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Remarks by Mark Carney
Governor of the Bank of Canada
Eric J. Hanson Memorial Lecture
University of Alberta
Edmonton, Alberta
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Monetary Policy After the Fall[1]

I. Introduction

It is an honour to deliver the Eric J. Hanson Memorial Lecture.

Raised on an Alberta farm, Eric Hanson was instrumental in the development of the University of Alberta's Department of Political Economy, which he led from 1957 to 1964. Professor Hanson expected that good education and intelligent planning would be ever more significant in the future, a future he viewed with optimism.

The Hanson Lecture figures importantly in Bank of Canada history. The Lecture delivered in 1988 by Governor John Crow was later dubbed the "Edmonton Manifesto." In his talk, Governor Crow enunciated a clear commitment to price stability as the ultimate goal of monetary policy. In doing so, he set the stage for the introduction of inflation targeting, and the subsequent dramatic fall in both the level and volatility of inflation.[2]

The preamble to the Bank of Canada Act has remained constant since it was first enacted in 1934. It mandates the Bank to:

> *… regulate credit and currency in the best interests of the economic life of the nation, to control and protect the external value of the national monetary unit and to mitigate by its influence fluctuations in the general level of production, trade, prices and employment, so far as may be possible within the scope of monetary action, and generally to promote the economic and financial welfare of Canada.*

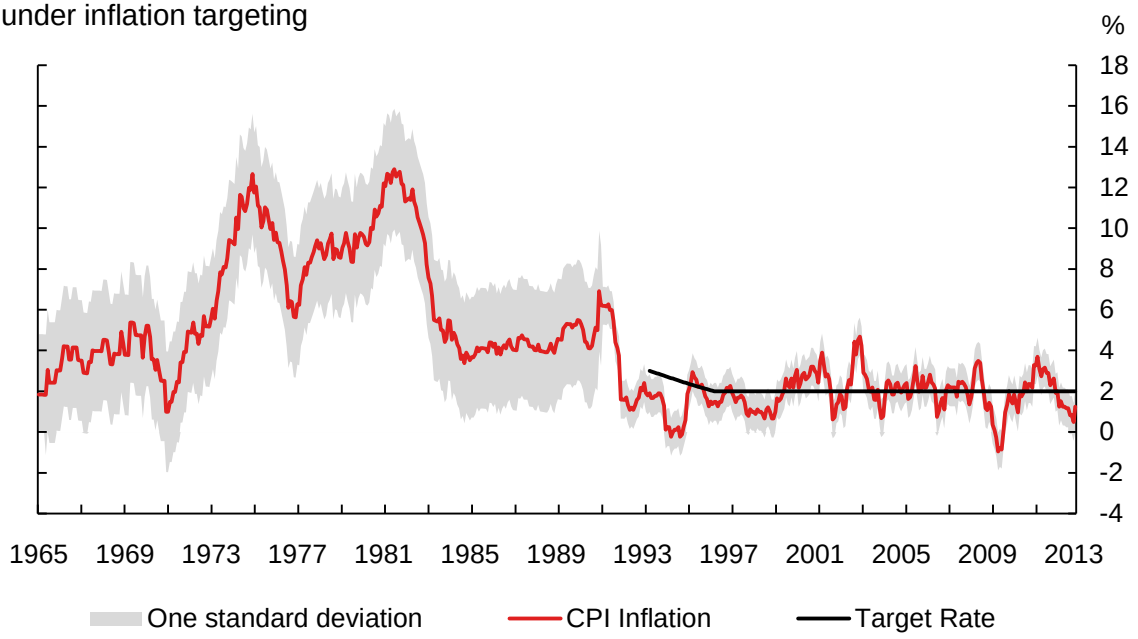
[1] I would like to thank David Wolf, Stephen Murchison, Rhys Mendes and Bob Fay for their research assistance. All errors and omissions remain my responsibility. Charles Bean gave a speech with the same title in Jackson Hole in August 2010. He certainly bears no responsibility for anything herein.
[2] Year-over-year CPI inflation has averaged 2 per cent since the beginning of 1995, down from 5.8 per cent over the 1977 – 94 period. Similarly, the standard deviation of year-over-year CPI inflation declined from 3.4 percentage points to 0.9 percentage points over the same period.

John Crow's core insight was that adopting the single objective of price stability would be the best way that the Bank could fulfill these obligations to Canadians.

Twenty years later, Governor David Dodge returned to this stage. His remarks followed almost two decades of the successful conduct of inflation targeting in Canada. Inflation had averaged exactly 2 per cent and real GDP growth 3 per cent since 1995 (**Chart 1**). Inflation targeting had been formally adopted by 27 countries and informally by more. Certainly, in early 2008, despite tremors in international financial markets, there was reason to believe that, at least with respect to monetary policy frameworks, this might be as good as it gets.

Chart 1: Inflation at 2 per cent since 1995

Both the level and variance of inflation have declined significantly under inflation targeting



Sources: Statistics Canada and Bank of Canada calculations

Last observation: March 2013

Still, in reconfirming the Bank's commitment to low, stable and predictable inflation, Dodge appropriately asked—consistent with the relentless quest to improve public policy that has characterised his long career—whether we were witnessing "the end of monetary policy history." Had we in fact found the ideal framework?

In response to Governor Dodge's challenge, the Bank began investigating two major research topics: What are the costs and benefits of an inflation target lower than 2 per cent? And what are the costs and benefits of a shift to price-level targeting? Implicitly the Bank was wondering whether the introduction of price-level targeting could herald an era of true price stability (i.e., zero average inflation), as originally envisaged in the 1991 inflation-control agreement.[3]

[3] The specific targets for the year-over-year rate of increase in the CPI were: 3 per cent by the end of 1992, 2.5 per cent by the middle of 1994, and 2 per cent by the end of 1995. Thereafter, the objective would be further reductions in inflation until price stability was achieved. See *Bank of Canada Review*, March 1991. While a precise definition of price stability was not provided,

Throughout the pre-crisis inflation-targeting period, the most compelling arguments against a further reduction of the inflation target were the challenges associated with the zero lower bound on interest rates. As subsequent Bank of Canada research would suggest, however, the adoption of a well-understood and credible price-level target could partially circumvent the zero lower bound, giving policy-makers more scope to deal with negative shocks in a low-inflation environment.[4] Furthermore, a price-level target could also reduce longer-term price-level uncertainty and therefore allow households and businesses to make economic decisions with greater certainty. The simplicity of an unchanging price-level target would also likely mitigate the concern that a price-level targeting regime would not be understood well enough for expectations to behave as needed to make it work. In theory, at least, a radical move to price-level targeting looked intriguing.

As we all know, events intervened. Within a few months, the global financial crisis erupted in its full fury. In its wake, the zero lower bound became a reality rather than a theoretical curiosity and more fundamental questions are being asked about monetary policy, its scope, and the roles and responsibilities of central banks.

For some, the debate has shifted from whether inflation targeting could be refined to whether it could be salvaged.

The crisis put into sharp relief the role of monetary policy in the pursuit of financial stability. Indeed, the crisis was a painful reminder that we value nothing so much as when we lose it. Even though Canada's financial system proved to be one of the most resilient in the world, the Bank recognised the importance of re-examining the relationship between monetary policy and financial stability, and we added this to our research agenda.

The issues facing monetary policy-makers around the world are broader still. Globally, central banks are now being simultaneously accused of being ineffective and too powerful. The goals of monetary policy are being called into question: Is price stability enough? It is also being recognised that how monetary policy interacts with other macro policies, including fiscal and macroprudential policies, can affect its independence and potentially its effectiveness.

At the same time, the instruments employed by central banks have been extended to include a wide range of unconventional measures. There have been important advances in communications. A spate of liquidity measures targeted at the financial sector has blurred the line between policies aimed at the maintenance of price stability and those to support financial stability.

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work for Canada at the time showed that it was consistent with a rate of inflation "clearly below 2 per cent."

[4] Depending on the depth and duration of the zero lower bound episode, Bank of Canada calculations suggest that the adoption of a (temporary) price-level target, if well understood and credible, could eliminate more than half of the losses associated with the impossibility of providing additional monetary stimulus through a lower policy rate. See R. Amano and M. Shukayev, "Monetary Policy and the Zero Bound on Nominal Interest Rates," *Bank of Canada Review*, (Summer 2010): 3 – 10, and C. L. Evans, "Monetary Policy in a Low-Inflation Environment: Developing a State-Contingent Price-Level Target," remarks delivered before the Federal Reserve Bank of Boston's 55th Economic Conference, Boston MA, 16 October 2010.

Although it has not been the case in Canada where policy has remained conventional; globally, central banks are being asked to do more, in more ways, than ever before. All of these developments put a premium on clearly articulated monetary policy frameworks.

In my remarks, I will review what recent experience means for monetary policy frameworks, the instruments and tactics central banks use to achieve their objectives, and how monetary policy interacts with other macro policies. I will organise my thoughts around key lessons learned from the crisis. I must warn you up front, however, these lessons have generated thus far more questions than answers, a trend I will largely extend today.

Allow me to start with a description of monetary policy, pre-2008, or pre-crisis.

II. Monetary Policy Pre-Crisis: Inflation Targeting as the Dominant Framework

Some view history as merely a series of events driven by a purposeless nature toward no particular end. The German philosopher Hegel and others challenged this view. Hegel viewed history as progress—oscillating toward a final, rational form of society, guided by the invisible hand of reason. It is in this sense that Francis Fukuyama asked in 1989 whether we were witnessing "The End of History," with the collapse of the Soviet Union and the end of the Cold War apparently in his view culminating in the triumph of Western liberal democracy as the best way of organising society. Fukuyama of course acknowledged that events would always happen and conflicts arise, but he argued these would not call into question the already-revealed ideal state.[5]

It was in a similar sense that Governor Dodge asked five years ago whether we had reached the end of monetary policy history. The widespread—if not universal—view was that inflation targeting had been revealed to be the best possible monetary policy framework.

Such optimism appeared well-founded. The adoption of inflation targeting in many countries generally coincided with a long period of macroeconomic tranquility. The Taylor frontier appeared to shift toward the axis: a lower level of inflation volatility could now be achieved for any given level of output volatility (**Chart 2**).[6] While causality remained an area of debate, it seemed clear that inflation targeting was at least consistent with economic stability. This distinguished inflation targeting from its antecedents and propelled the emerging consensus regarding its superiority.

The putative end of monetary policy history did not mean an end to economic shocks any more than Fukuyama's thesis suggested an end to events. Nor did it

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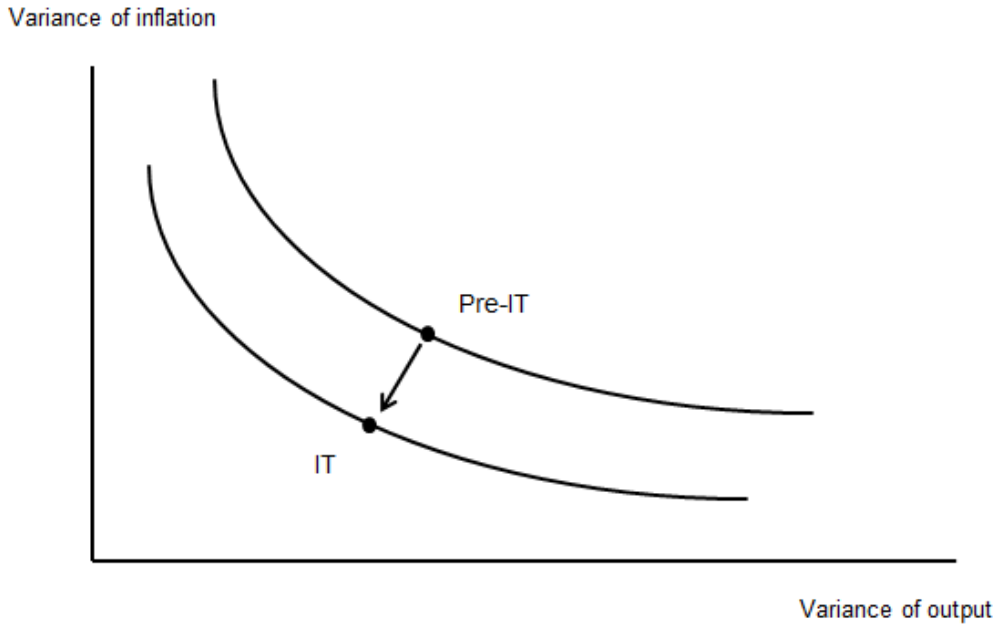
[5] There have been challenges to this more recently, including the economic success of the state capitalism model, exemplified by China.

[6] The Taylor frontier, named for economist John Taylor, is the set of efficient combinations of output and inflation volatility. That is, it shows the lowest achievable level of inflation volatility for any given level of output volatility. The frontier is a consequence of shocks that cause output and inflation to move in opposite directions. Thus, a central bank cannot completely stabilise both output and inflation. The best it can do is to choose a point on the Taylor frontier.

Chart 2: Taylor frontier: Volatility appeared to decline



mean an end to efforts to further refine the practice of inflation targeting to minimise the incidence and consequences of those shocks. But it did mean that in order "to promote the general economic and financial welfare" of a society, central banks should focus relentlessly on attaining price stability.

Some have suggested that recent events suggest we should re-evaluate this conclusion. To do so, we should first review the intellectual foundations and practical application of inflation targeting.

The theoretical underpinnings of inflation targeting are rooted in the new Keynesian synthesis.[7] This intellectual framework breaks with its forebears by embodying a central role for expectations and abandoning the assumption of a long-run trade-off between inflation and output. Monetary policy has real effects in new Keynesian models because some nominal prices and wages are assumed to adjust sluggishly. This nominal stickiness implies that inflation expectations also adjust gradually, allowing changes in the central bank's nominal policy rate to affect real interest rates and thereby encouraging households and firms to shift expenditures over time. Moreover, the forward-looking nature of behaviour in these models means that decisions depend on both current and expected future interest rates. Finally, since not all prices and wages are adjusted simultaneously, variable inflation leads to inefficient dispersion of relative prices. This further motivates inflation stabilisation as a key objective of monetary policy.

The practical application of these intellectual foundations was an inflation-targeting framework with the following main elements:

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[7] For an analysis of monetary policy in the canonical new Keynesian model, see R. Clarida, J. Gali, and M. Gertler, "The Science of Monetary Policy: A New Keynesian Perspective," *Journal of Economic Literature* 37 (1999): 1661–1707.

- **A clear objective**, typically defined as a level or, occasionally, a range for inflation. In many inflation-targeting countries, including Canada, the target is 2 per cent inflation, as measured by the consumer price index. Central banks generally aim to achieve this objective over a medium-term horizon: normally six to eight quarters. While inflation-targeting central banks had some scope for varying this horizon, most perceived this flexibility to be quite circumscribed. Other objectives—such as employment or output—were subject to a lexicographical ordering or avoided altogether. It was a clearly held belief that the best contribution of monetary policy to employment was to achieve the inflation target (there was no long-run trade-off between inflation and employment). Variables such as the exchange rate, money, credit and asset prices influenced monetary policy only to the extent that they had implications for inflation and output.[8, 9]
- **An independent central bank to pursue that objective**. Following the high-inflation periods of the 1970s and 1980s, it became widely understood that the best practice was for the executive or legislative branch of the government to decide the objective of monetary policy and then delegate operational authority for its achievement to the central bank. The central bank operates with "constrained discretion": it determines how and over what time frame it will achieve the inflation target. The central bank's operational independence insulates it from the short-run pressures of the political system. In particular, it avoids a fundamental time-inconsistency problem in which temptations to pursue short-term objectives undermine medium-term economic performance.[10]
- **One instrument**: a very short-term interest rate (the overnight rate in Canada). The expected path of this policy rate influences longer-term market rates, the interest rates set by financial institutions, as well as the exchange rate and other asset prices. These, in turn, affect aggregate

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[8] A flexible exchange rate has been, and remains, a critical element of Canada's inflation-targeting framework.

[9] While the Bank of Canada recognised that "it might be appropriate for monetary policy to respond to asset-price developments in exceptional circumstances, and, in so doing, to extend the horizon for returning inflation to its target level," those circumstances were thought to be extremely rare. Moreover, the Bank made clear that any response would "focus on the inflation and output consequences of…asset-price shocks." Financial stability considerations were not regarded as within the purview of monetary policy. See Bank of Canada, *Renewal of the Inflation-Control Target: Background Information—November 2006*.

[10] F. Kydland and E. Prescott, "Rules Rather than Discretion: The Inconsistency of Optimal Plans," *Journal of Political Economy*, 85, 3 (June 1977): 473 – 92, identified this time-inconsistency problem and proposed rules-based policy-making as a solution. Consider the case of a central bank with neither operational independence nor an explicit inflation objective. Suppose the central bank announces that inflation will be 2 per cent in the future. If private agents believe this announcement, they will set prices and wages accordingly. But, after prices and wages are set, the central bank may face political pressure to renege on its announcement and ease monetary policy in order to achieve higher employment and output in the short run. If the monetary authority reneges repeatedly, agents will begin to anticipate this behaviour, leading to higher inflation without any beneficial impact on employment or output. Operational independence insulates the central bank from political pressure to pursue short-run objectives at the expense of long-run performance. Moreover, making the central bank accountable for the achievement of the inflation target constrains its discretion and limits its ability to pursue other objectives.

demand and inflation. With inflation expectations well anchored, the basic task is to keep the level of aggregate demand roughly in balance with the level of potential output. Pre-crisis inflation targeting implemented in this manner satisfied the Tinbergen principle: the one available policy instrument was assigned to the achievement of a single objective. By limiting the number of objectives to the number of instruments, pre-crisis inflation targeting simplified the task of the central bank.

- **Transparent communications**. Research and experience demonstrate that clear and open communications are critical to both the effectiveness and the accountability of monetary policy. In particular, successful monetary policy requires transparency around two aspects of the policy approach—what central banks are trying to achieve and how they go about achieving it. The clarity of the inflation target allows households and firms to make longer-term plans with greater confidence, aligning their savings, investment and spending decisions with a common inflation-control objective, with these actions collectively serving to make the inflation target self-reinforcing. Transparent communications that illuminate how the central bank responds to the forces at work on the economy help markets and the public form and evolve their expectations efficiently, which further aids the achievement of the inflation objective.

One consequence of this well-defined inflation-targeting framework was a relatively narrow view of the scope for monetary policy to address potential financial vulnerabilities. Pre-crisis thinking focused on asset prices as the main indicator of emerging financial imbalances, and most believed that monetary policy should take into account asset-price movements only to the extent that they had implications for inflation and output over the usual medium-term policy horizon. The general consensus among central bankers was that “cleaning,” or mopping up after a burst bubble, was the best contribution monetary policy could make in this regard.

The preference for cleaning was based on three key premises: (i) bubbles are difficult to detect; (ii) monetary policy may be an ineffective, and therefore costly, way of pricking bubbles; and (iii) cleaning up after a bubble bursts is not too costly.[11] Reinforcing this clean principle were the implicit assumptions that markets were generally efficient and that core markets cleared in all states of the world.

This intellectual consensus had consequences for how central banks were organised, how they thought about the macroeconomy, and how well they were prepared for what was to come.

Although most central banks had added a financial stability objective in the years prior to the crisis, the monetary policy and financial stability wings of many institutions operated as two solitudes. For example, the standard new Keynesian transmission channels in workhorse monetary policy models ignored not only the

[11] A. Greenspan, “Issues for Monetary Policy,” remarks to the Economic Club of New York, New York City, 19 December 2002 and A. Greenspan, “Opening Remarks,” delivered at Rethinking Stabilization Policy, a symposium sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyoming, 29 – 31 August 2002.

financial accelerator but also broader procyclical dynamics in modern money and credit markets.

Macro modeling work focused on credit-market imperfections, only to the extent that they gave rise to financial-accelerator effects rather than broader financial system procyclicalities. In the most sophisticated models, lending conditions faced by firms and households were explicitly tied to collateral such as housing. As a result, credit expansion became more procyclical with household and business spending more closely tied to the health of their respective balance sheets. While an important step forward from the previous "lifetime budget constraint" approach, the dynamics created by these sorts of credit-market frictions remained benign and, hence, the policy dilemma facing the central bank was little changed.

More generally, without financial systems, these models didn't have the types of non-linear dynamics necessary to create the possibility of a financial crisis. Combined with the bluntness of monetary policy, this implied essentially no role for leaning. There was similarly little appreciation that broader procyclical dynamics in money and credit markets could be triggered by the attainment of price stability itself.

As central banks would belatedly realise, such downplaying of real-financial linkages obscured the scale of emerging vulnerabilities and challenged the initial crisis response.

III. Monetary Policy and the Financial Crisis

It is safe to say that most policy-makers didn't see the crisis coming. In part this was because central banks underappreciated the scale of endogenous liquidity creation in the system. In addition, while central banks may have lamented the large and persistent global current account imbalances that had emerged in the pre-crisis period, we failed to make the link between these flows and rising financial imbalances in many advanced economies.

As a result, when the crisis broke in 2007, it was regarded as an almost exogenous, limited event. Most of the initial explanations of its causes concentrated on micro factors such as bankers' incentives and the opaqueness of markets. Events did not even signal a crisis but rather mere "turbulence"—sufficiently bothersome to fasten seatbelts—but not serious enough to bring down the plane. Jean-Claude Trichet, then president of the European Central Bank, spoke for many when he admitted that it was only after the collapse of Bear Stearns that he was "prepared to speak of a crisis."[12]

Ultimately, the financial turbulence was too severe to ignore. As President Bush stated bluntly at an emergency cabinet meeting in September 2008: "This sucker could go down."[13]

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[12] "General Discussion: Central Banks and Financial Crises," chaired by S. Fischer, Jackson Hole Economic Policy Symposium, Maintaining Stability in a Changing Financial System, Federal Reserve Bank of Kansas City, August 2008.

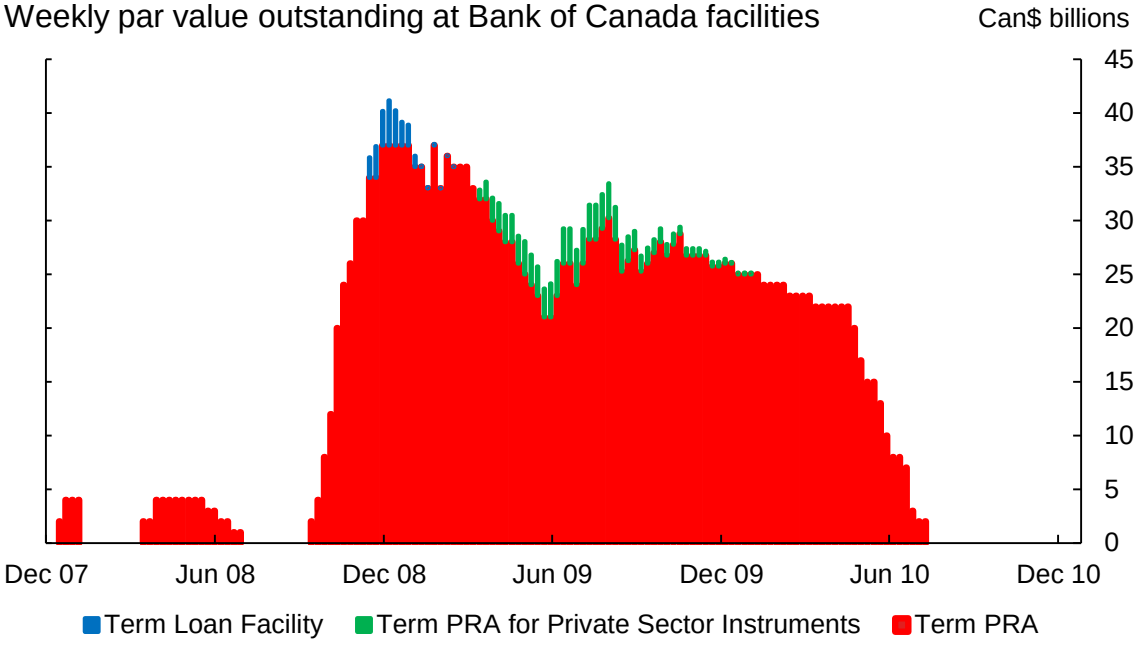
[13] "Talks Implode During a Day of Chaos; Fate of Bailout Plan Remains Unresolved," *New York Times*, 25 September 2008.

Policy-makers reacted quickly.

Central banks' dormant financial stability wings sprang into action. As money markets seized up, central banks followed Bagehot's dictum: lend liberally on good collateral at a penalty rate.[14] Echoes of the Great Depression motivated a swift and aggressive response. Major central banks provided hundreds of billions of dollars in extraordinary liquidity through a combination of repo facilities, standing facilities, securities lending and reciprocal swap agreements (**Chart 3**).

Chart 3: Lombard Street rules

Weekly par value outstanding at Bank of Canada facilities



Source: Bank of Canada

Last observation: 30 December 2010

In undertaking these liquidity measures, many central banks extolled a "separation principle" to distinguish actions in support of market functioning and financial stability from those directed to price stability. With time, however, this separation would be revealed to be increasingly arbitrary. The emergency liquidity measures, which were initially aimed at ensuring proper market functioning and financial stability, had the effect of repairing a broken monetary policy transmission mechanism. Over time, and in jurisdictions with more severe impairments, more aggressive measures had to be put into place.

These measures helped to provide the stimulus to support activity and price stability. The links between price and financial stability were increasingly evident.

The monetary policy response to the severe recession brought on by the financial crisis was bolder still, commensurate with the magnitude of the collapse in demand.

In the fall of 2008, in response to the rapidly deteriorating conditions in global financial markets, a weakening U.S. economy, and an abrupt drop in commodity prices, G-10 central banks, including the Bank of Canada, conducted an

[14] There was also a significant amount of lending at non-penal rates through market-based facilities.

exceptional, coordinated interest rate cut of 50 basis points, the first since the 11 September terrorist attacks. Policy rates in many advanced economies quickly reached their effective lower bounds.

As the crisis progressed, major central banks that needed to provide additional stimulus also deployed major unconventional measures, swelling central bank balance sheets to unprecedented sizes.

Ultimately, the combination of the scale of the demand shock, the need for clear communications, and the imperative of anchoring inflation expectations all helped to convince both the Federal Reserve and the Bank of Japan to adopt inflation-targeting regimes.

Indeed, Canada's inflation-targeting regime was shown to be an essential asset throughout the crisis. It provided a clear framework within which the Bank could supply the aggressive monetary stimulus required in response to large external shocks. The credible inflation-targeting regime was a critical anchor through those turbulent times, giving the Bank an unwavering goal to guide its policy actions, and providing financial markets and the public with a clear means to understand the rationale behind them. That understanding was reflected in the relative stability of inflation expectations during the crisis, which remained well anchored to the 2 per cent target.

While the experience of the crisis demonstrated the essential value of flexible inflation targeting as the dominant monetary policy framework, events suggested some core lessons that could influence its form and conduct.

IV. Lessons Learned

1. Price stability does not guarantee financial stability

As John Crow emphasised in 1988, the paramount goal of monetary policy in Canada is price stability. This remains the case.

How then to address a central lesson that price stability can be, in fact, associated with excessive credit growth and emerging asset bubbles, which in turn can ultimately compromise the achievement of price stability?

The crisis made painfully clear that low, stable and predictable inflation and low variability in activity—especially when associated with exceptionally low and stable interest rates—can breed complacency among financial market participants as risk-taking adapts to the perceived new equilibrium.[15] This dynamic sows the seeds for future, powerful financial instability and (ultimately) instability in output and inflation.

Experience suggests that prolonged periods of unusually low rates can cloud assessments of financial risks and induce a search for yield. Indeed, risk can be at its greatest when measures of it are at their lowest. Low variability of inflation and output (reduces current financial VaR and) encourages greater risk-taking (on a forward VaR basis).[16] Investors stretch from liquid to less-liquid markets. In

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[15] Bank of Canada, *Renewal of the Inflation-Control Target: Background Information—November 2011,* Technical Box 7, page 24.

[16] Value at Risk (VaR) is a measure of risk of loss on a portfolio.

parallel, low and stable interest rates promote larger asset-liability mismatches across credit and currency markets. These tendencies are particularly marked if there is a perceived certainty about the stability of low interest rates.

It would also appear that the "clean" doctrine could actually reinforce risk-taking behaviour. The combination of the central bank's silence over the existence of a possible bubble, the certainty that it would not respond to emerging financial pressures, and the expectation that it would mop up if the bubble burst all conspired to exacerbate the crisis.

None of these dynamics of the risk-taking channel of monetary policy is possible in the standard new Keynesian models, given their simplistic treatment of financial markets. However, the problem is deeper still, given the nature of asset-price formation and how individuals actually make decisions.

The new Keynesian approach highlighted the importance of credibility and expectations, but what if expectations themselves were a source of fluctuations? Financial markets are famously prone to bouts of euphoria and despair. The work of Hyman Minsky, rediscovered since the crisis, outlines a "financial instability hypothesis" in which stability encourages exuberance, excess and a subsequent reckoning.[17] More generally, given the inherent uncertainty about the future, people can make mistakes when estimating their future incomes. Reasons for this behaviour can vary from inappropriately extrapolating the consequences of a new technology or a prolonged period of stability to simply assuming that the future must look like the recent past.

Whatever the cause, excessive optimism can lead to overestimates of future growth in incomes and asset prices, creating for a time a self-reinforcing asset and credit boom. These misperceptions can build over years, leaving households, businesses and banks badly exposed when the scales fall from their eyes. Eventually, the future is now and reality reasserts.

With macroeconomic stability, including price stability, playing a role in the buildup of financial instability, the questions regarding the proper role of monetary policy need to be asked.

2. Monetary policy is the last line of defence against financial vulnerabilities

These questions remain highly relevant. In the crisis economies, market expectations that policy interest rates will stay at very low levels for a very long time appear firmly entrenched. In the non-crisis economies, the challenging external environment has also required bold policy actions and, despite well-functioning domestic financial systems, policy rates remain near historic lows and real rates have been generally negative.

A low-for-long world could trigger the dynamics just described, in particular excessive credit creation and risk-taking. Concerning levels of household debt can build in non-crisis economies, as they have in Canada, where a well-

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[17] H. Minsky, *Stabilizing an Unstable Economy*, Yale University Press 1986, and H. Minsky, "The Financial Instability Hypothesis," paper prepared for the *Handbook of Radical Political Economy*, May 1992.

functioning financial system has combined with an environment of low interest rates since 2008.

It does not necessarily follow that monetary policy must immediately react. Indeed, one of the most important considerations in designing effective policy is the assignment of responsibilities. In Canada, the hierarchy is very clear with the Minister of Finance having ultimate responsibility for the health of the financial system.

The first line of defence against a buildup of financial imbalances is responsible behaviour by individuals and institutions. Next come micro- and macroprudential regulation and supervision, which have been applied effectively in Canada. For example, since withstanding the crisis, Canadian banks have become considerably stronger. Their common equity capital has increased by 81 per cent, or $77 billion, and they already meet the new Basel III capital requirements, six full years ahead of schedule.

With respect to mortgage finance, the Government of Canada has made four timely and prudent adjustments to the terms of mortgage insurance and the Office of the Superintendent of Financial Institutions has tightened underwriting guidelines. Canadian authorities are co-operating closely and will continue to monitor the financial situation of the household sector.

These defences will go a long way toward mitigating the risk of financial excesses, but the Bank now recognises that there may be some cases when monetary policy may still have to take financial stability considerations into account. This is most obviously the case when financial imbalances affect the near-term outlook for output and inflation.

On the margin, monetary policy should be complementary to macroprudential efforts that have already been instituted. Whether it should actively lean depends on the severity of the imbalances and how effective the macroprudential measures are expected to be.

In exceptional circumstances, when financial imbalances pose an economy-wide threat or where imbalances themselves are being encouraged by a low interest rate environment, monetary policy itself may be needed to support financial stability. Monetary policy has a broad influence on financial markets and on the leverage of financial institutions that cannot easily be avoided. This bluntness makes monetary policy an inappropriate tool to deal with sector-specific imbalances but a valuable one to address imbalances that may have economy-wide implications. As Fed Governor Jeremy Stein has put it, monetary policy “has one important advantage relative to supervision and regulation—namely that it gets in all of the cracks.”[18]

[18] J Stein, “Overheating in Credit Markets: Origins, Measurement, and Policy Responses,” remarks to Restoring Household Financial Stability after the Great Recession: Why Household Balance Sheets Matter, a Research Symposium sponsored by the Federal Reserve Bank of St. Louis, St. Louis, Missouri, 7 February 2013.

Moreover, this role for monetary policy in the preservation of financial stability is perfectly consistent with ensuring longer-run price stability.[19] Financial imbalances ultimately breed crises, and crises threaten price stability. The clear lesson is that a central bank pursuing price stability without due regard for financial stability risks achieving neither. At present, the best way to accomplish these intertwined goals, which requires setting monetary policy in the context of other policies directed at financial stability, remains a matter of debate.

3. Central banks are not powerless at the zero lower bound

In the pre-crisis era, most saw the zero lower bound on nominal interest rates as something of a theoretical curiosity. Japan alone had faced this issue in recent times, and this was thought to be a special case.

With the onset of the crisis, the zero lower bound went from remote possibility to reality with frightening speed.

We have learned that central banks are not powerless at the zero lower bound, but nor should they relish finding themselves there. The effectiveness of unconventional policy is more uncertain, the risks more varied and its exit, as yet, untested.

As has been demonstrated, even if the policy rate is as low as it can go, longer-term market rates and the lending rates set by financial institutions are still likely to be well above zero. These interest rates directly affect the spending decisions of households and businesses. In these circumstances, the aim of monetary policy would be to continue to exert downward pressure on these rates and to improve the availability of credit and financial conditions more generally.

While the Bank of Canada has not had to use quantitative or credit easing, we have learned a great deal about these measures through contingency planning and by monitoring the experiences of other central banks (**Chart 4**).

Quantitative easing refers to outright purchases of financial assets funded by the expansion of the monetary base through the creation of central bank reserves, enlarging the central bank's balance sheet. If assets are imperfect substitutes, these purchases push up the price of, and reduce the yield on, the purchased assets (which normally are government securities but could include private assets).[20] The reduced yields on the purchased assets and the displacement of

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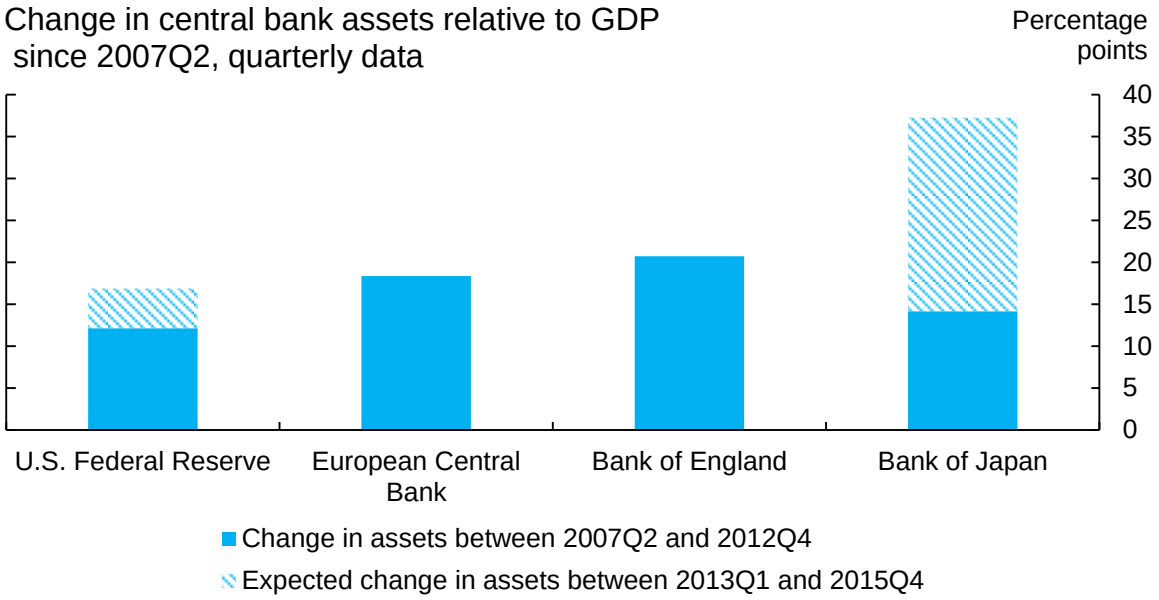
[19] Although the challenge is that it is not necessarily consistent with achieving the inflation target in the medium term.

[20] If the purchased long-term assets are perfectly substitutable with risk-free short-term assets, then the long-term interest rate will not deviate much from the expected path of short-term rates. If it were to deviate, investors would profitably substitute between short- and long-term assets until the deviation was eliminated. More generally, the magnitude of the impact on the yield of the purchased asset will depend importantly on the degree of substitutability between asset classes. The effect will be greater if the degree of substitutability is low. However, in that case, the pass-through from changes in the yields on the purchased assets to those on other asset classes in the economy is also likely to be low. If assets are highly substitutable, it will be more difficult to substantially affect their yields, but any given impact will be transmitted more broadly across asset classes. On the role of imperfect asset substitutability, see K. Brunner, and A. Meltzer, "Mr. Hicks and the 'Monetarists,'" *Economica* 40 (February 1973): 44 – 59, and J. Tobin, "A General Equilibrium Approach to Monetary Theory," *Journal of Money, Credit and Banking* 1 (1): 15–29,

Chart 4: Additional substantial unconventional monetary easing



Note: The expected increase in the assets of the U.S. Federal Reserve is based on an average of private sector forecasts. For the Bank of Japan, the expected change in assets is based on the most recent policy announcement.
Sources: U.S. Federal Reserve, U.S. Bureau of Economic Analysis; European Central Bank, Eurostat; Bank of England, U.K. Office for National Statistics; Bank of Japan, Cabinet Office of Japan; and Bank of Canada calculations

Last observation: 2012Q4

private investors lead to a rebalancing of private portfolios toward other riskier assets, thereby spreading the stimulative impact across financial markets. Ultimately, higher asset prices and lower yields support aggregate demand and the achievement of the inflation target.

Credit easing refers to purchases of private sector assets in certain credit markets that are important to the functioning of the financial system but that are temporarily impaired. The objective of credit easing is to reduce risk premiums and improve liquidity and trading activity in these markets. This would, in turn, stimulate credit flows and aggregate demand.

Moreover, as with any policy action, the effectiveness of unconventional policies requires that they remain credible and consistent with well-anchored inflation expectations.

The benefits of these unconventional policy measures in those countries that have deployed them are difficult to quantify. The available evidence suggests that it is very likely that had central banks not introduced such unconventional measures, the result might well have been a deeper recession, higher unemployment and even weaker inflation.

For example, the studies by the Bank of England and the U.S. Federal Reserve of their respective asset-purchase programs are broadly consistent.[21] It is clear

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1969. For treatments of imperfect asset substitutability in modern macroeconomic models, see J.D. Andrés, J. López-Salido and E. Nelson, "Tobin's Imperfect Asset Substitution in Optimizing General Equilibrium," *Journal of Money, Credit and Banking* 36 (4): 665–90, 2004, and J. Dorich, R. Mendes and Y. Zhang, "Introducing Multiple Interest Rates in ToTEM," *Bank of Canada Review* (Summer 2011): 3 -- 10.

[21] B. Bernanke, "Monetary Policy Since the Onset of the Crisis," speech at the Federal Reserve Bank of Kansas City Economic Symposium, Jackson Hole, Wyoming, 31 August 2012, and

that the programs have had some positive effects. Government bond yields were reduced. Corporate investment-grade and high-yield spreads also fell markedly, as did yields on mortgage-backed securities in the United States. The evidence is that the stimulative effects then fed into equity prices. It does not appear that there is such a thing as a fixed "multiplier" from asset purchases to other financial asset prices, but rather it seems likely that the scope to influence financial markets varies with market conditions. Asset purchases probably have a greater effect when markets are functioning poorly and liquidity premia are high.

It is even more difficult to judge how those effects in financial markets, whatever their magnitude, have been transmitted to the macroeconomy. The weakness of growth since quantitative easing was introduced is not itself a reason to doubt that it is an effective policy. There seems to be some evidence that large-scale asset purchases have boosted the demand for riskier assets, allowing those companies with access to capital markets to access funds more cheaply than otherwise. That probably includes banks, which have benefited both from higher demand for their debt and from an improved liquidity position through the boost to their holdings of reserves at central banks. What is less clear is the extent to which that has translated into an expansion of bank lending in support of the real economy.

It is clear that unconventional measures, while undertaken in pursuit of traditional monetary policy goals, raise broader issues regarding the role of the central bank. This puts a premium on well-articulated frameworks agreed between the central bank and its fiscal authority in advance of any such operation.

4. Communications matter

The crisis has reinforced the fundamental importance of effective communications.

When the Bank of Canada lowered interest rates to the zero lower bound and judged that additional stimulus was needed, the Bank deployed forward guidance. In designing forward guidance, central banks must trade off flexibility and impact. One can view the historical evolution of guidance as having proceeded through three "generations," becoming increasingly explicit and state-contingent over time.

In its first generation, extraordinary guidance was qualitative and provided no explicit indication of the timing or conditions under which policy may tighten. As with many policies at the zero lower bound, Japan was the pioneer of first-generation guidance. As early as 1999, Japan indicated that rates would stay at zero until "deflationary concerns" were "dispelled."[22] Later, the condition was

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M. Joyce, M. Tong and R. Woods, "The United Kingdom's Quantitative Easing Policy: Design, Operation and Impact," *Bank of England Quarterly Bulletin* (Q3 2011): 200–12.

[22] H. Fujiki and S. Shiratsuka, "Policy Duration Effect under the Zero Interest Rate Policy in 1999–2000: Evidence from Japan's Money Market Data," *Monetary and Economic Studies*, January 2002.

refined: rates would be kept at zero until the CPI registered "stably" non-negative inflation.[23]

The U.S. Federal Reserve employed a similar tactic in 2003 when it indicated "policy accommodation" could be maintained for a "considerable period."[24] Rates in the United States were not at the zero lower bound, but guidance was used, in part, because the Fed wanted to avoid cutting rates further. The Federal Reserve returned to this approach in late 2008 and early 2009 with its "some time" and "extended period" language.[25]

All of these first-generation variants required market participants to interpret words such as "stably," "considerable" or "extended." The scope for interpretation meant that central banks had effectively chosen to retain greater flexibility by sacrificing impact.

In April 2009, the Bank of Canada pioneered the second generation of guidance by providing a conditional commitment with an explicit date. With our key policy rate reaching one-quarter of one per cent, the lowest it could effectively go, we provided further stimulus by committing to hold rates at the effective lower bound, conditional on the outlook for inflation, through the second quarter of 2010.[26] The explicit conditionality on inflation provided critical information to the private sector about how the date may change in response to new information.

Our conditional commitment worked because it was exceptional, explicit and anchored in a highly credible inflation-targeting framework (**Chart 5**). It worked because we "put our money where our mouths were" by extending much of the almost $30 billion in exceptional liquidity programs we had in place for the duration of the conditional commitment. And it worked because it reached beyond central bank watchers to make a clear, simple statement directly to Canadians.

Last December, the Fed pioneered the third generation of guidance, when it publicly announced a precise threshold for unemployment that must be met before the policy rate is raised. This was combined with an inflation "knockout" to ensure consistency with price stability and mitigate the risk of underestimating the sustainable rate of unemployment. In principle, a central bank could design state-contingent thresholds using other real or nominal variables.

The various types of extraordinary guidance share some common channels of stimulus. In particular, guidance allows a central bank to substitute duration and greater certainty regarding the interest rate outlook for the negative interest rate setting that may be warranted but cannot be achieved.

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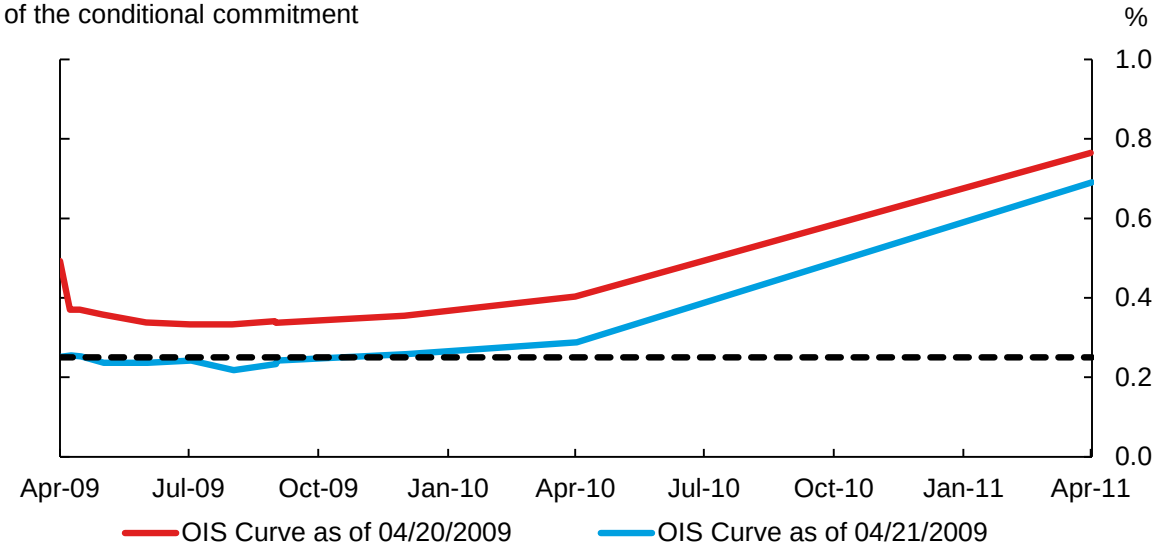
[23] Bank of Japan, "New Procedures for Money Market Operations and Monetary Easing," Press Release, 19 March 2001.
[24] U.S. Federal Reserve, Press Release, 12 August 2003.
[25] U.S. Federal Reserve, Press Releases, 16 December 2008 and 18 March 2009.
[26] In principle, the Bank could lower the policy rate to zero. However, that would eliminate the incentive for lenders and borrowers to transact in markets, especially in the repo market. Therefore, in April 2009, to preserve the effective functioning of markets in a low interest rate environment, the Bank of Canada set an effective lower bound of 25 basis points for the overnight rate, and pegged the deposit rate at the target overnight rate.

Chart 5: Impact of Bank's conditional commitment

OIS curve 0 to 2 years the day before and day of the announcement of the conditional commitment



Note: On 21 April 2009, the Bank of Canada announced commitment to hold the policy rate at 0.25% until the end of Q2 2010.
Source: Bloomberg
Last observation: April 2009

By increasing the expected duration at the lower bound, guidance can lead to lower long-term nominal rates. The increased certainty regarding the path of rates reinforces this stimulative effect. At the zero lower bound, interest rate risk is asymmetric: short-term rates can rise, but they cannot fall. This asymmetry causes the mean or expected outlook for short rates to be greater than the mode or most likely path. Thus, even if agents believe that short rates are most likely to remain at the lower bound for some time, the expected path of short rates can be higher. Since arbitrage in financial markets links yields on long-term bonds to the expected path of short rates, this effect buoys long rates. Guidance can lower long rates by reducing uncertainty about the future path of short rates. Specifically, by clarifying the conditions under which short rates may rise, guidance can reduce the perceived probability of rate increases. This can reduce long rates even if it does not extend the expected duration at the lower bound.

Real interest rates are further reduced by the positive impact of guidance on inflation expectations. As with any monetary policy, the exchange rate also plays a role in transmitting the effect of the policy to the real economy.

Regardless of its precise form, state-contingent guidance can reveal information about the central bank's discretion. For example, the Fed's state-contingent guidance draws into sharper relief the trade-offs that an inflation-targeting central bank makes when determining the optimal path to return inflation to target. Put another way, the combination of the threshold and the base-case (or central tendency) forecast can effectively reveal the central bank's reaction function. In the extreme, this can reveal the extent of the central bank's flexibility under its remit. Crucially, by outlining (and bounding) the consequences of its strategy for near-term inflation dynamics, the central bank can help anchor inflation expectations and retain credibility.

5. The need to "complete the contract"

This leads naturally to the final lesson. As I discussed earlier, the pre-crisis monetary policy consensus embodied an independent central bank pursuing its price-stability objective under "constrained discretion." Within limits, following a shock, the central bank determined the optimal path to return inflation to target in a manner that minimised excessive fluctuations in economic activity and employment. These boundaries were seldom explicitly defined; in this regard, the contract between the central bank and the government was incomplete.[27]

In the tranquil macroeconomic environment of the "Great Moderation," this ambiguity didn't matter. Central banks generally sought to return inflation to target over a standard medium-term monetary policy horizon of six to eight quarters. They were largely successful. This created a virtuous cycle of credibility and well-anchored inflation expectations.

With the scale and the persistence of the shocks now present, such ambiguity can be unhelpful.

The flexibility that central banks may require, both to address the consequences of the crisis and to reduce the risk of a repeat, raises a fundamental question about the appropriate constraints on central banks' delegated authority.

This is not a general appeal for looser policy. In some circumstances where financial vulnerabilities threaten to continue to build, policy may need to be tighter, all else equal. In all cases, the degree of flexibility must be constrained by central bank credibility and inflation expectations.

Making operational a more flexible role for monetary policy requires clear frameworks. By delineating the bounds on the authority delegated to the central bank, a clear framework enhances the central bank's accountability. It also helps private decision-makers understand the central bank's objectives and methods.

In this way, a clear framework can importantly enhance the effectiveness of monetary policy by allowing people to bring forward the effects of anticipated future policy. There is an analogy to the dynamics underpinning the firm anchoring of inflation expectations in Canada.

It is quite probable that a general understanding that monetary policy will be employed to counteract the buildup of certain types of financial imbalances will enhance the stabilising effect of leaning.[28] For example, private agents may choose to accumulate less debt if they understand that a broad-based buildup of debt is likely to cause the central bank to raise interest rates. Moreover, Bank of Canada research suggests that the magnitude of the required interest rate adjustment is likely to be smaller if the role of leaning within the monetary policy

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[27] C. Bean, M. Paustian, A. Penalver and T. Taylor, "Monetary Policy After the Fall," speech delivered at the Federal Reserve Bank of Kansas City Annual Conference in Jackson Hole, Wyoming, 28 August 2010.

[28] F. Mishkin, "Monetary Policy Strategy: Lessons from the Crisis," NBER Working Paper No. 16755, February 2011.

framework is credible and well understood. If leaning is understood, expectations will do some of our work for us.[29]

Expectation effects of this type are not foreign to central bankers. Most notably, the adoption of inflation targeting caused inflation expectations to become firmly anchored. Expectations went from being the destabilising driver of wage and price spirals in the 1970s to the stabilising anchor of the Great Moderation in the 1990s. As a consequence, policy rates have been much less volatile during the inflation-targeting era than anyone could have anticipated. Similarly, if we ignore the beneficial effects of expectations within a credible framework, we risk overestimating the policy rate adjustments required to lean effectively.

The Bank of Canada has found this approach to work in practice. The Bank adopted a tightening bias in April 2012, and noted that the evolution of the risks related to household imbalances in Canada may be a factor affecting the timing and degree of any withdrawal of monetary stimulus. This, along with the cumulative effects of changes to mortgage insurance rules and the tightening of mortgage underwriting guidelines, as well as an increasing appreciation among consumers of the risks associated with elevated debt levels, has resulted in a more constructive evolution of household imbalances in recent quarters. In 2011, household credit was growing at a pace of over 6 per cent, and only about half of new residential mortgage loans were arranged at fixed interest rates. Growth in household credit has since fallen closer to 3 per cent, and roughly 90 per cent of new mortgages are now fixed rate.

When to deploy flexibility

More generally, there are three sets of circumstances under which it may be desirable to return inflation to target, from above or below, over a horizon that is somewhat longer than usual.

First, the unfolding consequences of a shock could be sufficiently large and persistent that a longer horizon might be warranted in order to provide greater stability to the economy and financial markets (**Chart 6**). While optimal policy in new Keynesian models would advocate immediately and fully offsetting the inflationary consequences of shocks that do not create a tension between stabilisation objectives, reality is more complicated. For instance, following a very large shock, lags in the transmission mechanism alone would make it difficult to return inflation to target over the usual horizon without inducing a subsequent overshoot/undershoot of the target.

Second, a longer targeting horizon can allow monetary policy to promote adjustments to financial excesses or credit crunches (**Chart 7**). A tighter monetary policy that allows inflation to run below target for a longer period than usual could help to counteract pre-emptively excessive leverage and a broader buildup of financial imbalances. On the flip side, there could be situations where, even though inflation is above target, ongoing monetary policy stimulus and a somewhat longer horizon to return inflation to target would be desirable in order

[29] I. Christensen and C. Meh, “Countercyclical Loan-to-Value Ratios and Monetary Policy,” Bank of Canada Working Paper (forthcoming 2013).

Chart 6: Larger shocks require a longer horizon

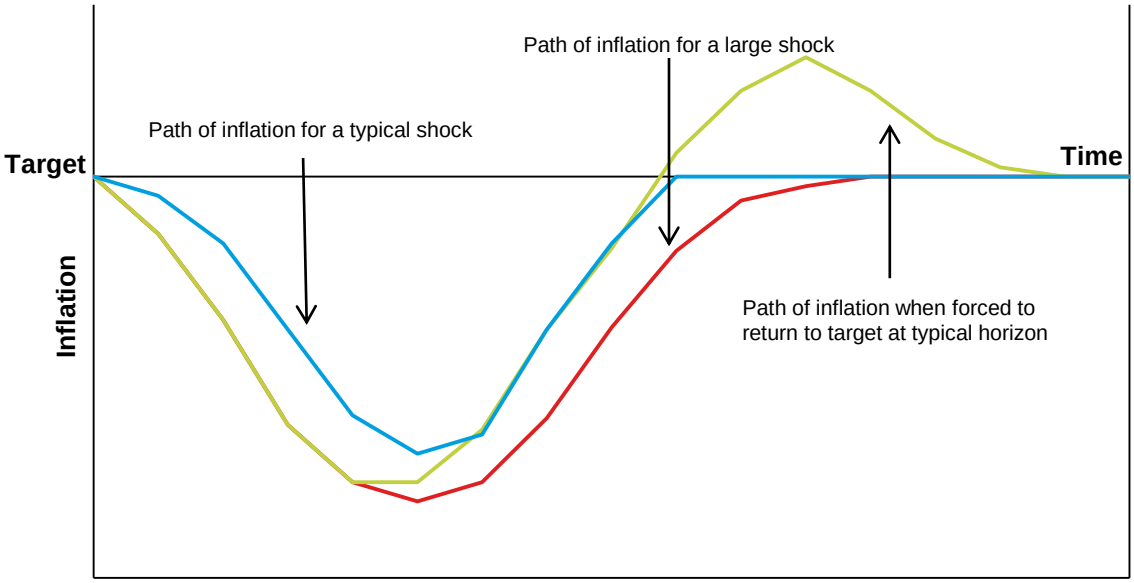
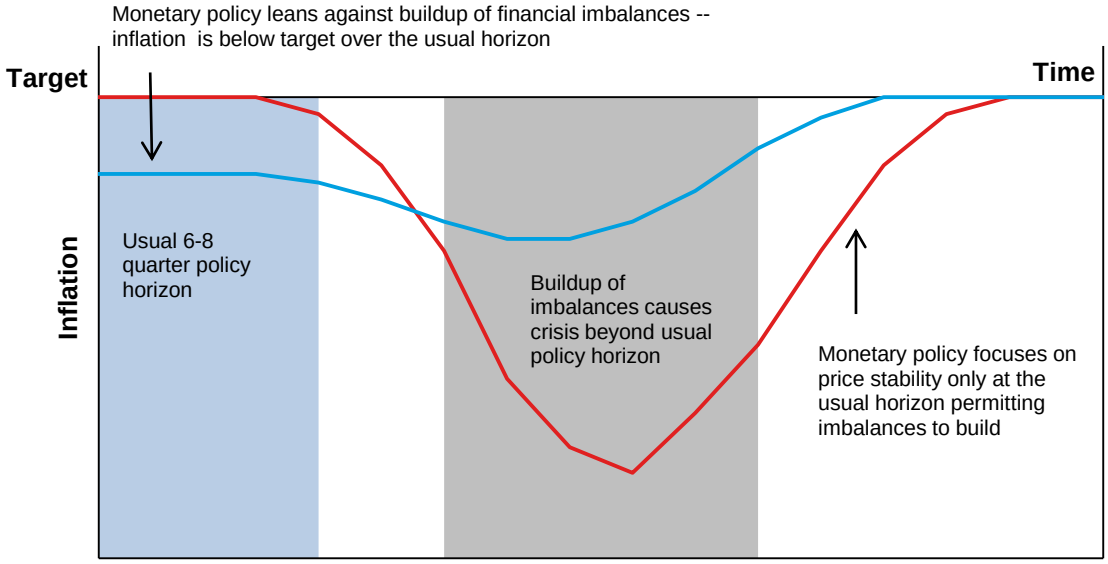


Chart 7: Extending policy horizon to promote adjustments to financial excesses or credit crunches

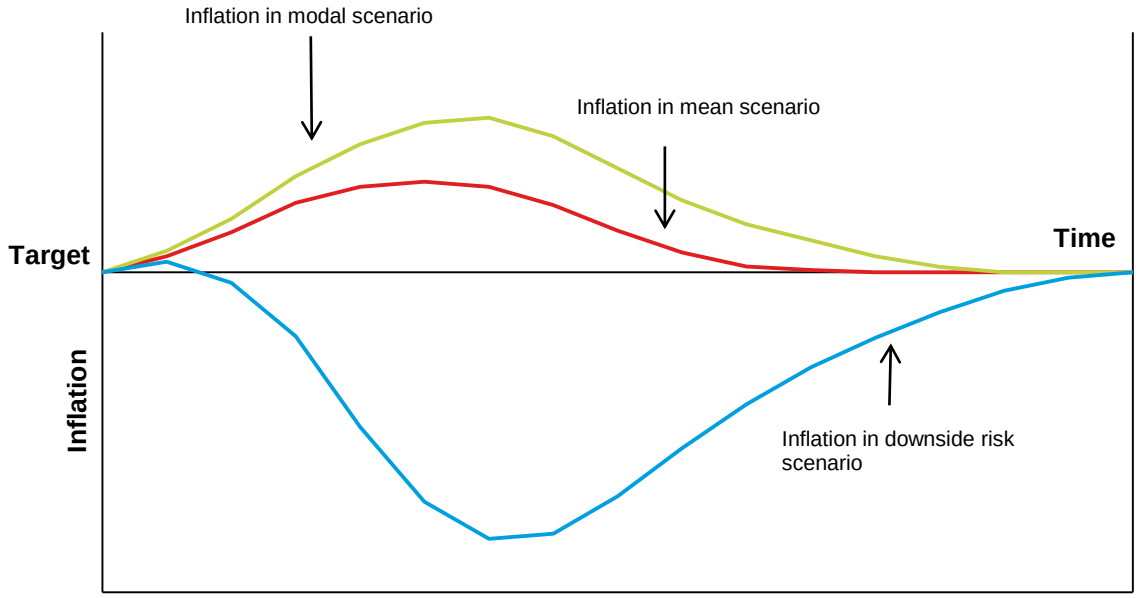


to facilitate the adjustment to the broad-based deleveraging forces that are unfolding. Similarly, a longer targeting horizon may be desirable if prolonged economic weakness risks eroding the economy's productive capacity. Current risks of hysteresis in the labour markets of a number of countries at the zero lower bound are a case in point.

Third, as the Bank of Canada has observed, the optimal inflation-targeting horizon will vary with the evolution of the risks to the outlook (**Chart 8**).[30] Shocks to the economy, both observed and prospective, are inevitably subject to a degree of uncertainty, as is the precise manner in which they are transmitted to the economy. This is symmetric; risks to the inflation outlook could be skewed to the downside or the upside.

Chart 8: Extending policy horizon with skewed risks

Inflation under different illustrative scenarios



In recent years, for instance, a failure to contain the crisis in Europe represents a clear downside risk and, absent any other risks, would skew the inflation outlook to the downside. In statistical terms, the mean or expected outlook for inflation could be lower than the most likely or modal outlook. In these cases, a balance must be struck between setting monetary policy to be consistent with the mode and the need to minimise the adverse consequences in the event that downside risks materialise. This balancing of the risks could warrant a more stimulative setting for monetary policy than would otherwise be desirable in the absence of the downside risks. However, if the downside risks fade away rather than materialise, the resulting stronger inflationary pressures could cause a small inflation overshoot and would therefore merit returning inflation to target over a longer horizon. The opposite would be true under circumstances where risks to inflation are skewed to the upside.

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[30] Bank of Canada, *Renewal of the Inflation-Control Target: Background Information—November 2011*.

In retrospect, it appears likely that monetary policy would ideally have leaned against growing domestic financial imbalances in the pre-crisis period, thereby mitigating the eventual fall. At the very least, explicit consideration of the role that monetary policy itself was playing in the buildup of imbalances would have been cause to lean. This is fully consistent with the view that the financial crisis was not simply an exogenous shock to which policy had to respond after the fact.

While there clearly would have been economic costs to leaning, these must be viewed in relation to the enormous costs associated with the crisis. Indeed, despite the swift and aggressive clean response by the Fed and other central banks, the U.S. economy still suffered a large and persistent economic downturn. With less capital investment and more structural unemployment, even once the U.S. economy recovers its cyclical losses, the Bank estimates that it will remain over $1 trillion smaller in 2015 than we had projected prior to the crisis. Already, U.S. weakness means that Canadian exports are $30 billion lower than they would normally be at this stage in the cycle.

Relative to the previous consensus, the lean versus clean debate now appears to be, at the very least, more finely balanced, if not tipping in favour of pre-emptive leaning (depending of course on the stance and effectiveness of macroprudential policy).

Nonetheless, there is no simple, one-size-fits-all rule for responding. Indeed, the crisis taught us that not all financial imbalances are created equal. Imbalances fuelled by a credit boom, which may manifest itself in asset-price movements, pose the greatest risk to the economy, because of the powerful deleveraging process they induce when they unwind. When exuberant credit creation is not part of the buildup of financial imbalances, the consequences for the economy of falling asset prices are not as dramatic, and hence the need to lean to avoid such disequilibria may be smaller.

In contrast, there is a more compelling argument for leaning when imbalances are broad based, as opposed to concentrated in a particular sector, since the effects of monetary policy itself are broad based. Similarly, monetary policy may have a greater role to play when imbalances themselves are being encouraged by a low interest rate environment.

V. Toward a More Effective Flexible Inflation-Targeting Framework

Allow me to review what I believe we have learned.

The conclusions that Governor Crow outlined a quarter century ago remain valid. Price stability should remain the paramount objective of monetary policy. Given the evident absence of a long-run trade-off between employment and inflation, maintaining price stability is consistent with promoting full employment and represents the best contribution of monetary policy to economic welfare.

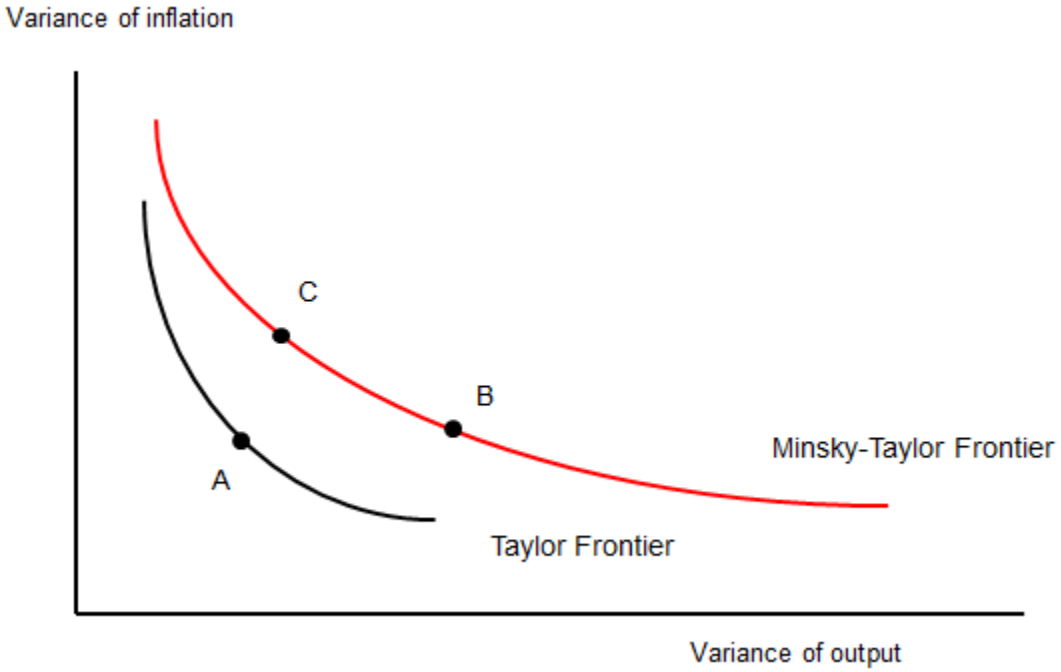
The core elements of pre-crisis inflation-targeting frameworks also remain essential. In particular, a clear inflation objective pursued by an independent central bank facilitates the achievement of both low inflation and full employment, while transparent communications ensure the effectiveness of policy and the accountability of the central bank.

We now better appreciate that price stability does not guarantee financial stability. Furthermore, we are beginning to recognise that price stability itself may actually promote financial instability over the medium term. This risk-taking channel of monetary policy limits the ability of monetary policy to stabilise inflation and output without fostering financial imbalances.

Central bankers overestimated their ability to stabilise inflation and output. Taking account of the disruptive potential of financial instability—absent effective macroprudential policies—leads to a less favourable Taylor frontier, or what Mervyn King has called the Minsky-Taylor frontier.[31] [32]

Consider the example in Chart 9. For a time, a central bank may appear to be able to achieve levels of inflation and output volatility on the Taylor frontier. However, the apparent stability of inflation and output may conceal the buildup of longer-run financial imbalances. If these imbalances result in a crisis, it will become obvious that the Taylor frontier was never feasible. Attempting to implement a policy that leads to point A on the Taylor frontier will ultimately leave

Chart 9: Minsky-Taylor frontier: Central bankers overestimated ability to stabilize inflation and output



[31] M. King, “Twenty Years of Inflation Targeting,” speech given at the Stamp Memorial Lecture, London School of Economics, 9 October 2012.

[32] There is a further consideration. Insofar as financial market imperfections are themselves inefficient and therefore welfare reducing, independent of their impact on output and inflation, they matter also for the objectives of monetary policy, as well as public policy more generally. In other words, thought should be given to whether financial stability should be a third argument in the central bank’s reaction function. To the extent that this modification creates additional short-run stabilisation trade-offs, the task of conducting and communicating monetary policy would be rendered more difficult. This would be especially true if welfare losses associated with financial instability are themselves asymmetric. While I am somewhat skeptical of the necessity of such a change, this is an area for further research and considered reflection.

the central bank at a point like B on the Minsky-Taylor frontier. But point B is arbitrary—it is not the outcome of a deliberate policy decision, and therefore may not strike an optimal balance between inflation and output volatility. Once the central bank recognises that it is operating on the Minsky-Taylor frontier, it can make a more informed decision, possibly choosing a point such as C.

The scale of the shocks now facing major advanced economies is stretching the conventional flexibility of inflation-targeting frameworks. Similarly, if macro-prudential policies were to prove insufficient, leaning might justify returning inflation to target over a horizon longer than historic norms.

These demands complicate the conduct of monetary policy, but those complications do not absolve the central bank of its responsibilities. In facing these challenges, it is critical to have a clear framework. The better this framework is understood by the public, the greater the chance of success.

It is fundamentally important that agents understand a central bank's reaction function. The clearer it is, the more effective policy will be. Leaning can promote financial stability more effectively if agents anticipate the central bank's actions. Guidance can crystallise boundaries on the degree of flexibility in inflation-targeting frameworks.

As with everything, there are limits. The time frame for returning inflation to target can be stretched, but the credibility essential for the success of such a tactic could be undermined if such flexibility is taken too far, deployed too frequently or undertaken by stealth.

Clear policy frameworks, combined with transparent communications, play a critical role in building and preserving credibility. For this reason, it is incumbent on central banks to enunciate clearly the expected path of inflation back to target and to explain any deviations from the normal horizon. This would not only help shed light on the central bank's reaction pattern, but also define the boundaries of the flexibility that may be employed. Changes to the previously understood horizons should be sanctioned by the relevant executive or legislative authority, which ultimately defines the constraints on the central bank's discretion.

Monetary policy tactics, particularly communications, can play an important role in anchoring inflation expectations and retaining the credibility necessary for monetary policy to be effective. Guidance and state-contingent thresholds are examples of mechanisms to define the boundaries of flexibility. In the extreme, they can effectively reveal and reinforce the central bank's reaction function, thereby helping to retain credibility and anchor inflation expectations.

Finally, consideration of the monetary policy framework cannot be set in a vacuum. The central bank can't be expected to do it all. Different authorities have different absolute and comparative advantages in addressing problems and achieving desired outcomes. This leads to a natural assignment of principal responsibilities.

Central banks clearly have an important role in assessing potential vulnerabilities. Micro- and macroprudential authorities are the obvious first responders to any such risks. There are several lines of defence against emerging financial vulnerabilities that can be employed before using monetary

policy. It is imperative that authorities continue to develop such tools and improve upon the effectiveness of their deployment. Needless to say, given the interrelationships, coordination and co-operation among authorities is essential.

We should recognise that progress in micro- and macroprudential instruments and supervision will lessen the burden on monetary policy. In addition, financial sector reform should limit the occurrence of systemic events. If the G-20's ambitions in this sphere are realised, monetary policy will be more likely to be able to focus on its main mission.

VI. Conclusion: Elements of a Forward Research Agenda

It has been a fascinating, sometimes harrowing, five years since Governor Dodge's Hanson Lecture. The fallout from the crisis has increased the demands on monetary policy and has stretched the flexibility of inflation-targeting frameworks.

While the crisis left us with many lessons, we still have much to learn. Allow me to conclude by highlighting some of the fields of research already under investigation at the Bank of Canada and elsewhere.

First, the financial crisis has given renewed importance to earlier research aimed at including in policy models the interactions between financial market imperfections and the real economy. To reflect fully financial market dynamics, the deceptive simplicity and elegance of complete markets operating in linear, rational expectations environments must give way to the chaotic reality of heterogeneous beliefs, risk-taking behaviour, feedback effects from excess leverage, endogenous uncertainty, and a non-trivial role for financial intermediaries. That is hard enough to pronounce, let alone to do, but progress is being made, and the eventual payoff will be large.[33]

A key benefit of this line of research will be a more complete understanding of the channels through which monetary policy itself can contribute to financial stability. Chief among these is a better understanding of the risk-taking channel of monetary policy.[34] While progress has been made in modeling elements of the risk-taking channel in isolation, incorporating it in a tractable way in macroeconomic policy models remains a work in progress.[35]

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[33] A summary of the key recent progress on the linkages between financial markets and the economy can be found in the special issue, "Real-Financial Linkages", of the *Bank of Canada Review*, Summer 2011.

[34] V. Bruno and H. Shin, "Capital Flows and the Risk-Taking Channel of Monetary Policy," 2013.

[35] Slow progress in this area is indicative of the more general problem of the insignificance of financial institutions in mainstream macro models. Recent work by Markus Brunnermeier and Yuliy Sannikov explores the full non-linear dynamics of an economy characterised by a key feature that is thought to have contributed to the financial crisis—an environment characterised by low exogenous risk can lead investors to assume higher leverage, thereby making the economy more prone to spikes in volatility, leading to what they refer to as the volatility paradox. See M. Brunnermeier and Y. Sannikov, "A Macroeconomic Model with a Financial Sector," *American Economic Review*, (in press) 2013. Michael Woodford has also introduced funding risks and the possibility of fire sales in an otherwise standard macroeconomic model, and shows that low interest rates can lead to excessive leverage and increased severity of crises when they occur. M. Woodford, "Monetary Policy and Financial Stability," a presentation at the NBER Summer Institute, Cambridge, Massachusetts, 15 July 2011.

Researchers at the Bank of Canada are exploring the policy implications of interactions between the balance sheets of banks, households and businesses. Importantly, this framework introduces a link between the risk appetite of investors and aggregate funding conditions in wholesale markets. Specifically, when funding liquidity is plentiful, the risk appetite of investors increases, inducing them to rebalance their portfolios toward riskier assets.[36]

The advantage of all of this is to better anticipate medium-term dynamics and promote better conduct of macroprudential policies and coordination with monetary policy.

Second, the zero lower bound has proven to be a larger and more persistent constraint on conventional and unconventional monetary policy than was generally predicted using models estimated with pre-crisis data.[37] This underscores the importance of the non-linearities and tail risks inherent in real economies that are largely absent from the workhorse models. Forthcoming work at the Bank of Canada shows that uncertainty effects alone can have a profound impact on private sector behaviour in the vicinity of the zero lower bound. Specifically, an important asymmetry is created when agents know there is a lower bound, but no corresponding upper bound, on the future path of the policy rate. As the policy rate approaches the zero bound, this asymmetry becomes more pronounced, resulting in weaker private sector spending which, in turn, further increases the probability of hitting the bound.[38]

Relatedly, to understand better how effective unconventional policies are in circumventing the constraints imposed by the zero lower bound, future research should continue to exploit data currently being generated by central banks employing such policies as quantitative easing and extraordinary guidance. For instance, while consensus has emerged that quantitative easing reduced longer-term yields on purchased instruments in the United States and the United Kingdom, more work is needed to assess its impact on demand and inflation.[39]

Third, additional quantitative work is needed to guide policy-makers on the power of, and limits to, forward guidance. Conditional commitments to maintain the policy interest rate at the zero lower bound can provide additional stimulus by lowering the expected path of short-term interest rates as well as by providing greater certainty around that path. While research to date finds evidence that the conditional commitment by the Bank of Canada in 2009, and the Fed more recently, did reduce longer-term yields, more work is required to assess the extent to which these declines in yields affected private sector spending and

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[36] S. Alpanda, G. Cateau, and C. Meh, “A Policy Model With Real-Financial Linkages and Macroprudential Policy,” forthcoming Bank of Canada working paper, 2013.

[37] While pre-crisis research predicted that encounters with the zero lower bound would occur fairly frequently, they were expected to be short lived and their impact small. See J. Williams, "Heeding Daedalus: Optimal Inflation and the Zero Lower Bound," *Brookings Papers on Economic Activity*, Economic Studies Program, The Brookings Institution, 40, 2 (Fall 2009), 1 – 49, and references therein.

[38] R. Mendes, “Uncertainty and the Zero Lower Bound: A Theoretical Analysis,” Forthcoming Bank of Canada Working Paper, 2013.

[39] The impact on the macroeconomy has generally been gauged using macro models that were tuned to non-crisis periods. More work is needed to assess whether the transmission of lower rates to private sector spending was weaker at the time these measures were taken.

inflation expectations relative to direct asset purchases and conventional policy measures.[40]

Recent research at the Bank of Canada indicates that the power of the expectations channel of monetary policy is highly sensitive to the precise manner in which expectations are formed, and additional work is needed to help distinguish between the various possibilities.[41] [42]

Fourth, a better understanding of expectations formation can also contribute to defining the limits of flexible inflation targeting as well as improving central bank communications strategies and, through them, the effectiveness of monetary policy. For this reason, the Bank of Canada will continue to invest in this area, both through traditional econometric analysis and by exploiting survey data and by drawing on experimental economics.

Finally, the Bank will continue to investigate potential improvements to the monetary policy framework, including the merits of alternative frameworks in avoiding and exiting the zero lower bound and the interaction of monetary and other macro policies. As we meet today, the combination of the difficulty of exiting the zero lower bound and the uncertainty over cost-benefits of unconventional policies underscore the desirability of having a monetary policy framework that will minimise the prospect of its attainment.

One of the core strengths of Canada's system is the periodic review of our monetary policy framework that leads to the renewal of our inflation-control agreement between the Bank of Canada and the Government of Canada every five years. Further research on some of the issues I have raised in this speech will help inform future agreements and the conduct of policy.

As promised, I am leaving you with more questions than answers. Perhaps a future Bank of Canada Governor will deliver the Hanson Lecture that ties this all together. Peut-être qu'elle m'écoute actuellement.

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[40] See, for example, Z. He, "Evaluating the Effect of the Bank of Canada's Conditional Commitment Policy," Bank of Canada Discussion Paper, August 2010, and E. Swanson and J. Williams, "Measuring the Effect of the Zero Lower Bound On Medium- and Longer-Term Interest Rates, Federal Reserve Bank of San Francisco Working Paper 2012-02, January 2013.

[41] The issues of private sector expectations and central bank credibility have been studied extensively by the Bank of Canada in the context of price-level targeting (a particular form of history-dependent policy). For a summary of the main conclusions of this work, see Bank of Canada, *Renewal of the Inflation-Control Target: Background Information—November 2011*.

[42] G. B. Eggertsson and M. Woodford, "The Zero Bound on Interest Rates and Optimal Monetary Policy," *Brookings Papers on Economic Activity*, 34 (2003): 139–211.