BANK OF CANADA
BANQUE DU CANADA

RENEWAL OF THE INFLATION-CONTROL TARGET

Background Information—October 2016

Contents

Introduction

The Government of Canada and the Bank of Canada have renewed Canada's inflation-control target for a further five-year period, ending 31 December 2021. Under this agreement, the Bank will continue to conduct monetary policy aimed at keeping inflation, as measured by the total consumer price index (CPI), at 2 per cent, with a control range of 1 to 3 per cent around this target.

The Bank of Canada's mandate is to promote the economic and financial welfare of Canadians. The best way monetary policy can achieve this goal is by giving Canadian households and businesses confidence in the value of their money. Canada's experience with inflation targeting has demonstrated that this is best accomplished by keeping inflation low, stable and predictable.

Canada adopted an inflation-targeting framework in 1991, with the target of 2 per cent in place since 1995. The framework is defined in a joint agreement between the Bank of Canada and the Government of Canada and is reviewed and renewed every five years.

The inflation target is symmetric—the Bank is equally concerned about inflation rising above or falling below the 2 per cent target. Changes in the Bank's target for the overnight rate of interest (its policy rate) are transmitted to the economy through their effects on market interest rates, asset prices and the exchange rate. A flexible exchange rate has a role in the transmission of monetary policy and also serves as an automatic buffer, helping to insulate the economy from internal and external shocks.

Monetary policy actions take time to work their way through the economy. An easing (tightening) of monetary policy can be expected to boost (restrain) total demand for Canadian goods and services in the future. Thus, through its policy actions, the Bank pursues a balance between the strength of this demand and the economy's productive capacity in order to influence inflationary pressures in a way that is consistent with bringing inflation back to the 2 per cent target.

Since the adoption of inflation targeting, inflation (as measured by the CPI) has averaged close to 2 per cent and has deviated narrowly around the target. The Bank's monetary policy has been successful in keeping inflation low, stable and predictable, despite significant economic and financial volatility. This price stability has reduced uncertainty, helping households and firms make spending and investment decisions with more confidence; encouraging investment in Canada's economy; contributing to sustained growth in output, employment and productivity; and improving the standard of living of Canadians.

The inflation-targeting framework combines a clearly specified objective agreed to by the government and the central bank with sufficient flexibility in the conduct of monetary policy to achieve that objective in the face of economic shocks and a highly uncertain global economic environment. Over time, the credibility of this proven framework has become self-reinforcing, with the 2 per cent midpoint of the inflation-control range providing an anchor for expectations of future inflation and thus enhancing the efficacy of monetary policy.

Each time the inflation-control agreement is renewed, the Bank carefully reassesses important aspects of the targeting framework. Every five years, the Bank asks itself an important question: Is a monetary policy framework based on a 2 per cent inflation target the best contribution that the Bank can make to Canada's economic and financial welfare? The Bank's perspectives on this question have continued to evolve, taking into account the latest knowledge in economics and policy experience in Canada and around the world (**Box 1**).

For the 2016 renewal, the Bank focused its review and research on the following three questions (Côté 2014):

- Should the 2 per cent inflation target be increased?
- How should core inflation be measured and used?
- To what extent should the conduct of monetary policy take into account financial stability considerations?

In addition to exploring the answers to these questions, this report provides an overview of the use of risk management in monetary policy to help address economic uncertainty (Poloz 2014).

The Bank's analysis finds that while an inflation target above 2 per cent could reduce the frequency of episodes when the policy interest rate is constrained by a lower bound, the availability of unconventional monetary policy tools mitigates that constraint. At the same time, a higher target could exacerbate the costly distortions caused by inflation, and transitioning to a new target could lead to a loss of credibility. Overall, the Bank considers the arguments for maintaining the 2 per cent target to be compelling and the evidence does not justify a change in the target at this time.

After evaluating different measures of core inflation and reviewing the practices of other central banks, the Bank has decided to replace its current measure of core inflation with three new measures. The use of three measures manages the risks associated with the shortcomings of any single indicator.

Meanwhile, the Bank's thinking on the interaction of monetary policy and financial stability is evolving. With a deeper appreciation of the complexity of the interactions, a risk-management approach to monetary policy provides flexibility to incorporate financial stability considerations into monetary policy. Because of the inherent uncertainty associated with economic projections, different interest rate paths could be broadly consistent with achieving the inflation target over a reasonable horizon, particularly given the flexibility in the inflation-targeting framework. A risk-management approach then allows policy-makers to evaluate the different implications of these alternative paths for other aspects of the economic and financial environment, including financial stability concerns.

Box 1

Key Take-Aways from the 2011 Renewal of the Inflation Target

Bank analysis focused on three questions in the lead-up to the renewal of the agreement on the inflation-control target in 2011: Should the inflation target be lowered to a rate below 2 per cent? Should a price-level target be adopted? To what extent should monetary policy take account of financial stability considerations? The key take-aways of the 2007–09 crisis experience and the new research were as follows.

Targeting a lower rate of inflation. While the prospective net benefits of a lower inflation target were assessed to be greater than previously estimated, new research and the experience of the global economic and financial crisis pointed to sizable costs associated with the effective lower bound (ELB) on interest rates. Thus, before the benefits of a lower target could be confidently pursued, it would be important for central banks to find a way to limit the probability of hitting the ELB and to manage more effectively if they did.

Price-level targeting (PLT). With PLT, following periods of below-target average inflation, policy-makers would seek a period of above-target inflation to ensure the desired rate of change in the price level over time. Theoretical modelling showed that PLT could potentially deliver gains in terms of increasing both long-term certainty about the price level and short-term macroeconomic stability. However, the theoretical gains would be contingent on public understanding of the framework and rational forward-looking expectations. Moreover, the gains were estimated to be small under ordinary circumstances. Overall, the Bank concluded that the potential benefits of PLT over the inflation-targeting framework did not clearly outweigh the costs and the risks of moving away from a policy framework that had resulted in well-anchored expectations and strong central bank credibility.

Monetary policy and financial stability. The global financial crisis reinforced the reality that economic stability and financial stability are inextricably linked. From the point of view of financial stability, macroprudential policies that incorporate system-wide perspectives were recognized as being necessary since strong individual financial institutions would not be sufficient to ensure the safety and soundness of the financial system as a whole. In addition, in some exceptional circumstances, monetary policy might be the appropriate tool to support financial stability. From the point of view of economic and price stability, a framework anchored on a solid and credible inflation target was regarded as providing the flexibility for monetary policy to play an occasional role in supporting financial stability. In particular, the Bank recognized that because the effects of financial imbalances on output and inflation could manifest themselves over a long period, some flexibility might be needed regarding the time horizon over which inflation should be expected to return to target. While this flexibility might involve sacrificing some inflation performance over the usual policy horizon, it would lead to greater financial, economic and, ultimately, price stability over a somewhat longer horizon.

While the formulation of monetary policy always incorporates financial system developments, financial stability objectives should be primarily met with a strong financial regulatory and supervisory framework that has the necessary microprudential and macroprudential policies and tools. Moreover, improved financial system resilience, the development and use of macroprudential tools, and a better understanding of the complex relationship between monetary policy and financial stability all suggest that episodes of tension between the inflation-targeting objective of monetary policy and risks to financial stability will be less common than previously assessed. Nevertheless, central banks, including the Bank of Canada, can make important ongoing contributions to the promotion of financial stability through their system-wide assessment of vulnerabilities and risks and through public communications.

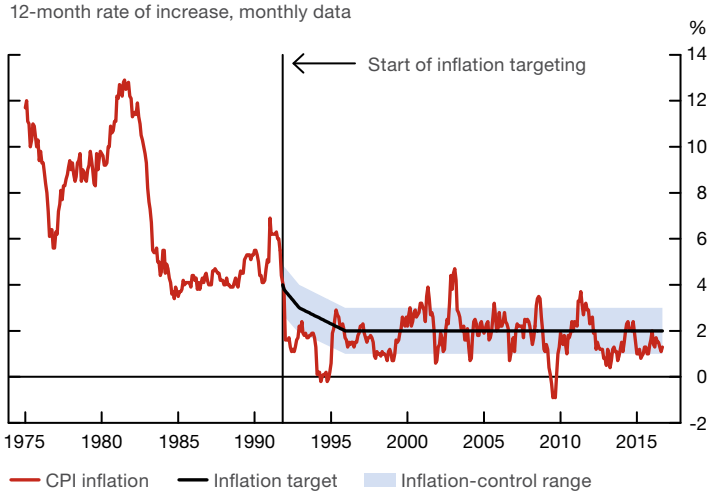
Canada's Experience with Inflation Targeting

The results of Canada's inflation-targeting framework have been impressive. Inflation in Canada, as measured by the CPI, has been remarkably stable since 1991. With the introduction of inflation targeting, inflation was quickly brought down (**Chart 1**). Since 1995, it has averaged close to 2 per cent with no persistent episodes outside the control range of 1 to 3 per cent. The standard deviation of inflation has also declined to less than half of what it was previously (**Table 1**). This reduction can be largely attributed to the anchoring that an explicit numerical target provides for inflation expectations and for economic and policy decisions. In addition, nominal interest rates have been lower across a range of maturities, primarily because inflation expectations have declined, but also partly because the premiums to compensate investors for inflation risk have been smaller, on average.

Canada's inflation-targeting regime successfully withstood the test of the 2007–09 global financial crisis and economic recession and helped strengthen the Canadian economic recovery. Past success with maintaining inflation around 2 per cent had anchored the public's confidence that, despite the extreme conditions of that period, policies would continue to achieve the inflation target. As a result, the well-established credibility of the inflation target allowed the Bank of Canada to pursue an aggressive monetary policy response to forestall a deeper and more prolonged economic slump.

Chart 1: Consumer price index inflation

12-month rate of increase, monthly data



Sources: Statistics Canada and Bank of Canada calculations

Last observation: September 2016

Table 1: Canada's economic performance

	Average (per cent)			Standard deviation		
	1975M1 to 1991M1	1991M2 to 2016M9	1995M1 to 2016M9	1975M1 to 1991M1	1991M2 to 2016M9	1995M1 to 2016M9
CPI: 12-month increase	7.1	1.9	1.9	2.9	1.1	0.9
Real GDP growth[a]	2.8	2.4	2.4	3.8	2.6	2.5
Unemployment rate[b]	8.9	8.0	7.5	1.7	1.5	1.0
3-month interest rate[c]	10.9	3.5	3.0	3.0	2.2	1.9
10-year interest rate[d]	10.7	4.9	4.3	2.0	2.2	1.8

Note: The table incorporates real GDP data through the second quarter of 2016.

a. Annualized quarter-over-quarter growth rate for quarters within the time period. Real GDP data incorporate the latest historical revisions of the Canadian System of National Accounts for quarters starting in 1981Q1. Annualized quarter-over-quarter growth rates prior to 1981Q2 are based on the real GDP series that was terminated with the introduction of the 2012 historical revisions.

b. Unemployment data start in 1976M1, owing to the introduction of a new labour force survey at that time.

c. The 3-month interest rate refers to the 3-month prime corporate rate.

d. Owing to data availability, prior to June 1982, the 10-year interest rate refers to the yield of government bonds with maturations longer than 10 years; after June 1982, it is based on the 10-year government bond yield from Statistics Canada.

Sources: Statistics Canada and Bank of Canada calculations

By April 2009, the Bank had lowered the policy rate to 25 basis points (bps) and instituted forward guidance in the form of a commitment to maintain the policy stance through the second quarter of 2010, conditional on the outlook for inflation. The Bank also used the flexibility in the inflation-targeting framework to lengthen the horizon for returning inflation to 2 per cent to beyond two years, longer than the average horizon of six to eight quarters.[1] The strength of the broader domestic policy and regulatory framework also contributed to the Canadian economy's resilience to the global shocks. In 2010, with the resumption of global and domestic economic growth, a narrowing of the output gap and inflation close to 2 per cent, the Bank raised the policy rate to 1 per cent.

After rebounding to pre-crisis highs in 2010, global economic growth weakened in 2011. From 2011 through 2013, growth in Canada was challenged by global economic uncertainty, the sovereign debt crisis and recession in the euro area, the modest pace of the recovery in the United States, and slowing growth in some emerging-market economies. Economic slack and competitiveness pressures on retailers were sources of disinflationary pressure in Canada.

Through this period, the Bank had been projecting a rebalancing of growth in Canada. Debt-fuelled household spending, which had carried the economy through a period of subpar export and investment growth, was expected to moderate and contribute to a constructive evolution of household imbalances. At the same time, exports were expected to gather strength on the back of an increasingly robust US economy and lead naturally to more business investment. However, during 2013, it became clear that the anticipated rebalancing of real activity would take longer to unfold than anticipated, and downside risks to inflation were becoming increasingly important, with inflation remaining below target from mid-2012.

1 While the Bank has sought to return inflation to 2 per cent on a horizon of six to eight quarters, on average, there has been considerable variation in the inflation-targeting horizon, reflecting the nature of the shocks hitting the economy (Bank of Canada 2011).

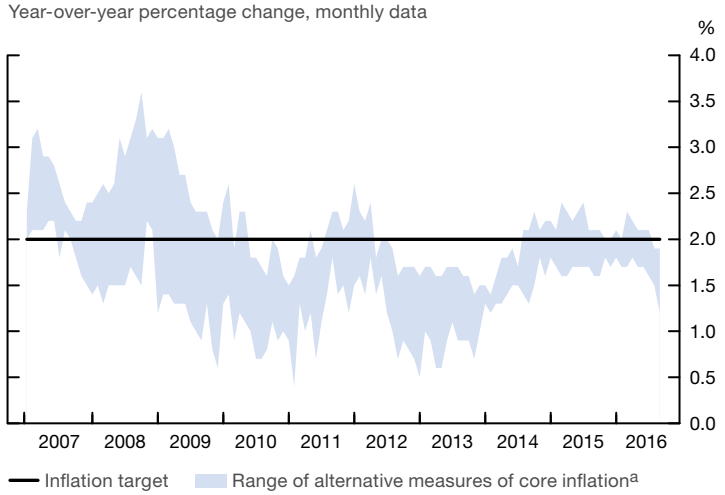
The change in the Bank's outlook required a significant shift in communications in the second half of 2013. The Bank adopted a neutral monetary policy stance and stopped providing forward guidance about the future path of interest rates. At the same time, heightened uncertainty led the Bank to explicitly incorporate confidence bands into discussions of the economic projection. The shift to a neutral policy stance indicated that the level of the policy interest rate was within a zone that was consistent with the expectation of achieving the inflation target over a reasonable horizon. The flexibility in the framework regarding the horizon provided scope for hedging against the risk that lower interest rates might exacerbate household imbalances. This new portrayal helped characterize the policy dialogue as an exercise in risk management.

In 2014, global growth continued to disappoint. The United States fared relatively well, having taken aggressive and sustained policy actions to stimulate economic activity and increase the resilience of the US financial system. Meanwhile, Canadian real GDP growth held up, with important support from household spending. While excess capacity pressures persisted, disinflationary pressures associated with retail competition waned and measures of core inflation started to drift up (**Chart 2**).

A growing global supply of commodities in the context of weak global demand first appeared as softness in non-energy commodity prices but subsequently spread: in the second half of 2014, oil prices fell sharply. Confronted with the impact of lower prices for oil and other commodities, the Bank lowered its policy interest rate in January 2015 and again in July as the impact and persistence of the terms-of-trade shock became clearer. In contrast to 2013, the size and nature of the shocks were such that leaving the policy rate unchanged would not have been consistent with achieving the inflation target in a reasonable time frame. The decline in Canada's terms of trade and in the value of the Canadian dollar set in motion complex adjustments that were expected to influence the evolution of economic activity in Canada over several years.

Chart 2: Alternative measures of core inflation used until 2016

Year-over-year percentage change, monthly data



a. These measures are CPIX; MEANSTD; the weighted median; CPIW; CPI excluding food, energy and the effect of changes in indirect taxes; and the common component. For definitions, see Statistics > Indicators > Indicators of Capacity and Inflation Pressures for Canada > Inflation on the Bank of Canada's website.

Sources: Statistics Canada and Bank of Canada calculations Last observation: September 2016

The depreciation of the Canadian dollar associated with the decline in resource prices has since been providing support to prices of consumer goods with high import content and, as a result, measures of core inflation have been close to 2 per cent. However, the decline in consumer energy prices and disinflationary pressures associated with economic slack have more than offset the effects of exchange rate pass-through, and total inflation has remained in the lower part of the inflation-control range since the first quarter of 2015. Despite persistent disinflationary pressures, inflation expectations have remained well anchored by the Bank's 2 per cent target.

The Level of the Inflation-Control Target

As noted in the previous section, the 2 per cent inflation target has served Canada well. Despite this success, the Bank studied the costs and benefits associated with an inflation target below 2 per cent in preparation for the last renewal in 2011. This research found that the prospective benefits associated with a lower inflation target were greater than previously estimated. However, the research also indicated that pursuing a target below 2 per cent would substantially increase the frequency of potentially costly encounters with the effective lower bound (ELB) on nominal interest rates.[2] Overall, the Bank concluded that the benefits of a lower inflation target were insufficient to offset the possible increased costs associated with the ELB.

Experience and analysis since 2011 have reinforced the importance of the ELB for the conduct of monetary policy in an environment of persistently weak aggregate demand and inflation. In many jurisdictions, the ELB has been a more persistent constraint than anticipated, eliciting a greater appreciation for the potentially long-lasting nature of ELB episodes. At the same time, the Bank's estimate of the real neutral rate of interest—the real (inflation-adjusted) policy rate consistent with output at its potential level and inflation on target after the effects of all cyclical shocks have dissipated—has declined. The analysis suggests that interest rates are likely to be lower, on average, in the future than they were during the first two decades of inflation targeting. These and other factors have led to suggestions that consideration should be given to targets above 2 per cent (see, for example, Williams 2009; Blanchard, Dell'Ariccia and Mauro 2010; Ball 2014; Krugman 2014a and 2014b). Therefore, in preparation for the 2016 renewal, the Bank undertook a careful analysis of the costs and benefits of raising the target.

Benefits of a higher inflation target

The principal benefit of a higher inflation target is that it reduces the likelihood that monetary policy will find itself operating at the ELB. A higher inflation target would raise the average level of nominal interest rates in general and the policy rate in particular, providing greater scope for easing through conventional policy before reaching the ELB and reducing the frequency of

2 Normally, central banks conduct monetary policy by setting a target for the overnight interest rate. The traditional view was that investors would not accept interest rates that were less than zero because they could always hold currency and earn a zero return. While the lower bound is now estimated to be below zero, it remains the case that, at some point, the central bank would not be able to lower policy rates further to provide additional monetary stimulus.

ELB episodes.[3] In addition, with inflation expectations anchored at a higher target, it would be possible to make real interest rates more negative in ELB episodes, attenuating the severity of such episodes and reducing the likelihood of persistently undershooting the inflation target.[4]

In recent years, three important changes have influenced estimates of the probability of being constrained by the ELB. First, the Bank's analysis suggests that the real neutral rate has declined from about 3 per cent in the mid-2000s to about 1.25 per cent.[5] All else being equal, the decline in the neutral rate raises the likelihood of encounters with the ELB. Second, estimates of the ELB itself have also declined, partially offsetting the impact of the lower neutral rate. In 2009, the Bank viewed 0.25 per cent as the ELB.[6] Since then, several central banks have adopted negative policy rates, and markets in these jurisdictions have continued to function effectively (Jackson 2015). Currently, the Bank's best estimate is that the ELB is approximately -0.5 per cent in Canada (Witmer and Yang 2015 and 2016). In isolation, the lower ELB reduces the likelihood of ELB episodes. But, on net, these two changes cause the estimated probability of being constrained by the ELB to rise (**Box 2**).

Financial regulatory reform is the third influence on the probability of being constrained by the ELB. Experience over the past decade has shown that banking crises tend to be associated with deeper recessions and prolonged slow-growth recoveries, which in turn prompt reductions in policy rates, raising the constraint probability. To the extent that regulatory reform has reduced the likelihood of financial crises, the probability of ELB episodes and of a breakdown of the monetary policy transmission mechanism has likely also been reduced. A more detailed discussion of regulatory reform and the implications for monetary policy appears in the later section, "Financial Stability Considerations in the Conduct of Monetary Policy," on page 23.

Ultimately, the goal of a higher target would be to enhance economic stability by reducing the adverse consequences of the ELB on economic activity and inflation. The Bank's analysis suggests that a higher inflation target would yield modest but material improvements in macroeconomic performance at the ELB if unconventional monetary policy tools were not used. But, in practice, central banks can employ a range of unconventional policy measures.[7] In addition to negative policy rates, these measures include the following.[8]

3 The analysis in the main text abstracts from changes in the CPI measurement bias. At the time of the 2011 renewal, the Bank estimated that measured CPI inflation was biased upward by about 0.5 percentage points (Sabourin 2012). More recent estimates indicate that the bias is now about 0.3 percentage points (Sabourin forthcoming). This finding suggests that the estimated true rate of inflation that is consistent with 2 per cent measured inflation has risen from 1.5 per cent to about 1.7 per cent. The higher estimate of the true rate of inflation would tend to increase the average level of nominal interest rates. While this effect is small, it captures some of the benefits that would be associated with a higher inflation target.

4 A higher target would also reduce the risk of persistent deflation, which is often said to exert malignant effects by creating an incentive to delay purchases and by raising the real value of nominal debt. But these effects do not qualitatively distinguish deflation from low inflation. For a given nominal interest rate, low expected inflation raises the real interest rate and causes households to delay consumption. In addition, ex post, lower-than-expected inflation raises the real burden of nominal debt, depressing demand. Therefore, if deflation is special, it is perhaps because of its psychological significance. For example, a negative inflation rate might draw more attention than a low positive rate, possibly causing inflation expectations to become unanchored more quickly.

5 The Bank's most recent estimate of the neutral policy rate appeared in the April 2016 *Monetary Policy Report*. For a discussion of the reasons for the decline in the neutral rate, see Mendes (2014).

6 The choice of a slightly positive ELB was motivated in part by concerns about the need to provide lenders and borrowers with the incentive to transact in markets. At the time, there was substantial uncertainty about the impact of very low interest rates on market functioning. This uncertainty led most central banks to exercise due caution by keeping policy rates slightly positive.

7 See Bank of Canada (2015) for further details.

8 Negative interest rates are included in the list of unconventional policy measures available to a central bank because the zero limit on interest rates can be obtained by simply holding bank notes, implying the potential for some changes to the traditional transmission mechanism once policy rates fall below zero.

Forward guidance: Conditional statements by a central bank about the future path of its policy rate, usually aimed at influencing longer-term interest rates when the policy rate is at the ELB.

Large-scale asset purchases (LSAPs): Outright purchases of financial assets through the creation of excess settlement balances (that is, central bank reserves), with the goal of pushing up the price of, and reducing the yield on, the purchased assets (which could include longer-term government securities or private assets such as mortgage-backed securities and corporate debt).

Funding for credit: Provision of collateralized term funding to banks at a subsidized rate if they meet certain lending objectives, with the goal of alleviating impairments to the flow of credit.

While the Bank's policy rate reached what was then perceived to be the ELB in 2009–10, monetary policy was not materially constrained. The Bank made effective use of forward guidance during this episode, it did not need to employ any of the other unconventional measures, and the duration of the ELB episode was limited to about a year. Globally, all of the measures, including negative policy rates, have been used by central banks. The Bank has reviewed international evidence to assess the effectiveness of the various unconventional policy measures, but data limitations and economic developments in the wake of the crisis make it difficult to precisely identify the impact of any given policy measure. Nevertheless, the available evidence suggests that these unconventional measures are effective at influencing market interest rates and asset prices at the ELB.[9] For example, the international experiences of Switzerland, Sweden and the euro area suggest that while negative rates may not be fully transmitted into some bank lending rates, they do appear to be passed on to longer-term market interest rates.[10]

However, as with conventional policies, the use of the unconventional tool kit may have its limits (Santor and Suchanek 2016).[11] For example, significant purchases of a security can impair market functioning by reducing liquidity in the market and even disconnecting the purchased security from the rest of the market (Bernanke and Reinhart 2004). However, as seen in the United Kingdom and Sweden, central bank holdings of close to 40 per cent of the government bond market do not seem to have caused any significant market impairment. And, while negative rates have the potential to impair the functioning of financial markets such as repo markets, it is expected that Canadian financial markets will be able to adapt to small negative interest rates, as markets of other countries with negative rates have done (Witmer and Yang 2016).[12] Until more central banks have exited from their use of

9 The Bank evaluated unconventional policies by conducting original research and reviewing the broader literature. Charbonneau and Rennison (2015) review the literature on forward guidance. The Bank has also conducted research on forward guidance, including an evaluation of the impact of the Bank's conditional commitment in 2009–10 by He (2010) and a model-based assessment of state-contingent forward guidance by Mendes and Murchison (2014). Kozicki, Santor and Suchanek (2011); Santor and Suchanek (2013); and Reza, Santor and Suchanek (2015) review the evidence on the effectiveness of LSAPs. Santor and Suchanek (2016) review the international experience with LSAPs and negative interest rates. Bank research in this area includes estimates of the impact of LSAPs on the real economy by Baumeister and Benati (2013) and an analysis of international transmission mechanisms by Dahlhaus, Hess and Reza (2014).

10 For this reason, the Bank's analysis in Box 2 assumes that only half of any policy rate changes below zero are passed through to lending rates in the simulations.

11 LSAPs appear to be subject to diminishing returns to scale and may hinder price discovery and reduce welfare due to a diminished supply of safe assets, and, more generally, unconventional monetary policies (UMPs) may lead to excessive risk taking (Santor and Suchanek 2016). Bauer et al. (2016) suggest that the effectiveness of some, but not all, UMPs may be limited in small open economies.

12 While negative interest rates may also lower bank profitability, this possible negative impact could be offset, since negative rates would help boost domestic demand, improve loan credit quality and result in capital gains on banks' bond holdings (Viñals, Gray and Eckhold 2016).

Box 2

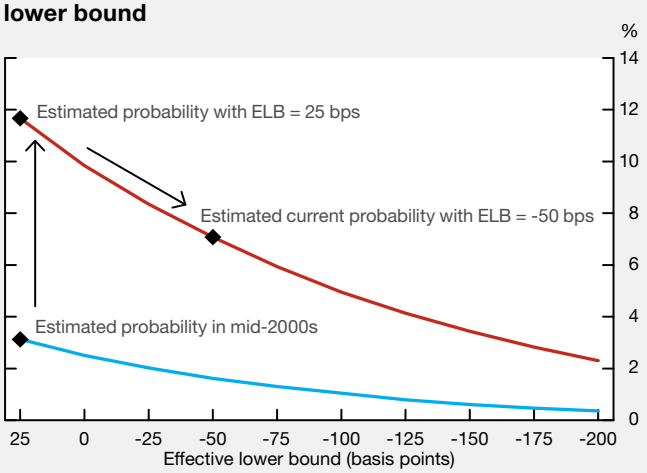
The Probability of Being Constrained by the Effective Lower Bound on Nominal Interest Rates

The neutral rate of interest is a key determinant of the probability that conventional monetary policy is constrained by the effective lower bound (ELB). Here, the real neutral rate is defined as the real policy rate consistent with output at its potential level and inflation equal to target after the effects of all cyclical shocks have dissipated. In the mid-2000s, the Bank assumed the real neutral rate was about 3 per cent. Currently, the Bank's estimates are in the range of 0.75 to 1.75 per cent (with a 1.25 per cent midpoint).[1] This decline implies that interest rates will, on average, be lower in the future, meaning there will be less room for conventional monetary policy to ease before hitting the ELB.

In 2009, the Bank viewed 25 basis points (bps) as the ELB. At this ELB, the decline in the neutral rate raises the estimated probability of being constrained by the ELB from about 3 per cent to about 12 per cent (Chart 2-A). More recently, the Bank revised its view of the ELB, which is now judged to be about -50 bps. Assuming an ELB of -50 bps would eliminate roughly half of the increase in the probability, leaving it at 7 per cent.[2] The lower ELB therefore provides a partial, but significant, offset to the lower neutral rate.

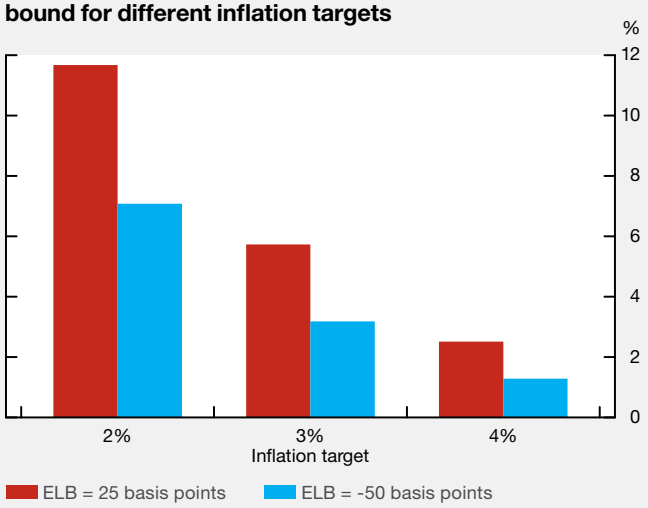
Raising the inflation target could also help reduce the probability of being constrained by the ELB (Chart 2-B and Chart 2-C). A higher inflation target would lead to higher nominal interest rates on average (for a given real neutral rate). This would create more space for conventional policy to ease before hitting the ELB. A higher target could materially reduce the frequency and duration of ELB episodes. Indeed, raising the inflation target to 3 per cent would be sufficient to offset the remaining effects of the lower neutral rate on the probability of being constrained by the ELB. However, the overarching goal of a higher target would not be to reduce the frequency and duration of ELB episodes but to enhance economic stability by reducing the impact of the ELB on output and inflation. The impact of the ELB under alternative levels of the inflation target is addressed in Box 3 on page 14.

Chart 2-A: Relative frequency of a binding effective lower bound



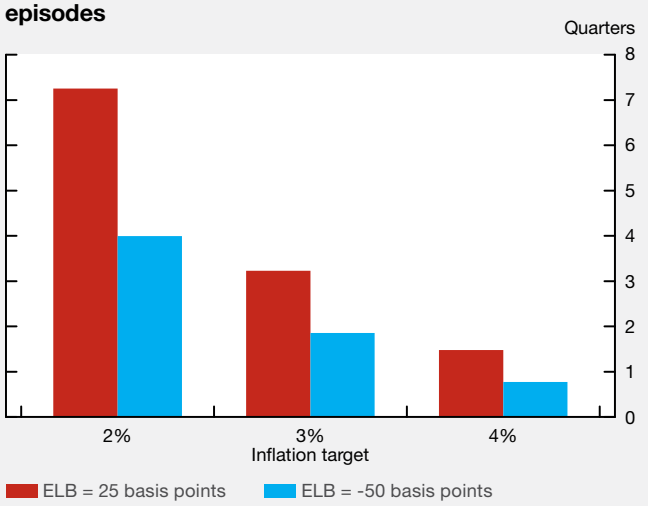
Source: Bank of Canada estimates

Chart 2-B: Relative frequency of a binding effective lower bound for different inflation targets



Source: Bank of Canada estimates

Chart 2-C: Average duration of effective lower bound episodes



Source: Bank of Canada estimates

1 For details on the various approaches used to estimate the neutral rate, see Mendes (2014).

2 Based on the experience of other central banks with negative rates, the analysis assumes that only half of any policy rate changes below zero are passed through to lending rates in the simulations.

unconventional monetary policy measures, it will be difficult to fully assess the longer-term effectiveness of these policies, particularly regarding their impact on economic activity and inflation.

The availability of unconventional policy measures diminishes the potential benefits associated with a higher inflation target. A higher target creates additional scope for conventional policy easing and therefore reduces the need for unconventional policy actions. But when negative policy rates, forward guidance and LSAPs are incorporated into the analysis, raising the inflation target yields only small improvements in macroeconomic performance (**Box 3**).[13]

While a second possible benefit to a higher inflation target has been associated with downward nominal wage rigidity (DNWR), an opposing view is that there is no clear link between DNWR and the optimal level of the inflation target. DNWR refers to the observation that declines in wages occur less frequently than economic conditions warrant because, even during periods of recession, workers dislike outright cuts to nominal wages, and firms are concerned that such cuts would hurt worker morale and lower productivity. The hypothesis is that DNWR impedes economic adjustment and thereby leads to a higher unemployment rate, on average. According to this hypothesis, a higher inflation target may have benefits associated with a lower incidence of DNWR (Akerlof, Dickens and Perry 1996; Fortin 1996; Fortin et al. 2002; Fortin 2013).

There is, however, insufficient evidence of a link between DNWR and an optimal level of inflation. The Bank of Canada has previously found little indication that labour market adjustment had been inhibited by low inflation—although there was evidence of a limited amount of DNWR, the employment and output consequences of these rigidities were not economically significant (Crawford and Wright 2001; Bank of Canada 2001 and 2006; Brouillette and Kyui forthcoming). In more recent analysis, microeconomic survey data suggest that the incidence of zero wage changes has increased recently, but the macroeconomic significance or implications of this result for a central bank's inflation target remain unclear (Amano et al. 2016).

Theoretical research indicates that the presence of DNWR may not always lead to lower employment or justify a higher inflation target. Amano and Gnocchi (forthcoming), for example, study a potentially mitigating interaction between DNWR and the ELB. They argue that because DNWR tends to attenuate declines in prices and wages during downturns, it supports inflation expectations, helping lower real interest rates and thus reducing the likelihood and severity of ELB episodes. As a result, once a central bank chooses a sufficiently high inflation target to alleviate its concerns about hitting the ELB, the inclusion of DNWR into the mix does not require an increase in the target rate.

More generally, the traditional view embodied in the work of John Maynard Keynes, which argues that nominal wage flexibility is needed to facilitate labour market adjustment, rests on the assumption that employment is determined by the real wage in isolation. Galí (2013) has challenged this view and finds that the implications of sticky wages for consumer welfare depend on the importance of real wages relative to aggregate demand conditions. Overall, the latest research provides additional support for the view that DNWR need not imply that a higher inflation target is necessary.

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13 Estimates of the potential benefits of a higher inflation target are based on simulations that do not incorporate fiscal policy considerations. The estimated benefits would be further diminished were the simulations to take into account possible countercyclical effects of fiscal policy, particularly the potential use of discretionary fiscal stimulus in periods of pervasive and persistent weak aggregate demand, as in ELB episodes.

Box 3

Unconventional Monetary Policy Achieves Many of the Benefits of a Higher Target

This box examines the extent to which a higher inflation target could enhance economic stability by reducing the impact of the effective lower bound (ELB) on output and inflation. In particular, the Bank of Canada's quarterly projection model, ToTEM, is used to simulate how a higher inflation target might change outcomes during periods when a 25-basis-point ELB would be binding under a 2 per cent target.[1] Results are shown for two values of the ELB: 25 basis points (bps) and -50 bps. In addition, two different monetary policy environments are examined. In the first, only conventional monetary policy is considered: once the policy interest rate is lowered to the ELB, monetary policy cannot be eased further. In the second, once the policy rate reaches the ELB, monetary policy can be eased further through the use of unconventional monetary policy tools.

Unconventional monetary policy tools are operationalized in the simulations as follows.

Forward guidance provides monetary stimulus through conditional statements about the future path of the policy interest rate. Such statements usually extend the expected length of time for which the policy rate will remain at the ELB and thereby reduce longer-term interest rates. To make this systematic, it is assumed that when the policy rate reaches the ELB, the Bank commits to not raise rates at least until the unemployment rate falls below a threshold level or the inflation rate rises more than 1 percentage point above target.[2] The unemployment threshold level is chosen to minimize the squared deviations of output from potential and inflation from target. In most cases, the threshold lies slightly below the natural rate of unemployment.

Quantitative easing (QE) provides stimulus by reducing longer-term interest rates through its impact on the term premium. It is assumed that when the policy rate reaches the ELB, the Bank buys longer-term government bonds in sufficient quantities to reduce the term premium by 40 bps.[3] The Bank is assumed to hold the purchased assets for five years before it begins to gradually normalize the balance sheet.

The stimulus provided by both forward guidance and QE has a direct impact on domestic demand but can also influence the exchange rate and therefore the competitiveness of Canadian goods and services.

When the central bank has access only to conventional monetary policy, raising the target from 2 to 3 per cent would narrow the output gap by 0.2 to 0.4 percentage points during the periods under consideration (**Chart 3-A**). Raising the target from 3 to 4 per cent implies an additional narrowing of only 0.1 to 0.2 percentage points. Deviations of inflation from target (i.e., the inflation gap) are also smaller when the target is higher (**Chart 3-B**). Because the ELB binds less frequently when it is lower, the marginal gains associated with raising the target are smaller when the ELB is assumed to be -50 bps.

A higher target also attenuates the decline in potential output in these episodes. A better outcome for potential output is obtained because when the inflation target is higher, the real interest rate can fall by a greater amount, mitigating the decrease in investment. For this reason, the effects of a higher target on the output gap are about half the size of the effects on the level of output itself.

When unconventional monetary policy tools are also available, the marginal gains from raising the inflation target are small. When the ELB is assumed to be 25 bps, raising the target from 2 to 3 per cent would narrow the output gap by 0.2 percentage points during the periods under consideration (**Chart 3-C**). However, when the ELB is assumed to be -50 bps, the narrowing of the output gap associated with a 3 per cent target is only 0.1 percentage point. Moreover, there is virtually no further narrowing of the output gap as the target is raised above 3 per cent. The gains in terms of inflation performance are similarly small (**Chart 3-D**).

(*continued...*)

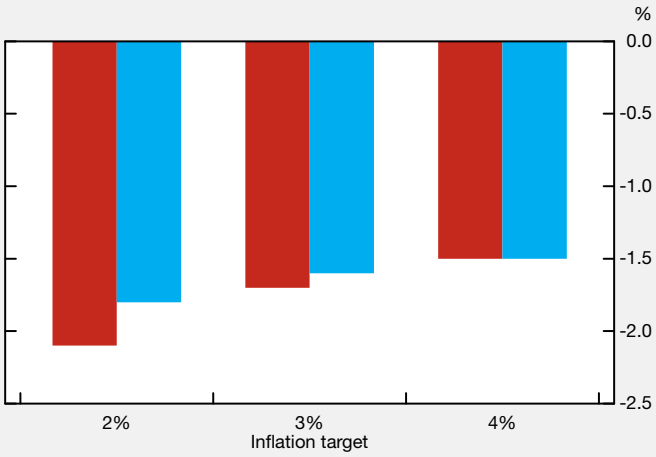
1 The same set of random shocks is used across all of the simulations, with different targets and ELB assumptions. To provide a fair comparison, the analysis focuses on the same periods (and thus the same shocks) across the different simulations. For this reason, Bank staff identify the periods in which a 25-basis-point ELB would be binding under a 2 per cent target. They then look at economic outcomes in these same periods in the simulations with different targets and ELB assumptions. In some of these periods, the ELB is not actually binding when the target is above 2 per cent or the ELB is below 25 basis points. For example, there are periods in which the ELB is binding under a 2 per cent target and 25-basis-point ELB, but it is not binding when the target is 4 per cent and the ELB is -50 bps. These periods are included in the analysis because they capture part of the improvement in economic performance due to a higher target or a lower ELB. Excluding these periods would cause the results to understate the positive impact of a higher target or lower ELB. For further details on the methodology, see Dorich et al. (forthcoming).

2 For a discussion of threshold-based forward guidance, see Mendes and Murchison (2014).

3 This magnitude is consistent with conservative estimates of the cumulative effects of the first two rounds of QE in the United States and the United Kingdom. Reza, Santor and Suchanek (2015) survey the literature and report ranges for the impact of QE on long-term yields in the United States and the United Kingdom. The average of the lower bounds of these ranges is about 60 bps. A reduction of about 40 bps in the term premium is implied by the assumption that about two-thirds of the decline in yields is attributable to a decline in the term premium (consistent with results in Joyce et al. 2011).

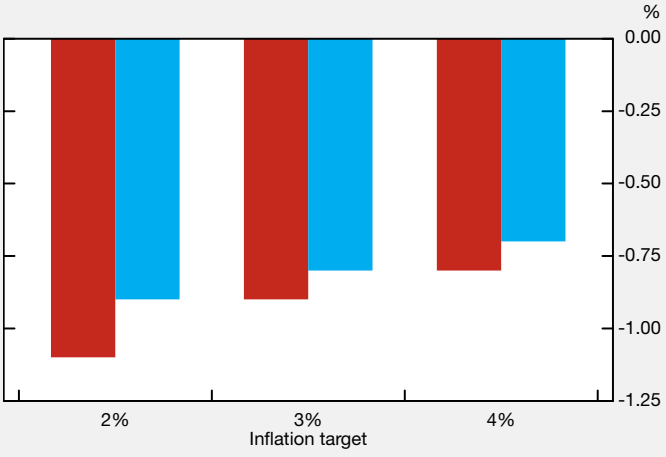
Box 3 (*continued*)

Chart 3-A: Average output gap at the effective lower bound



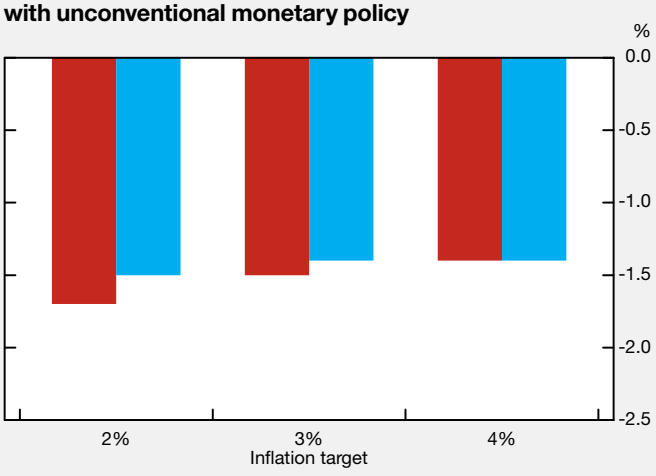
Source: Bank of Canada estimates

Chart 3-B: Average inflation gap at the effective lower bound



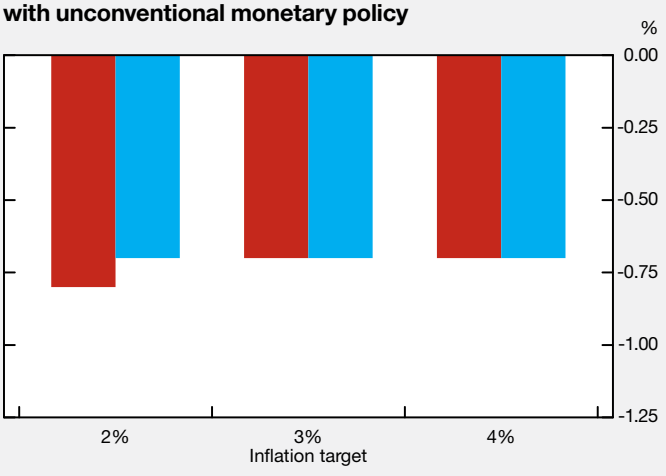
Source: Bank of Canada estimates

Chart 3-C: Average output gap at the effective lower bound with unconventional monetary policy



Source: Bank of Canada estimates

Chart 3-D: Average inflation gap at the effective lower bound with unconventional monetary policy



Source: Bank of Canada estimates

Costs associated with raising the inflation target

The costs associated with a higher inflation target fall into two categories: one-time costs associated with the transition to a higher target and ongoing costs associated with higher steady-state inflation.[14]

One potential transition cost arises from the redistribution of wealth that would result from a change in the target. Financial contracts are generally set in nominal terms and can have durations measured in decades rather than years. Changes in long-term inflation expectations shift the real value of long-term nominal assets. Thus, an increase in the target can result in a wealth transfer from lenders to borrowers (**Box 4**). Bank staff estimate that for every 1-percentage-point increase in the target, the household sector would lose about 0.6 per cent of its initial wealth, a magnitude comparable to 4 per cent of annual GDP. The government sector would be the main

14 One-time costs would also arise with the transition to a lower inflation target.

Box 4

Redistributive Effects of the Transition to a Higher Inflation Target

When assessing the costs and benefits associated with shifting to a higher target, it is important to note that this transition will have redistributive effects. This redistribution occurs because financial contracts are often written in nominal terms so that their real value changes with inflation.[1] Data on the distribution of nominal assets and liabilities were used to predict the redistribution of wealth that would occur following a permanent 1-percentage-point increase in the rate of inflation, both across sectors and between various demographic cohorts, using methods developed by Meh and Terajima (2011) and Meh, Ríos-Rull and Terajima (2010).

Net nominal positions (i.e., nominal assets minus nominal liabilities) for various sectors are shown for household, foreign and government sectors in Table 4-A. Firms' assets and liabilities have been distributed to each of these three sectors in proportion to those sectors' equity holdings (McGrattan and Prescott 2005). Because assets with greater maturity are more sensitive to permanent changes in the rate of inflation, the data have also been broken down across four categories: short-term, long-term, mortgage and pension.[2]

The household and foreign sectors are both net nominal savers, with the nominal savings of households concentrated in long-term assets and unindexed pensions. The government sector is a net nominal borrower, with nominal debt concentrated in long-term bonds. As a result, a permanent increase in the rate of inflation would be expected to trigger a redistribution of wealth from households to government. Following a permanent and unanticipated increase in inflation from 2 to 3 per cent, the household sector experiences a loss equal to 4.3 per cent of GDP, while the government sector experiences a gain of 4.2 per cent (Table 4-B). The foreign sector also experiences a small gain of 0.2 per cent.

The distribution of the household sector's losses across various age and socio-economic brackets can be estimated using the nominal assets and liabilities that households reported in the 2005 Survey of Financial Security.[3] Young, poor households emerge as net gainers, while older and/or wealthier households tend to bear the brunt of the sector's losses (Table 4-C). Middle-aged, middle-class households are especially affected, with losses reaching up to 2.7 per cent of net worth in the 46–55 age bracket. These substantial losses occur because middle-class households have more of their wealth tied up in pensions and fixed-income products, while rich households own disproportionately more equity.

Table 4-A: Net nominal positions as a percentage of GDP
Based on 2012Q1 data from the National Balance Sheet Accounts, per cent

	Short-term	Long-term	Mortgage	Pension	Overall
Household	8.5	27.0	-13.6	17.3	39.3
Foreign	-0.7	10.8	10.8	-9.1	11.7
Government	-7.8	-37.8	2.8	-8.2	-51.0

Sources: Statistics Canada and Bank of Canada calculations

Table 4-B: Redistribution of wealth as a percentage of GDP after a 1-percentage-point increase in inflation
Based on 2012Q1 data from the National Balance Sheet Accounts, per cent

	Short-term	Long-term	Mortgage	Pension	Overall
Household	-0.08	-2.13	0.45	-2.55	-4.32
Foreign	0.01	-0.85	-0.36	1.35	0.15
Government	0.08	2.98	-0.09	1.21	4.17

Sources: Statistics Canada and Bank of Canada calculations

Table 4-C: Redistribution of wealth as a percentage of net worth for various age and socio-economic brackets
Based on 2005 data from the Survey of Financial Security, per cent

	Poor	Middle-class	Rich
< / = 35	0.96	1.27	-0.63
36–45	1.14	-1.10	-0.03
46–55	-0.21	-2.69	-0.61
56–65	-0.35	-1.85	-0.04
66–75	-0.13	-1.18	-0.57
> 75	-0.43	-0.74	-0.65

Sources: Statistics Canada and Bank of Canada calculations

Note: For a given age bracket, "rich" households are those in the top 10 per cent of the wealth distribution. The other 90 per cent are then divided on the basis of income, with the bottom 20 per cent labelled "poor" and the remainder labelled "middle-class."

(*continued...*)

1 To be precise, the relevant channel operates as follows: When a nominal contract is first written, agents have certain expectations of future inflation. If shocks subsequently cause those expectations to change, the contract's real value changes as well. In particular, unexpectedly higher inflation would imply a transfer of real wealth from lenders to borrowers, since it reduces the real value of the debt owed by the borrowers to the lenders. In the case of an unanticipated permanent increase in the rate of inflation, the magnitude of this effect depends on the maturity of the underlying contract. This is because the gap between agents' pre- and post-shock expectations of the price level at maturity is wider for longer-lived contracts.

2 The short-term category includes short-maturity instruments such as currency and deposits, and trade and consumer credit; the long-term category includes long-maturity instruments such as loans and bonds.

3 For a given age bracket, "rich" households are those in the top 10 per cent of the wealth distribution. The other 90 per cent are then divided on the basis of income, with the bottom 20 per cent labelled "poor" and the remainder labelled "middle-class."

Box 4 (*continued*)

In light of this heterogeneity in the household sector, it is natural to ask how many households would ultimately emerge as net losers. An examination of households' losses as a percentage of their initial net worth reveals that most households would suffer net losses. More specifically, 74 per cent of all households (10.8 million) would experience net losses, with 47 per cent (6.7 million) losing more than 1 per cent of their initial net worth. In contrast, only 21 per cent of households (3.1 million) would experience a gain greater than 1 per cent of their initial net worth.

beneficiary because of its large stock of long-term nominal liabilities. While the ultimate welfare implications of the redistribution would depend on what the government does with its windfall, adverse indirect consequences of increasing the inflation target may arise in the form of negative wealth effects on households (Meh, Ríos-Rull and Terajima 2010).

More generally, a change in the target may lead to greater uncertainty about longer-term price stability, thereby impairing the credibility of the new target. At least two types of credibility-related costs are associated with raising the target. The first is that an increase in the target may lead to expectations of future increases, causing inflation expectations to drift above the new target. Re-establishing the credibility of the target would require the Bank to lean against these expectations with tighter monetary policy. Expectations could, however, be sticky at 2 per cent, failing to adjust upward to the new target.[15] In this scenario, the Bank would have to provide additional stimulus to push inflation up to the new target, possibly exacerbating financial vulnerabilities. While the Bank's success at establishing credibility with a 2 per cent inflation target suggests these credibility scenarios are probably not the most likely outcome, they cannot be ruled out.

International experience offers little guidance on the potential effects on credibility of changes to an inflation target. Among advanced economies, only two countries—New Zealand and Japan—have experience with raising their inflation targets. New Zealand did not encounter any significant credibility issues. In Japan, while inflation has risen since the higher target came into effect, it has not yet reached the new target rate, and progress in reaching the target has been slower than expected. It is difficult to generalize from these two observations.

In addition to the transition costs, there appear to be several ongoing costs associated with higher steady-state inflation (Bank of Canada 2011). First, in the presence of various types of nominal price and wage rigidities, inflation can lead to arbitrary differences in relative prices and a less efficient allocation of resources.[16] Second, the interaction of inflation with the tax system can lead to important distortions. However, changes to the tax system since the 1990s, together with other developments, appear to have reduced the costs of higher inflation due to tax distortions (Barnett and Mendes forthcoming). Third, inflation imposes a cost on holdings of highly liquid assets, such as currency, whose zero or minimal rate of return does not fully adjust to inflation. This implies that the burden of higher rates of inflation is more likely to be borne by households that are generally less able to hedge against inflation risk. For example, low-income and/or older or retired households are more likely to use cash-like liquid assets for a larger fraction of their total transactions (Cao et al. forthcoming). Finally, inflation can cause

15 De Michelis and Iacoviello (2016) show that the effects of an increase in the inflation target during a liquidity trap are weakened by the slow response of inflation and inflation expectations.

16 Amano et al. (2016) provide evidence of the presence of DNWR in Canada.

changes in wage- and price-setting behaviour. For example, at higher levels of inflation, indexation of wage contracts may become more widespread and lead to greater inflation persistence. Taken together with the transition costs, these steady-state costs pose a significant obstacle to the adoption of a higher target.

Bottom line

Given the success of the 2 per cent inflation target, the bar for making any change is set high. Pursuing a higher target may yield modest and largely episodic improvements in macroeconomic performance by alleviating the effects of the ELB constraint, but estimates of these gains are uncertain, particularly when unconventional policy is taken into account. A higher target could also exacerbate the costly distortions caused by inflation on an ongoing basis. Moreover, a target inflation rate of 2 per cent is in line with that adopted in most advanced economies (Fay and Hess 2016). Therefore, transitioning to a new target, which is a departure from the norm, could put at risk the hard-won credibility that has underpinned the success of Canada's inflation-targeting framework. Overall, the Bank considers the arguments for maintaining the 2 per cent target to be compelling and finds the evidence does not justify a change in the target at this time.

The Measurement and Use of Core Inflation

The inflation target in Canada is expressed in terms of total CPI inflation, which is a broad measure of inflation that is familiar to Canadians. Monetary policy achieves its inflation target by influencing demand for domestically produced goods and services—which, in turn, affects underlying inflationary pressures. However, many other factors can influence total CPI inflation (for example, changes in the prices of commodities set in global markets, movements in the Canadian dollar, sector-specific developments and changes in indirect taxes). The Bank "looks through" the temporary effects of these other factors on inflation when making its policy decisions because the related price movements are likely to be short-lived and monetary policy affects inflation with a lag.

The Bank does this by examining forecasts of total CPI inflation beyond the horizon of the impact of the temporary factors (most frequently, their effects dissipate within a year) and by looking at measures of core inflation as operational guides to policy. The Bank calculates and publishes several measures of core inflation designed to strip out some of the transitory fluctuations in total inflation.

Since 2001, the Bank's main measure of core inflation has been CPIX inflation, which excludes eight of the most volatile components of the CPI (fruit, vegetables, gasoline, fuel oil, natural gas, mortgage interest, intercity transportation and tobacco products) and adjusts the remainder for the effect of changes in indirect taxes. Alternative measures of core inflation have also been regularly used as indicators of pressure on inflation associated with excess demand or supply.

In recent years, the usefulness of CPIX inflation as an operational guide to policy has deteriorated. Some components (e.g., electricity prices) have shown particularly high volatility, leading to noticeable movements in CPIX inflation, while others (e.g., auto prices) have often moved countercyclically, thereby obscuring the relationship between CPIX and the deviation of actual from potential output. The Bank's *Monetary Policy Report* has provided projections of CPIX inflation and regularly described the extent to which movements in CPIX are due to sector-specific factors and therefore discounted in policy deliberations. However, this practice may have led to a misperception that CPIX inflation, or another measure of inflation constructed by excluding some price components, is the actual target for monetary policy rather than merely a (sometimes noisy) operational guide. For these reasons, the Bank has evaluated the properties of a wide selection of core inflation measures and revisited their use in economic projections and Bank communications.

Experience has shown that simply excluding the most volatile components does not guarantee that the resulting measure will effectively filter out all transitory inflation movements that monetary policy would want to look through. Since monetary policy primarily acts on inflation through its effect on demand, measures of core inflation that move with the output gap and are largely insensitive to transitory sector-specific developments would be more effective as operational guides to policy. In addition, a measure of core inflation should be easily understood to facilitate clear communications.

An evaluation of different measures of core inflation and a summary of the practices of other central banks regarding their use of core inflation in communications is provided in **Box 5**.[17] Overall, this evaluation found little compelling evidence to continue the existing practice of using CPIX inflation as the primary measure of core inflation. In contrast, a measure of core

Box 5

Evaluating Measures of Core Inflation

An effective core measure must have several key properties. It must (i) closely track long-run movements in total consumer price index (CPI) inflation (in other words, be unbiased); (ii) be less volatile than total inflation and capture persistent movements in inflation; (iii) be related to the underlying drivers of inflation, notably the output gap; and (iv) be easy to understand and explain to the public.

Table 5-A summarizes an evaluation of different measures of core inflation (for more details, see Khan, Morel and Sabourin 2015). Overall, this exercise uncovered little compelling evidence in favour of CPIX inflation. In contrast, CPI-trim, CPI-median and CPI-common were found to perform favourably across a range of evaluation criteria, in particular because they better capture persistent movements in inflation and tend to move with macroeconomic drivers.

Definitions of core inflation measures

CPIX inflation is calculated using a price index that excludes eight of the most volatile components of the CPI and the effect of indirect tax changes on the remaining components. The eight components that are excluded from the all-items index to construct CPIX are fruits, vegetables, gasoline, fuel oil, natural gas, mortgage interest, intercity transportation and tobacco products.

CPIXFET inflation is calculated using the CPI excluding food, energy and the effect of changes in indirect taxes.

CPIW is a volatility-weighted measure of core inflation that assigns a weight to each CPI component that is inversely proportional to its historical volatility.

CPI-trim (trimmed mean) is a measure of core inflation that excludes CPI components whose rates of change in a given month are located in the tails of the distribution of price changes.

CPI-median (weighted median) is a measure of core inflation corresponding to the price change located at the 50th percentile (in terms of CPI basket weights) of the distribution of price changes in a given month.

CPI-common (common component) is a measure of core inflation that tracks common price changes across categories in the CPI basket.

(*continued...*)

Table 5-A: Summary of an evaluation of different core inflation measures

	CPIX	CPIXFET	CPIW	CPI-trim	CPI-median	CPI-common
Unbiased?	✓	✗	✓	✓	✓	✓
Persistent?	✗	✓	✗	✓	✓	✪
Moves with output gap?	✗	✗	✗	✓	✓	✪
Looks through sector-specific shocks?	✗	✗	✗	✓	✓	✓
Easily understood?	✓	✓	✓	✓	—	✗

✪ = top performer

17 Additional details on the technical evaluation can be found on the Bank's website at http://www.bankofcanada.ca/wp-content/uploads/2015/10/dp2015-12.pdf.

Box 5 (*continued*)

Overall, no single measure of core inflation dominates across all the evaluation criteria, and each of them has limitations. These results support the case for the practice of monitoring a set of measures to help assess underlying inflation. The three preferred measures are CPI-trim, CPI-median and CPI-common. The use of a set of measures, as opposed to a single focal measure, is not uncommon across other inflation-targeting central banks (**Table 5-B**).

Table 5-B: Central bank practices for measuring core inflation

	Exclusion-based	Trimmed mean	Weighted median	Volatility-weighted	Factor model	Projection of core inflation?[a]
Reserve Bank of Australia	✓	⊙	✓			Semi-annual (range only)
Bank of England	✓					None
European Central Bank	⊙					Annual
Bank of Japan	⊙	✓				Annual (range only)
Reserve Bank of New Zealand		✓	✓		⊙	None
Norges Bank	⊙	✓	✓			Annual
Sveriges Riksbank	⊙	✓		✓		Annual
Swiss National Bank	✓	✓				None
US Federal Reserve System	⊙	✓	✓		✓	Annual (range only)

⊙ = focal measure

a. The Bank of England, Swiss National Bank and Reserve Bank of New Zealand offer projections of total inflation despite not projecting core inflation. Others largely follow the same practice for total inflation as they do for core inflation.

inflation that tracks common price changes across categories in the CPI basket (CPI-common), a measure of inflation excluding upside and downside outliers (CPI-trim), and the median inflation rate across CPI components (CPI-median) were found to perform well across a range of evaluation criteria. These measures better capture persistent price movements and tend to move with the macroeconomic drivers affected by monetary policy. Still, each measure of core inflation was judged to have limitations, thus making the case to consider a set of measures instead of relying on a single focal measure, and reinforcing that monetary policy decisions should not be based on the mechanical use of such indicators.

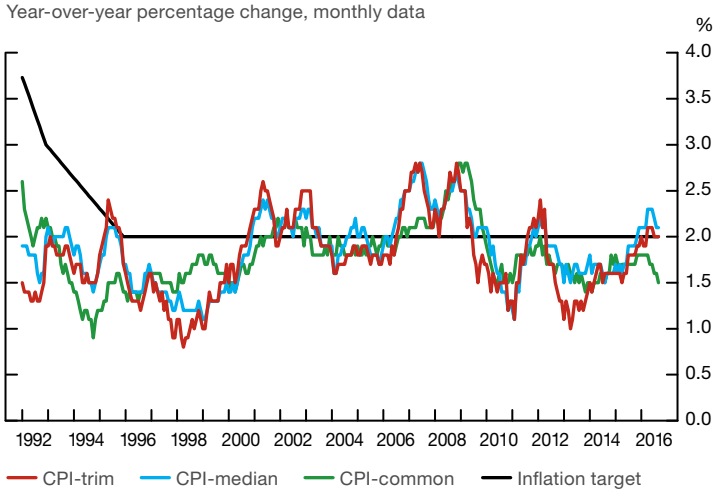
Bottom line

As a result of this analysis, the Bank has decided to cease using CPIX inflation as its preferred measure of core inflation and to replace it with three new measures—CPI-common, CPI-trim and CPI-median (**Chart 3**). Using multiple indicators will help the Bank transparently manage the risks associated with the shortcomings of any single indicator.[18] This practice will also help the Bank achieve the ultimate goal of monetary policy—namely, to keep total CPI inflation close to the midpoint of the inflation-control range.

18 In addition, the Bank has worked with Statistics Canada to ensure that the definition and construction of these measures are carefully explained and well communicated. Statistics Canada will be producing and publishing these measures in the coming months.

Chart 3: Preferred measures of core inflation

Year-over-year percentage change, monthly data



Sources: Statistics Canada and Bank of Canada calculations

Last observation: September 2016

Financial Stability Considerations in the Conduct of Monetary Policy

Monetary policy works by adjusting the cost of credit and affecting asset prices, thereby influencing the borrowing, spending and investment decisions of households and firms. These decisions, in turn, affect aggregate demand and inflationary pressures. Financial system developments are always part of monetary policy considerations because the transmission of monetary policy occurs through the financial system. The system's ability to perform financial intermediation functions is essential for monetary policy to be effective. Consequently, financial system stability is a necessary ingredient of price stability. Conversely, price stability and macroeconomic stability (achieved, in part, through appropriate monetary policy) help promote financial stability, but they cannot guarantee it: robust microprudential and macroprudential rules and supervision must also be in place.[19, 20] Financial stability and monetary policy are therefore inextricably linked.

To consider the interactions between monetary policy and financial stability, the Bank employs a comprehensive framework for assessing risks to the Canadian financial system, explained in detail in the June 2014 *Financial System Review*. Key to this framework is the explicit identification of vulnerabilities to inform the assessment of risks. A vulnerability is a pre-existing condition that could amplify and propagate shocks throughout the financial system. For this discussion, it is beneficial to divide vulnerabilities into two types:

- those that are sensitive to the interest rate and are directly influenced by monetary policy (e.g., leverage by households, firms and financial institutions; liquidity and maturity transformation in financial intermediation; and asset prices);[21] and
- those that are more structural in nature (e.g., the complexity and opaqueness of financial intermediation, and the interconnectedness and common exposures among financial institutions, financial markets and financial market infrastructures).

19 Monetary policy effectively contributed to Canada's economic recovery after the 2007–09 global financial crisis because Canada's strong financial regulatory and supervisory framework limited the impact of the crisis on the functioning of the Canadian financial system, which was much less affected than those in other major jurisdictions.

20 Clearly, the fiscal policy framework must also be sustainable and supportive of price, macroeconomic and financial stability.

21 The impact of accommodative monetary policy on financial vulnerabilities is an intended consequence of the normal monetary policy transmission process. These vulnerabilities may, however, become elevated in a situation where policy interest rates are "low for long" because of persistently weak aggregate demand. Such an outcome has been characterized as "excessive risk taking" or the "search for yield" (Rajan 2006; Borio and Zhu 2012; Borio 2015).

Table 2: How monetary policy and financial stability policy influence risks to the financial system

	Policy impacts on vulnerabilities		Policy impacts on triggers
	Interest-rate-sensitive vulnerabilities (e.g., leverage, liquidity and maturity transformation, and asset prices)	Structural vulnerabilities (e.g., complexity and opaqueness, interconnectedness and common exposures)	
Financial stability policy	▪ Regulatory reform (e.g., Basel III) has increased capital and liquidity buffers and limited leverage, improving financial system resilience. ▪ Housing finance policies may limit household leverage and mitigate increases in house prices.	▪ Regulatory reform has addressed structural weaknesses by expanding the perimeter of regulation, increasing transparency, realigning incentives and reducing moral hazard.	
Monetary policy	▪ Monetary policy in the form of persistently low interest rates may exacerbate these vulnerabilities. ▪ Monetary policy tightening may lean against growing financial imbalances, or the time horizon to achieve the inflation target could be adjusted to avoid increasing existing vulnerabilities.	▪ Monetary policy cannot directly influence these vulnerabilities.	▪ Under inflation targeting, monetary policy responds to adverse shocks and reduces the likely impact of a macroeconomic trigger event. ▪ With borrowing constraints and elevated leverage, monetary policy tightening could also raise the probability of a trigger event.

Financial stability policy, both microprudential and macroprudential, can mitigate both types of vulnerabilities by closing regulatory gaps, by enhancing through-the-cycle capital and liquidity buffers or by leaning against the financial cycle.

In the Bank's framework, financial system risks are outcomes that could threaten the ability of the financial system to perform its core functions. Risks materialize when triggers or shocks—either domestic or foreign—interact with vulnerabilities to cause stress in the domestic financial system. Financial stability policies address these risks by mitigating vulnerabilities and increasing the resilience of the financial system to shocks (**Table 2**). Risks to financial stability can be characterized by their probability and their impact should they occur. The potential impact is correlated with the size of the underlying vulnerability.[22]

Monetary policy can influence both the impact and the likelihood of triggers. For example, if the policy interest rate were lowered in response to an adverse shock to demand and inflation, the potential impact of that shock on the financial system could also be reduced. As well, increases in the policy rate to slow down economic activity and avoid overshooting the inflation target could, in situations with constrained access to credit or other credit-market frictions, raise the probability of trigger events such as large asset repricing and widespread defaults.[23]

Early work on the interrelationships between monetary policy and financial stability focused largely on the risks associated with elevated asset prices. Indeed, this was the genesis of the "lean" versus "clean" debate

22 For example, the Bank of Canada *Financial System Review* (December 2015) identifies the risk of a collapse in house prices and financial system stress, given the related vulnerabilities of elevated house prices and household indebtedness, that could be triggered by an adverse macroeconomic shock that causes a significant increase in national unemployment.

23 An increase in policy interest rates designed to rein in inflationary pressures could also increase the probability of a decline in asset prices. In situations of elevated household indebtedness, a sufficiently large decline in asset prices, house prices in particular, could be a trigger event for a financial stability risk (Mian, Rao and Sufi 2013; Auclert 2016; Bauer and Granziera forthcoming). Clearly, if monetary policy actions triggered a large decline in asset prices, which, in turn, led to the materialization of financial stability risk, these actions, ex post, would be a monetary policy error because there would also be a decline in economic activity that would push inflation away from target. Nonetheless, monetary policy tightening, ex ante, could increase the probability of a trigger for a financial stability risk, but the risk is more likely to materialize when an effective macroprudential policy is absent.

regarding the appropriate conduct of monetary policy (Bernanke and Gertler 1999 and 2001; Cecchetti et al. 2000). Trigger events associated with asset price corrections that occur in the absence of excessive leverage (a vulnerability) have had a smaller impact on the financial system and economic activity (Schularick and Taylor 2012; Jordà, Schularick and Taylor 2013).

In 2011, with experience gained from the global financial crisis and economic recession, the Bank increased its focus on household indebtedness (leverage) and on interactions in the interest-rate-sensitive vulnerabilities (see **Table 2**). The Bank examined the benefits of pre-emptive monetary policy that attempted to mitigate these vulnerabilities as they build (the lean side of the debate), rather than trying to lessen the economic fallout after they unwind (clean). A key conclusion from the analysis is that flexibility regarding the time horizon over which inflation should be expected to return to target is important. Because the economic effects of financial vulnerabilities could manifest themselves over a long period, some flexibility might be needed. This might involve sacrificing some inflation performance over the usual policy horizon but would lead to greater financial, economic and, ultimately, price stability in the long run.[24]

Since 2011, it has become evident that the negative consequences of financial crises can be worse and more prolonged than previously thought. Research on the implications of financial system vulnerabilities and risks for the conduct of monetary policy has contributed to a better understanding of the sources of financial instability and an improved analytical framework for assessing vulnerabilities and risks. New analysis examines whether financial reforms and macroprudential measures lessen pressures to adjust monetary policy to reduce financial vulnerabilities and risks to financial stability. As well, the Bank's analysis weighs the costs and benefits of using monetary policy to contain growing financial vulnerabilities and examines the possible effects of monetary policy on the probability of trigger events.

Global financial reforms

The G20's post-crisis agenda for regulatory and supervisory reform increased financial system resilience globally. The banking sector in many countries has become more and better capitalized and subject to more effective supervision.[25] Reforms have also been implemented for over-the-counter derivatives and other financial instruments, such as repurchase agreements (repos), to increase transparency and reduce systemic risk, and progress is being made in the development of resolution plans for large banks and insurance companies that are seen as being too big to fail. Canada has been a leader in implementing the reforms.[26]

24 Based on the research conducted for the 2016 renewal, financial stability policies that have increased resilience may have also lessened the need for horizon flexibility for financial stability considerations. However, this flexibility is still important when taking a risk-management approach to conduct monetary policy in an uncertain environment. This issue is examined in the next section.

25 Higher bank capital levels are generally associated with a significant reduction in the frequency and severity of a banking crisis (Miles, Yang and Marcheggiano 2013; Macroeconomic Assessment Group 2010; Junge and Kugler 2013), and additional buffers should be capable of absorbing losses during periods of distress. Empirical evidence suggests that doubling risk-weighted capital levels (Common Equity Tier 1) from 7 to 14 per cent results in a decrease in the annual probability of a banking crisis of between 3.6 and 4.2 percentage points (from 4.2–4.6 per cent to 0.6–0.4 per cent).

26 The first annual report from the Financial Stability Board (FSB) on the implementation and effects of the reforms, released in 2015, includes a dashboard regarding implementation of reforms across FSB jurisdictions (FSB 2015). Canada is at the forefront of implementation of the reform agenda, especially in the areas of Basel III, over-the-counter derivatives and resolution. By committing to implementing Basel III in its entirety, and doing so ahead of schedule, Canada introduced higher capital, tighter leverage and more-stringent liquidity requirements, which might help reduce the risk of adverse contagion effects from abroad and knock-on effects in markets (Chouinard and Paulin 2014).

Meanwhile, the financial system and the nature of vulnerabilities continue to evolve. The ongoing challenges are to be vigilant in identifying and assessing emerging vulnerabilities and for the appropriate regulatory and supervisory authorities to take appropriate and timely measures to mitigate their buildup. Vulnerabilities may emerge with financial innovation or as a result of the unintended consequences of regulatory reforms, including regulatory arbitrage (leakages). In this context, steps are being taken to develop a regulatory framework to control systemic risks in market-based financial intermediation and to ensure consistent implementation of global minimum standards across major jurisdictions. These standards will need to be adopted in legislation and regulation and enforced through intensive and effective supervision (Palhau Mora and Januska 2016).

National macroprudential measures

National macroprudential measures, especially those aimed at addressing structural weaknesses at the sectoral level, appear to have been effective in mitigating vulnerabilities and increasing the financial system's resilience to shocks (Damar and Molico 2016). Although the efficacy of countercyclical macroprudential policies in reducing the cyclicality of credit growth (or leaning against the financial cycle) is still not well understood, available evidence suggests that sectoral macroprudential tools work better than broad-based tools that target all credit exposures of the banking system.[27] Among the different sectoral measures, those that target borrowers (such as changes in limits to loan-to-value or debt-to-income ratios) appear to have the largest impact. Nevertheless, it is important to note that most of the existing evidence is based on the experiences of policies implemented in large economies, and some of these policies may be less effective in small open economies.[28]

In Canada, the federal government has tightened the rules governing insured mortgages multiple times since 2008, including by raising minimum down payments and reducing maximum amortization periods. The Office of the Superintendent of Financial Institutions has enhanced the underwriting standards for mortgages and mortgage insurance. These measures helped lower credit growth and support the creditworthiness of mortgage borrowers.[29]

Monetary policy, vulnerabilities and trigger events

In many economic circumstances, there is little or no tension between the goals of price stability and financial stability, which means that central banks can focus on conducting monetary policy to achieve the inflation target. Indeed, inflation-targeting and financial stability objectives are often complementary (Lane 2016). For example, in the lead-up to the global economic and financial crisis, excess demand in a number of countries was creating

27 For some cross-country evidence, see Cerutti, Claessens and Laeven (2015) and Akinci and Olmstead-Rumsey (2015). In Canada, the introduction of a number of regulatory and macroprudential policy changes to address growing financial system vulnerabilities (particularly household imbalances) was generally followed by a slowing of household credit growth (see, for example, Krznar and Morsink 2014). In turn, early warning indicators that incorporate information on credit growth eased, suggesting some mitigation of stress in the financial system.

28 Bauer et al. (2016) review some studies that show a lower effectiveness of some macroprudential policies in economies that are more open financially (e.g., Cerutti, Claessens and Laeven 2015). The reduced level of effectiveness may also result from leakages due to evasion or incomplete coverage of the tools (e.g., Aiyar, Calomiris and Wieladek 2014).

29 For further details, see Crawford, Meh and Zhou (2013) and Kuncl (2016). Schembri (2016a) argues that these policies complemented post-crisis monetary policy in Canada by helping ensure that the borrowing fostered by the accommodative policy was by more creditworthy households with the capacity to service their debts.

inflationary pressures and building financial vulnerabilities, both pointing to tighter monetary policy. After the crisis, an easing of US monetary policy was the appropriate response to an economy that was operating below potential and a financial system that was deleveraging.

In most situations, monetary policy responses to economic and financial developments that focus on achieving an inflation target also lessen the risks to financial stability. In general, by pursuing a symmetric inflation target, central banks will help to stabilize aggregate demand and output, asset prices, long-term interest rates, and corporate and household incomes. Moreover, macroeconomic stability reduces uncertainty and facilitates efficient financial intermediation.[30]

Bank research investigating the extent to which monetary policy should be adjusted to lean against the buildup of household indebtedness supports this evaluation. In this research, it is difficult to justify having tighter monetary policy to slow the growth of household imbalances, since the benefits of such a policy do not outweigh the costs. Leaning may slow debt growth and reduce emerging vulnerabilities, but it also slows real GDP growth and adds disinflationary pressures (**Box 6** and **Box 7**) (Gorea, Kryvtsov and Takamura 2016; IMF 2015; Svensson 2016). More generally, monetary policy may be too blunt an instrument to mitigate financial system vulnerabilities, especially those that arise in one sector of the financial system.[31] The conclusion of this research is that monetary policy should focus on its inflation objective.

In situations of significant and persistent weakness in aggregate demand, tension between financial stability and inflation objectives is more likely. In such an environment, policy interest rates may need to be lowered to stimulate demand and help achieve the inflation target. Lower interest rates will encourage borrowing by households and firms and likely increase credit growth, debt levels and leverage. Risk taking and asset prices will also typically rise. These are the normal channels for the transmission of stimulative monetary policy. However, the persistence of low policy rates implies that financial vulnerabilities are more likely to increase. At the same time, in trying to achieve the inflation target in these circumstances, monetary policy also reduces financial stability risks by dampening the likelihood of the underlying trigger event associated with persistently weakening aggregate demand. Overall, the impact of monetary policy on financial system risk is complex: it involves a trade-off between the reduction (increase) in the probability of a trigger event in the short term and persistently greater (lower) vulnerabilities over the medium term.

In this context, it is natural to ask whether other policies are better suited to address financial system vulnerabilities and risks. Global financial reforms have helped increase capital and liquidity buffers and reduce financial vulnerabilities and have made the global and Canadian financial systems more resilient now than they were in 2011. In addition, progress has been made on developing national macroprudential policy frameworks, and some knowledge has been gained about the effectiveness of macroprudential tools. Financial system vulnerabilities are reduced through a combination of regulatory reform and macroprudential policy that is set and adjusted by

30 The argument that price and macroeconomic stability may promote undue risk taking and help generate financial vulnerabilities is not a case against central banks pursuing such objectives through monetary policy but is a rationale for robust financial regulation and supervision to identify, assess and mitigate emerging financial vulnerabilities before they pose a significant threat to financial stability.

31 This result is obtained because the financial stability "benefits" of leaning are not sufficiently elevated to overcome the economic costs to the broader economy. The benefits are related to the interest rate sensitivity of debt, while the costs are a function of the interest sensitivity of the entire economy.

Box 6

Costs and Benefits of Leaning Against Rising Household Indebtedness

To counteract rising financial stability concerns, monetary policy can set a path for policy rates that is higher or more persistent than the path prescribed by price stability considerations alone. Such monetary policy leaning is expected to provide a countercyclical influence on financial vulnerabilities, leading to lower firm and household debt levels, reduced bank risk taking and slower growth of asset prices over the medium term. Less severe financial vulnerabilities could, in turn, imply a lower probability and reduced severity of periods of significant financial stress brought on by such things as a sharp fall in house prices accompanied by significant household deleveraging and defaults.

Gorea, Kryvtsov and Takamura (2016) survey the costs and benefits of monetary policy leaning using several models designed for policy analysis at the Bank of Canada.[1] The benefits stem from the ability of monetary policy to curb the buildup of household debt and the associated decrease in the probability of a financial crisis. Across policy models, the effect of leaning on household indebtedness is rather limited: for example, a temporary anticipated 1-percentage-point increase in the interest rate over one year would shave off less than 2 per cent of a household's stock of debt over five years. This small effect implies only a marginal reduction in the incidence of financial crises or collapses in house prices.

The costs of leaning stem from weaker economic activity caused by the higher-than-otherwise interest rates over the short run: a temporary leaning by 1 percentage point over one year results in declines of close to 0.5 percentage points for inflation and 1 per cent for output. These responses dissipate around five years after the beginning of the leaning adjustment. On balance, the social benefits of leaning implied by most standard policy models tend to be smaller than the social losses from the suppressed inflation and output. This result highlights the well-known bluntness of monetary policy as a tool for reducing financial stability risks: its effect on growing financial imbalances is limited relative to its contractionary effects on the economy.

Recent research highlights additional factors that to date have not been commonly incorporated in central bank policy models. First, the presence of non-linear effects may imply that the effectiveness of monetary policy leaning depends on existing economic conditions, such as after an adverse income shock or during a crisis that is more severe because nominal interest rates are being constrained by the effective lower bound (Bauer and Granziera forthcoming; Alpanda and Ueberfeldt 2016). Second, policy models need to incorporate explicit mechanisms that amplify the effects of financial market inefficiencies (e.g., incomplete markets, fire-sale externalities, asymmetric information) and generate financial imbalances that could lead to crises. For example, Auclert (2016) shows that the fall in consumption spending in response to monetary policy tightening can be amplified if interest rate changes are unevenly distributed across households that vary in their willingness to spend out of their disposable incomes. Third, monetary policy models should incorporate the risk-taking behaviour of financial institutions to gauge whether low-for-long nominal interest rates can increase the probability and severity of financial crises.

1 These models are the Macroprudential and Monetary Policy Model (Alpanda, Cateau and Meh 2014), the Terms-of-Trade Economic Model (Dorich et al. 2013) and the Large Empirical and Semi-Structural Model (Gervais and Gosselin 2014). The latter two models are augmented with a model of household credit.

a prudential authority with a mandate to maintain financial stability. These considerations significantly mitigate any tensions between the inflation objective and financial stability risk.

It is worth noting that there are likely other interactions among financial system vulnerabilities and risks, macroprudential policy and monetary policy. For example, the effectiveness of monetary policy may depend on the level of household indebtedness—an easing of monetary policy generally provides an incentive for households to take on additional debt, but highly indebted households may have already reached their borrowing limits. Similarly, macroprudential policies may influence households' willingness and ability to spend out of their disposable income, constraining the effectiveness of monetary policy actions.

More generally, a clear assignment of policies and responsibilities helps in achieving both monetary policy objectives and financial stability objectives (Lane 2016). As long as monetary policy has a larger effect on inflation than it does on financial stability risk, and macroprudential policy has a greater impact on financial stability risk than it does on inflation, there may be no

Box 7

The Impact of an Alternative Policy Path on Economic Variables

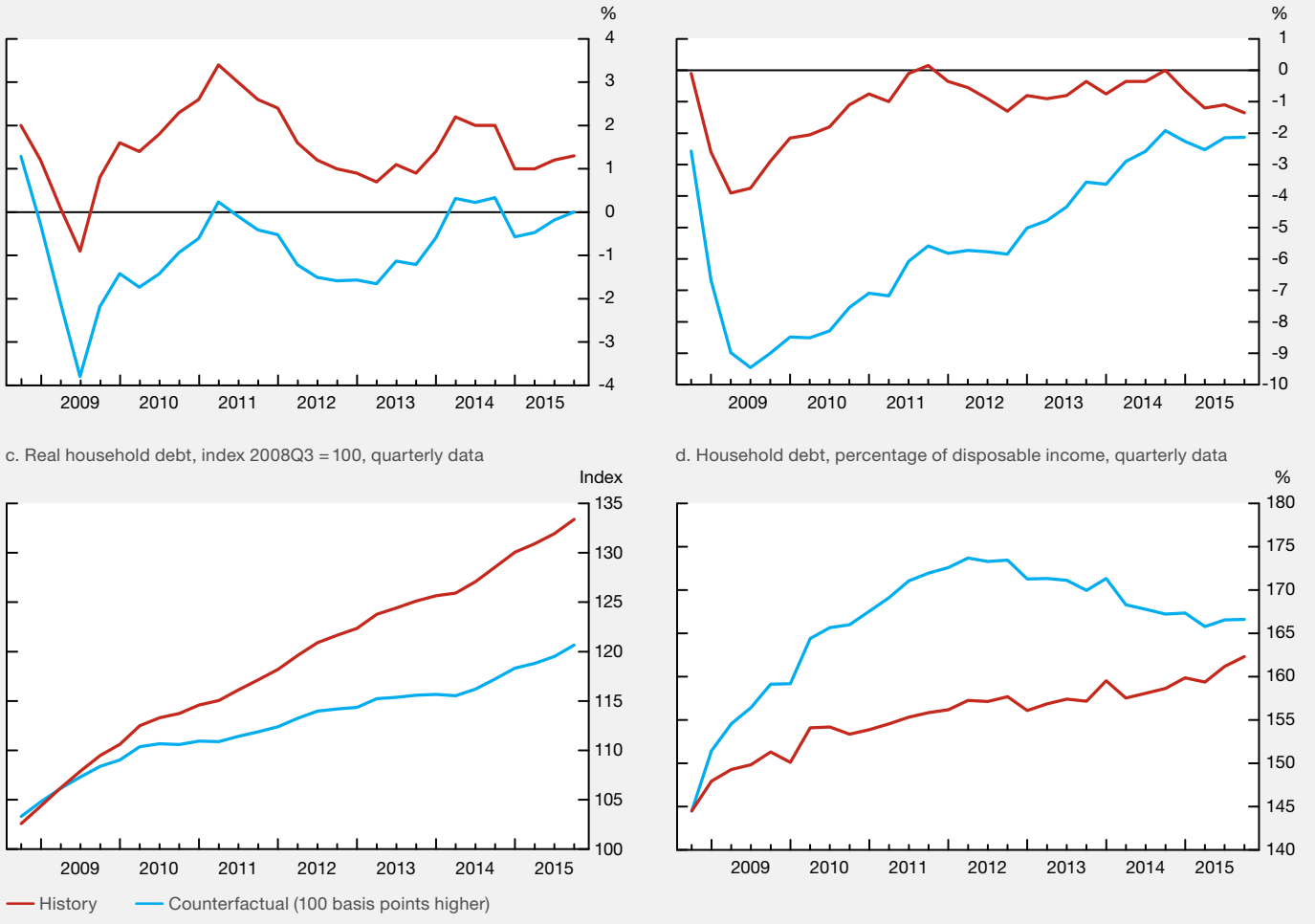
The policy rate in Canada has remained near historically low levels since it was lowered in response to the 2007–09 global financial crisis and economic recession in order to achieve the 2 per cent inflation target. At the same time, household debt has expanded rapidly, increasing financial stability risks.

An alternative policy path could have reduced the accumulation of household debt, but at the cost of significantly damaging Canada's macroeconomic performance. Chart 7-A shows the evolution of inflation, the output gap, real household debt and the ratio of household debt to disposable income if the policy rate had been 100 basis points higher from the fourth quarter of 2008 to the fourth quarter of 2015. In this scenario, real household debt would have been 10 per cent lower than it actually was by the end of 2015. This would have reduced the likelihood of a 10 per cent real house price correction over the next two years by 1 percentage point; therefore, on average over 2015, the likelihood would have been 20 per cent instead of 21 per cent.[1] However, the Canadian economy would have experienced deflation, on average, from 2009 to 2015, and the output gap would have reached a trough of -9 per cent in 2009, with a very slow return toward zero.[2] As a result of this weak economic performance, the ratio of household debt to disposable income would have been higher over the medium term.

1 The likelihood is determined as in Alpanda and Ueberfeldt (2016), based on the methodology in Bauer (2014).

2 For illustrative purposes, the output gap over history is calculated as a simple average of the Bank's two measures (estimated using the integrated framework and the extended multivariate filter).

Chart 7-A: The effects of a higher policy rate



Sources: Statistics Canada, Bank of Canada and Bank of Canada calculations

Last observation: 2015Q4

need for the agencies responsible to coordinate their actions. Still, they should share information to account for spillovers. In the end, the ability of the central bank to focus monetary policy on achieving the inflation target is conditional on authorities with financial stability responsibilities having the will and the policy tools to mitigate financial system vulnerabilities and increase resilience.

Bottom line

The primary objective of monetary policy is to achieve the inflation target, and the formulation of monetary policy always incorporates financial system developments.[32] Moreover, new analysis continues to support the importance of a strong financial regulatory and supervisory framework that has the necessary microprudential and macroprudential policies and tools to mitigate emerging vulnerabilities on a timely basis and increase the resilience of the financial system.

Although monetary policy should be adjusted only in exceptional circumstances to address financial vulnerabilities, central banks, including the Bank of Canada, can contribute importantly to the promotion of financial stability through their system-wide assessment of vulnerabilities and risks and through public communications. This transparency will raise awareness and thereby promote responsible behaviour by borrowers and lenders and help encourage the appropriate regulatory and supervisory responses (Schembri 2016b).

In summary, episodes of tension between a monetary policy objective of low and stable inflation and risks to financial stability will be less common than assessed previously. This reassessment reflects improved financial system resilience, the development and use of macroprudential tools, and a better understanding of the complex relationships between monetary policy and financial stability. Moreover, such episodes are likely to be limited to situations where policy interest rates are held very low for an extended period.

32 As was recognized in 2011, adjustments in monetary policy could be considered a tool for reducing financial vulnerabilities in circumstances where vulnerabilities pose a significant economy-wide threat, the vulnerabilities are being exacerbated by a low interest rate environment and other tools cannot effectively mitigate these vulnerabilities in a timely manner.

The Bank's Risk-Management Approach to Monetary Policy

The conduct of monetary policy is complicated by the inherent uncertainty associated with economic projections. For example, there is a risk that macroeconomic and econometric models do not capture fundamental shifts in economic behaviour, and such structural changes may have become more pervasive since the global economic and financial crisis. Moreover, some economic and many financial considerations are not fully incorporated into the models used to generate the projections. More generally, monetary policy decisions may be based on analysis using more than one macroeconomic model, supplemented by informed judgment. And, within each of these models, there is uncertainty about the strength of the interactions between economic variables and about the economic data.[33] Finally, the Bank cannot foresee the size and nature of future shocks.

In this context of uncertainty, the Bank's risk-management approach to the conduct of monetary policy goes beyond determining the most likely outcome for the economy. It also seeks to identify the major risks the economy faces in either direction and to evaluate how policy should react if those risks were to materialize. For each decision, the Bank's Governing Council can consider a number of potential paths for the policy rate that provide reasonable confidence that the inflation target will be achieved over an acceptable time frame, although each path will tend to have different implications for other aspects of the economic and financial environment.

In formulating monetary policy, the Governing Council weighs all of the risks to the economy (including to financial stability), the probabilities that these risks will be realized and the potential consequences of a policy error. Taking into consideration the various risks, estimates of the most appropriate horizon for returning inflation to target will always be imprecise and will vary depending on the nature and persistence of the shocks buffeting the economy. That is why having flexibility in the horizon over which the Bank seeks to restore inflation to target is crucial.

For example, there can be times when some policy paths that achieve the inflation target within the usual time frame could increase financial stability risk to an unacceptable level. The flexibility in the monetary policy framework allows the Bank to opt for a policy path that aims to return inflation to target over a longer time frame than normal so that its policy actions do not significantly worsen financial stability concerns.

33 Issues related to the conduct of monetary policy when faced with uncertainty are explored in research on robust monetary policy rules (i.e., monetary policy responses to economic developments that generate reasonable outcomes across different models, while accounting for parameter and data uncertainty), including Levin and Williams (2003); Brock, Durlauf and West (2007); and Cateau (2007).

Risk management does not mean that the central bank will adjust policy to try to lean against every emerging financial imbalance. An inflation-targeting central bank must always direct its policy tools first at achieving the inflation target. Even in extreme conditions, when financial conditions may make it unlikely that the inflation target will be achieved over a reasonable time frame, monetary policy may not be an effective tool for addressing financial stability risks.

Another example is related to uncertainty associated with the links between strong demand and production capacity. Flexibility regarding the time frame for returning inflation to target provides a mechanism to manage risks associated with the permanent destruction of capacity that may occur in a long and severe recession. In particular, a near-term upside risk to inflation associated with strong demand growth may be balanced with a downside risk to inflation associated with an endogenous supply response to the strong demand. This supply response includes investment spending that facilitates the rebuilding of production capacity and job creation, thereby leading to a higher profile for potential output and resulting in a somewhat longer time frame before inflation returns sustainably to target.

Risk management does not imply that risks to the inflation outlook should always be balanced. For example, when inflation is close to the border of the inflation-control range—just above 1 per cent or just below 3 per cent—risks that inflation could fall outside the range are greater than if inflation is closer to the middle of the range. Moreover, for policy decisions, the risk of inflation falling below 1 per cent implicitly outweighs the risk of inflation being greater than 3 per cent. This is because possible ELB constraints to policy are more relevant when inflation is lower.[34]

The Bank's scope to exercise appropriate flexibility is founded on the credibility built up through its demonstrated success in achieving the inflation target and on its regular, clear and transparent communications. The Bank's record of more than 25 years as a successful inflation-targeting central bank has helped individuals and businesses make financial decisions with confidence and has contributed to sustained economic growth and price and financial stability. The renewal of the agreement on the inflation-control target provides the framework to extend this track record of policy success for another five years.

34 An asymmetric policy is consistent with the prescriptions of the literature on optimal monetary policy at the ELB for nominal interest rates. When faced with large negative shocks to underlying inflation, monetary policy could both front-load and back-load stimulus. Front-loading would entail cutting rates more aggressively than normal and signalling a willingness to use all necessary measures to limit the decline in inflation. Back-loading would incorporate communicating the intention to be cautious when raising rates in recognition of asymmetric risks closer to the lower bound of the inflation-control range. In particular, the risks associated with a faster return to target, or a temporary overshoot of the target from below, would be lower than the risks of a further undershoot of the target. For example, pre-recognition of the need for caution in raising rates could lead to lower long-term interest rates and a weaker exchange rate during an ELB episode, lessening the severity of the downturn.

References

Aiyar, S., C. W. Calomiris and T. Wieladek. 2014. "Does Macro-Prudential Regulation Leak? Evidence from a UK Policy Experiment." *Journal of Money, Credit and Banking* 46 (s1): 181–214.

Akerlof, G., W. Dickens and G. Perry. 1996. "The Macroeconomics of Low Inflation." *Brookings Papers on Economic Activity* 27 (1): 1–76.

Akinci, O. and J. Olmstead-Rumsey. 2015. "How Effective Are Macroprudential Policies? An Empirical Investigation." International Finance Discussion Papers, Board of Governors of the Federal Reserve System, No. 1136.

Alpanda, S., G. Cateau and C. Meh. 2014. "A Policy Model to Analyze Macroprudential Regulations and Monetary Policy." Bank of Canada Staff Working Paper No. 2014-6.

Alpanda, S. and A. Ueberfeldt. 2016. "Should Monetary Policy Lean Against Housing Market Booms?" Bank of Canada Staff Working Paper No. 2016-19.

Amano, R., D. Brouillette, S. Gnocchi and N. Kyui. 2016. "The Micro and Macro of Downward Nominal Wage Rigidity." *Bank of Canada Review* (Spring): 15–28.

Amano, R. and S. Gnocchi. "2 + 2 < 4? Monetary Policy in the Presence of Downward Nominal Wage Rigidity and the Zero Lower Bound." Bank of Canada Staff Working Paper, forthcoming.

Auclert, A. 2016. "Monetary Policy and the Redistribution Channel." January. Available at http://web.stanford.edu/~aauclert/mp_redistribution.pdf.

Ball, L. 2014. "The Case for a Long-Run Inflation Target of Four Percent." IMF Working Paper No. WP/14/92.

Bank of Canada. 2001. "Technical Background Document 1: A Brief Review of the Literature on Whether a Low-Inflation Regime Leads to Economic Difficulties." May. Reprinted in *Bank of Canada Review* (Summer 2001): 64–66.

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

———. 2011. *Renewal of the Inflation-Control Target: Background Information—November 2011.* Ottawa: Bank of Canada.

Bank of Canada. 2015. *Framework for Conducting Monetary Policy at Low Interest Rates*. Ottawa: Bank of Canada, December.

Barnett, R. and R. Mendes. "Changes to the Canadian Tax System and Distortions Stemming from Inflation: A Qualitative Assessment." Bank of Canada Staff Analytical Note, forthcoming.

Bauer, G. 2014. "International House Price Cycles, Monetary Policy and Risk Premiums." Bank of Canada Staff Working Paper No. 2014-54.

Bauer, G. and E. Granziera. "Monetary Policy, Private Debt and Financial Stability Risks." Bank of Canada Staff Working Paper, forthcoming.

Bauer, G., G. Pasricha, R. Sekkel and Y. Terajima. 2016. "The Global Financial Cycle, Monetary Policies and Macroprudential Regulations in Small, Open Economies." Bank of Canada Staff Working Paper No. 2016-38.

Baumeister, C. and L. Benati. 2013. "Unconventional Monetary Policy and the Great Recession: Estimating the Macroeconomic Effects of a Spread Compression at the Zero Lower Bound." *International Journal of Central Banking* 9 (2): 165–212.

Bernanke, B. S. and M. Gertler. 1999. "Monetary Policy and Asset Price Volatility." Federal Reserve Bank of Kansas City *Economic Review*, 4th Quarter: 17–51.

———. 2001. "Should Central Banks Respond to Movements in Asset Prices?" *American Economic Review* 91 (2): 253–257.

Bernanke, B. S. and V. R. Reinhart. 2004. "Conducting Monetary Policy at Very Low Short-Term Interest Rates." *American Economic Review* 94 (2): 85–90.

Blanchard, O., G. Dell'Ariccia and P. Mauro. 2010. "Rethinking Macroeconomic Policy." IMF Staff Position Note SPN/10/03 (12 February).

Borio, C. 2015. "Persistent Unusually Low Interest Rates. Why? What Consequences?" Speech on the occasion of the BIS Annual General Meeting, Basel, 28 June. Available at http://www.bis.org/speeches/sp150628a.htm.

Borio, C. and H. Zhu. 2012. "Capital Regulation, Risk-Taking and Monetary Policy: A Missing Link in the Transmission Mechanism?" *Journal of Financial Stability* 8 (4): 236–251.

Brock, W., S. Durlauf and K. West. 2007. "Model Uncertainty and Policy Evaluation: Some Theory and Empirics." *Journal of Econometrics* 136 (2): 629–664.

Brouillette, D. and N. Kyui. "Downward Nominal Wage Rigidity and Unemployment: New Evidence Using Micro-Level Data." Bank of Canada Staff Analytical Note, forthcoming.

Cao, S., C. Meh, J. V. Ríos-Rull and Y. Terajima. "Demand for Liquidity and Welfare Cost of Inflation by Cohort and Age of Households." Bank of Canada Staff Working Paper, forthcoming.

Cateau, G. 2007. "Monetary Policy Under Model and Data-Parameter Uncertainty." *Journal of Monetary Economics* 54 (7): 2083–2101.

Cecchetti, S. G., H. Genberg, J. Lipsky and S. Wadhwani. 2000. "Asset Prices and Central Bank Policy." Geneva Reports on the World Economy 2. London: International Center for Monetary and Banking Studies; Center for Economic Policy Research.

Cerutti, E., S. Claessens and L. Laeven. 2015. "The Use and Effectiveness of Macroprudential Policies: New Evidence." IMF Working Paper WP/15/61.

Charbonneau, K. and L. Rennison. 2015. "Forward Guidance at the Effective Lower Bound: International Experience." Bank of Canada Staff Discussion Paper No. 2015-15.

Chouinard, É. and G. Paulin. 2014. "Making Banks Safer: Implementing Basel III." Bank of Canada *Financial System Review* (June): 53–59.

Côté, A. 2014. "Inflation Targeting in the Post-Crisis Era." Speech to the Calgary CFA Society, Calgary, Alberta, 18 November.

Crawford, A., C. Meh, and J. Zhou. 2013. "The Residential Mortgage Market in Canada: A Primer." Bank of Canada *Financial System Review* (December): 53–63.

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

Dahlhaus, T., K. Hess and A. Reza. 2014. "International Transmission Channels of U.S. Quantitative Easing: Evidence from Canada." Bank of Canada Staff Working Paper No. 2014-43.

Damar, E. and M. Molico. 2016. "On the Nexus of Monetary Policy and Financial Stability: Effectiveness of Macroprudential Tools in Building Resilience and Mitigating Financial Imbalances." Bank of Canada Staff Discussion Paper No. 2016-11.

De Michelis, A. and M. Iacoviello. 2016. "Raising an Inflation Target: The Japanese Experience with Abenomics." *European Economic Review* 88 (September): 67–87.

Dorich, J., M. Johnston, R. Mendes, S. Murchison and Y. Zhang. 2013. "ToTEM II: An Updated Version of the Bank of Canada's Quarterly Projection Model." Bank of Canada Technical Report No. 100.

Dorich, J., N. Labelle St-Pierre, V. Lepetyuk and R. Mendes. "Could a Higher Inflation Target Enhance Macroeconomic Stability?" Bank of Canada Staff Working Paper, forthcoming.

Fay, R. and K. Hess. 2016. "Monetary Policy Frameworks: Recent International Developments." *Bank of Canada Review* (Spring): 43–56.

Financial Stability Board (FSB). 2015. "Implementation and Effects of the G20 Financial Regulatory Reforms." Report of the Financial Stability Board to G20 Leaders, 9 November. Available at http://www.fsb.org/wp-content/uploads/Report-on-implementation-and-effects-of-reforms-final.pdf.

Fortin, P. 1996. "The Great Canadian Slump." *Canadian Journal of Economics* 29 (4): 761–787.

Fortin, P. 2013. "The Macroeconomics of Downward Nominal Wage Rigidity: A Review of the Issues and New Evidence for Canada." CIRPÉE (Centre Interuniversitaire sur le Risque, les Politques Économiques et l'Emploi) Working Paper No. 13-09.

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

Galí, J. 2013. "Notes for a New Guide to Keynes (I): Wages, Aggregate Demand, and Employment." *Journal of the European Economic Association* 11 (5): 973–1003.

Gervais, O. and M.-A. Gosselin. 2014. "Analyzing and Forecasting the Canadian Economy Through the LENS Model." Bank of Canada Technical Report No. 102.

Gorea, D., O. Kryvtsov and T. Takamura. 2016. "Leaning Within a Flexible Inflation-Targeting Framework: Review of Costs and Benefits." Bank of Canada Staff Discussion Paper No. 2016-17.

He, Z. 2010. "Evaluating the Effect of the Bank of Canada's Conditional Commitment Policy." Bank of Canada Staff Discussion Paper No. 2010-11.

International Monetary Fund (IMF). 2015. "Monetary Policy and Financial Stability." IMF Staff Report, September.

Jackson, H. 2015. "The International Experience with Negative Policy Rates." Bank of Canada Staff Discussion Paper No. 2015-13.

Jordà, Ò., M. Schularick and A. Taylor. 2013. "When Credit Bites Back." *Journal of Money, Credit and Banking* 45 (s2): 3–28.

Joyce, M. A. S., A. Lasaosa, I. Stevens and M. Tong. 2011. "The Financial Market Impact of Quantitative Easing in the United Kingdom." *International Journal of Central Banking* 7 (3): 113–161.

Junge, G. and P. Kugler. 2013. "Quantifying the Impact of Higher Capital Requirements on the Swiss Economy." *Swiss Journal of Economics and Statistics* 149 (III): 313–356.

Khan, M., L. Morel and P. Sabourin. 2015. "A Comprehensive Evaluation of Measures of Core Inflation for Canada." Bank of Canada Staff Discussion Paper No. 2015-12.

Kozicki, S., E. Santor and L. Suchanek. 2011. "Unconventional Monetary Policy: The International Experience with Central Bank Asset Purchases." *Bank of Canada Review* (Spring): 13–25.

Krugman, P. 2014a. "Four Observations on Secular Stagnation." In *Secular Stagnation: Facts, Causes and Cures*, edited by C. Teulings and R. Baldwin, 61–68. London: Centre for Economic Policy Research, VoxEU.org eBook.

———. 2014b. "Inflation Targets Reconsidered." ECB Forum on Central Banking, Sintra, Portugal.

Krznar, I. and J. Morsink. 2014. "With Great Power Comes Great Responsibility: Macroprudential Tools at Work in Canada." IMF Working Paper WP/14/83.

Kuncl, M. 2016. "Assessment of the Effects of Macroprudential Tightening in Canada." Bank of Canada Staff Analytical Note No. 2016-12.

Lane, T. 2016. "Monetary Policy and Financial Stability—Looking for the Right Tools." Remarks at HEC Montréal, Montréal, Quebec, 8 February.

Levin, A. and J. Williams. 2003. "Robust Monetary Policy with Competing Reference Models." *Journal of Monetary Economics* 50 (5): 945–975.

Macroeconomic Assessment Group. 2010. *Final Report: Assessing the Macroeconomic Impact of the Transition to Stronger Capital and Liquidity Requirements.* Bank for International Settlements.

McGrattan, E. R. and E. C. Prescott. 2005. "Taxes, Regulations, and the Value of U.S. and U.K. Corporations." *Review of Economic Studies* 72 (3): 767–796.

Meh C., J. V. Ríos-Rull and Y. Terajima. 2010. "Aggregate and Welfare Effects of Redistribution of Wealth Under Inflation and Price-Level Targeting." *Journal of Monetary Economics* 57 (6): 637–652.

Meh, C. and Y. Terajima. 2011. "Inflation, Nominal Portfolios, and Wealth Redistribution in Canada." *Canadian Journal of Economics* 44 (4): 1369–1402.

Mendes, R. 2014. "The Neutral Rate of Interest in Canada." Bank of Canada Staff Discussion Paper No. 2014-5.

Mendes, R. and S. Murchison. 2014. "Should Forward Guidance Be Backward-Looking?" *Bank of Canada Review* (Autumn): 12–22.

Mian, A., K. Rao and A. Sufi. 2013. "Household Balance Sheets, Consumption, and the Economic Slump." *Quarterly Journal of Economics* 128 (4): 1687–1726.

Miles, D., J. Yang and G. Marcheggiano. 2013. "Optimal Bank Capital." *The Economic Journal* 123 (567): 1–37.

Palhau Mora, P. and M. Januska. 2016. "On the Nexus of Monetary Policy and Financial Stability: Is the Financial System More Resilient?" Bank of Canada Staff Discussion Paper No. 2016-12.

Poloz, S. S. 2014. "Integrating Uncertainty and Monetary Policy-Making: A Practitioner's Perspective." Bank of Canada Staff Discussion Paper No. 2014-6.

Rajan, R. 2006. "Has Finance Made the World Riskier?" *European Financial Management* 12 (4): 499–533.

Reza, A., E. Santor and L. Suchanek. 2015. "Quantitative Easing as a Policy Tool Under the Effective Lower Bound." Bank of Canada Staff Discussion Paper No. 2015-14.

Sabourin, P. 2012. "Measurement Bias in the Canadian Consumer Price Index: An Update." *Bank of Canada Review* (Summer): 1–11.

Sabourin, P. "Measuring the Size of the Bias in the Canadian Consumer Price Index: An Update." Bank of Canada Staff Discussion Paper, forthcoming.

Santor, E. and L. Suchanek. 2013. "Unconventional Monetary Policies: Evolving Practices, Their Effects and Potential Costs." *Bank of Canada Review* (Spring): 1–15.

———. 2016. "A New Era of Central Banking: Unconventional Monetary Policies." *Bank of Canada Review* (Spring): 29–42.

Schembri, L. 2016a. "Connecting the Dots: Elevated Household Debt and the Risk to Financial Stability." Remarks to the Guelph Chamber of Commerce, Guelph, Ontario, 24 February.

———. 2016b. "Stress Prevention: Central Banks and Financial Stability." Remarks at the Joint Workshop: Bank of Canada, International Monetary Fund, Centre for International Governance Innovation and Peterson Institute for International Economics, Ottawa, Ontario, 6 May.

Schularick, M. and A. Taylor. 2012. "Credit Booms Gone Bust: Monetary Policy, Leverage Cycles, and Financial Crises, 1870–2008." *American Economic Review* 102 (2): 1029–1061.

Svensson, L. 2016. "A Simple Cost-Benefit Analysis of Using Monetary Policy for Financial-Stability Purposes." In *Progress and Confusion: The State of Macroeconomic Policy*, edited by O. J. Blanchard, R. Rajan, K. S. Rogoff and L. H. Summers. Cambridge, MA: MIT Press.

Viñals, J., S. Gray and K. Eckhold. 2016. "The Broader View: The Positive Effects of Negative Nominal Interest Rates." iMFdirect blog, 10 April. Available at https://blog-imfdirect.imf.org/2016/04/10/the-broader-view-the-positive-effects-of-negative-nominal-interest-rates.

Williams, J. 2009. "Heeding Daedalus: Optimal Inflation and the Zero Lower Bound." *Brookings Papers on Economic Activity* 40 (2): 1–49.

Witmer, J. and J. Yang. 2015. "Estimating Canada's Effective Lower Bound." Bank of Canada Staff Analytical Note No. 2015-2.

———. 2016. "Estimating Canada's Effective Lower Bound." *Bank of Canada Review* (Spring): 3–14.

Appendix: Issues for Further Research

To ensure that Canada's inflation-targeting framework remains current with ongoing economic developments and consistent with international best practices, it is important to continuously examine ways to enhance the existing framework. The environment in which monetary policy is conducted has been evolving substantially over recent years, and the tool box of central banks has expanded rapidly. Within this environment, the Bank of Canada is committed to continuing its research on the monetary policy framework and its implementation.

This research will reassess the ability of monetary policy to stimulate the economy, since, despite years of expansionary policy, the recovery in many economies remains tepid, especially in countries whose financial systems were impaired or had to undergo significant deleveraging. In light of this, it is important to study the effects and effectiveness of both conventional and unconventional monetary policies, particularly in a small open economy.

Over the coming years, several central banks will begin exiting from their unconventional monetary policies. Their experiences through this process will allow for a more complete assessment of the effectiveness of the various measures and will help the Bank assess the extent to which these unconventional monetary policies should become part of its standard tool kit.

The changing role of monetary policy since the 2007–09 global economic and financial crisis has also had substantial effects on the way central banks communicate with their various stakeholders and on the growing importance of their contribution to the public economic debate. For example, central banks needed to explain the functioning of unconventional monetary policies and, at the effective lower bound, used their communication in the form of forward guidance as a policy instrument. With the incorporation of financial stability considerations into monetary policy, there is now more public debate about the role of central banks. The Bank will therefore conduct research on the relevant communication channels that it should pursue.

Improving policy decisions in an environment with complex trade-offs will also remain on the Bank's research agenda. In particular, the Bank will study the impact of regulatory changes and the effectiveness of macroprudential policies and their implications for monetary policy. In addition, research will examine the optimal mix of monetary, macroprudential and fiscal policies, including their interactions and coordination.

While these will be ongoing areas of Bank research in the years to come, the Bank will adjust its research according to changing circumstances. It will therefore reassess its research work plan on a regular basis and react to evolving needs in a flexible manner.