. Pioro. 2001. "Price Level Targeting—The Role of Credibility." In *Price Stability and the Long-Run Target for Monetary Policy*, 153–85. Proceedings of a seminar held by the Bank of Canada, June 2000. Ottawa: Bank of Canada.

Mankiw, N.G. 2005. "Comments: 'Inflation Targeting, Price-Path Targeting, and Output Variability' by S.G. Cecchetti and J. Kim." In *The Inflation-Targeting Debate*, edited by B.S. Bernanke and M. Woodford, 195–9. Chicago: University of Chicago Press.

McCallum, B.T. 1997. "Crucial Issues Concerning Central Bank Independence." *Journal of Monetary Economics* 39(1): 99–112.

———. 1999. "Issues in the Design of Monetary Policy Rules." In *Handbook of Macroeconomics 1*, edited by J.B. Taylor and M. Woodford, 1483–1530. Amsterdam: North-Holland Publishing Company.

Mishkin, F.S. 2001. "Issues in Inflation Targeting." In *Price Stability and the Long-Run Target for Monetary Policy*, 203–22. Proceedings of a seminar held by the Bank of Canada, June 2000. Ottawa: Bank of Canada.

———. 2006. "The Inflation-Targeting Debate." In *Issues in Inflation Targeting*, 195–220. Proceedings of a conference held by the Bank of Canada, April 2005. Ottawa: Bank of Canada.

Nessén, M. and D. Vestin. 2005. "Average Inflation Targeting." *Journal of Money, Credit and Banking* 37(5): 837–63.

Ortega, E. and N. Rebei. 2006. "The Welfare Implications of Inflation versus Price-Level Targeting in a Two-Sector, Small Open Economy." Bank of Canada Working Paper No. 2006-12.

Parkin, M. 2001. "What Have We Learned About Price Stability?" In *Price Stability and the Long-Run Target for Monetary Policy*, 223–59. Proceedings of a seminar held by the Bank of Canada, June 2000. Ottawa: Bank of Canada.

Prescott, E.C. 2005. "Comments: 'Inflation, Output, and Welfare' by R. Lagos and G. Rocheteau." *International Economic Review* 46(2): 523–31.

Ragan, C. 2006. "The Road Ahead for Canadian Inflation Targeting." In *Issues in Inflation Targeting*, 3–45. Proceedings of a conference held by the Bank of Canada, April 2005. Ottawa: Bank of Canada.

Rotemberg, J. and M. Woodford. 1997. "An Optimization-Based Econometric Framework for the Evaluation of Monetary Policy." *NBER Macroeconomics Annual*. 12: 297–346.

Smets, F. 2003. "Maintaining Price Stability: How Long is the Medium Term?" *Journal of Monetary Economics* 50(6): 1239–1309.

Srour, G. 2001. "Price-Level versus Inflation Targeting in a Small Open Economy." Bank of Canada Working Paper No. 2001-24.

Svensson, L.E.O. 1999. "Price-Level Targeting Versus Inflation Targeting: A Free Lunch?" *Journal of Money, Credit, and Banking* 31(3): 277–95.

Vestin, D. 2006. "Price-Level versus Inflation Targeting." *Journal of Monetary Economics* 53(7): 1361–76.

Williams, J.C. 1999. "Simple Rules for Monetary Policy." Finance and Economics Discussion Series Paper No. 1999–12. Board of Governors of the Federal Reserve System.

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

Yetman, J. 2005. "The Credibility of the Monetary Policy 'Free Lunch'." *Journal of Macroeconomics* 27(3): 434–51.

Yun, T. 2005. "Optimal Monetary Policy with Relative Price Distortions." *American Economic Review* 95(1): 89–109.