



BANK OF CANADA REVIEW

Autumn 2014

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Bank of Montreal, 1903, \$50 specimen (detail), Waterlow and Sons Limited

Known for its extremely ornate and colourful notes, the British printing firm Waterlow and Sons would drum up business by presenting financial institutions with elaborate designs to demonstrate its printing capabilities. This Bank of Montreal \$50 note from 1903 is a perfect example. Its large size, twice the height of

a regular bank note, was intended to remind bearers that they were in possession of an unusually large amount of money for the time. It is likely that the Bank of Montreal did not subscribe to the idea, since it did not order notes for circulation. These extra-large notes are extremely rare.

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For further information, contact:

Public Information
Communications Department
Bank of Canada
Ottawa, Ontario, Canada K1A 0G9

Telephone: **613 782-8111**; **1 800 303-1282** (toll free in North America)

Email: info@bankofcanada.ca

Website: bankofcanada.ca

ISSN 1483-8303

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Recent Developments in Experimental Macroeconomics

Robert Amano, Canadian Economic Analysis; Oleksiy Kryvtsov, Canadian Economic Analysis; and Luba Petersen, Simon Fraser University

- Experimental macroeconomics is a relatively new approach to investigating important macroeconomic questions.
- The experimental approach is well suited for studying the implications of different public policies and for inferring unobservable behaviour such as expectations formation.
- The Bank of Canada has started using experimental macroeconomics to examine important monetary policy issues such as the relative efficacy of inflation targeting versus price-level targeting, and the nature of inflation expectations.
- Although only suggestive, results to date indicate that experimental macroeconomics is a useful tool in central bank research.

Canada's public institutions have a responsibility to continuously review their policy frameworks, ensuring that they are contributing as best as they can to the standard of living of Canadians. Part of this review includes re-examining important questions through a new lens. In this article, we describe research being conducted at the Bank of Canada and elsewhere in which, in a novel approach, experimental economics is used at the macro level to gain new insights into key monetary policy issues.

Experimental economics is the application of experimental methods to study and answer economic questions. The approach is similar to a scientific experiment, where a controlled environment is created and different factors are manipulated to assess their impact on a variable of interest. Unlike experiments in the sciences, however, people, rather than chemicals or organic matter, for example, are used as the reactants.

Early applications of experimental methods tended to focus on micro-economic debates surrounding issues such as individual and group behaviour, and on how to effectively design contracts, incentive structures and market platforms. In one of the first applications of an experimental approach to an economic question, Thurstone (1931) considered the problem of determining an individual's preferences over a range of goods

(i.e., indifference curves). In his experiments, each subject was asked to make a large number of hypothetical choices between commodity bundles consisting of three different combinations—hats and coats, hats and shoes, or shoes and coats. Upon examining the data, Thurstone concluded that choice data could be adequately represented by indifference curves.

In another early example that had enormous influence on how economists think about interactive behaviour, Flood (1958) conducted an experiment analyzing an economics game known as the prisoner's dilemma. In contrast to theoretical results, Flood found evidence against the general hypothesis that players tend to choose non-co-operative (Nash equilibrium) strategies.¹ Instead, the results reinforced the hypothesis that a co-operative "split the difference" principle is a more effective way to organize the data from games of this type. From these early roots, the literature of experimental economics experienced exponential growth in the decades that followed, and Vernon Smith was recognized in 2002 with a Nobel Prize in economics for his contributions to this field.

With respect to issues related to monetary policy, laboratory-generated data possess several advantages over naturally occurring macroeconomic data. First, experimental methods are useful for studying factors that cannot be readily observed or measured. The formation of inflation expectations is an important example from the perspective of a central bank. Indeed, a better understanding of how households and firms form inflation expectations would be helpful across a broad range of important monetary policy decisions, such as predicting inflation dynamics, calibrating interest rate movements to fluctuations in the economy and choosing an appropriate monetary policy regime. Since the process according to which inflation expectations are generated is unobservable, making it a difficult subject to study using standard economic methods, experimental economics is well suited to help researchers infer how people form these expectations.

Second, the laboratory provides an opportunity to "experiment" with policies in a controlled manner. In the laboratory—unlike the real world—there is no need to fear unintended or irreversible consequences of unexpectedly "bad" policies. Experiments, therefore, can inform policy-makers on which policies may be more or less desirable. Moreover, in a laboratory, aggregate outcomes can be easily scrutinized and linked to parameters of the experiment, including those that are difficult to identify from macroeconomic data, such as preferences, expectations and non-fundamental variables (or "sunspots").² Finally, an experiment can be run many times to produce more data, while we cannot "rerun" an economy to produce multiple versions of macroeconomic data.³

Experimental economics has been used recently, with some success, to explore topics central to macroeconomics, such as optimal lifetime consumption and savings decisions, theories of money, strategic behaviour, coordination issues, commitment versus discretion, and fiscal and tax

¹ The Nash equilibrium describes a situation where each player does the best that he or she can, given the behaviour of the other players in the game.

² Sunspots include phenomena such as asset-price bubbles, self-fulfilling prophecies and animal spirits. These sunspots do not affect economic fundamentals directly but may have an effect on outcomes because they influence expectations.

³ Surveys of professional forecasters have been useful for studying the dynamics of expectations in response to past economic fluctuations. See, for example, Coibion and Gorodnichenko (2012), Kozicki and Tinsley (2012), and Jain (2013). While the survey approach is based only on expectations formed at a point in history and cannot be replicated, the experimental approach is based on many artificial histories and can be replicated many times.

policies.⁴ The usefulness of experiments in addressing macroeconomic problems naturally makes them an attractive tool for central bankers; however, before discussing this line of research, it is important to understand how these experiments are conducted.

This article first describes a generic economics experiment, noting several limitations to the approach. It then provides examples of where experimental economics has been used to examine a number of macroeconomic issues. Recent contributions of experimental macroeconomics to monetary policy are then highlighted, followed by concluding remarks.

Experiments in Economics

An economics experiment, like any other scientific experiment, involves the creation of a controlled and simplified environment to examine a question of interest. Control helps to isolate features of the experimental economy that have a material effect on the behaviour of participants (subjects). Control factors often include information available to participants, a set of possible decisions, and how those decisions translate into outcomes and monetary payoffs for subjects. In practice, control factors are individually manipulated to gauge their effect on economic behaviour. An experiment could, for example, study how changes in the monetary policy regime influence a participant's ability to forecast inflation, as will be explored later in the article.

Once an economics experiment has been designed, it is usually conducted in a computer laboratory at a university or research institute. Participants are given detailed oral and written instructions on their experimental environment and the decisions they will be making. Most importantly, they are informed on how their decisions would translate into monetary payoffs. Depending on the complexity of the experiment, subjects may have the opportunity to practise making decisions and to ask the experimenter for clarifications.

Sessions typically last for one to two hours, but may be shorter or longer, depending on the nature of the experiment. An experiment may involve participants making a single decision or it may involve many repeated decisions. After the session is complete, participants are paid according to the rule specified in the instructions. For example, in experiments where participants are asked to forecast inflation, their payoff could depend on the accuracy of their forecasts. Higher payoffs are given for more accurate forecasts, creating an incentive for participants to make an effort throughout the experiment.

Despite its potential efficacy, the experimental approach has certain limitations. First, laboratory-generated data are frequently subject to the concern of "external validity"; that is, individuals may behave differently in the simplified laboratory environment than they would in their everyday environment. For example, individual decisions can be affected by the amount and complexity of relevant information; in addition, individuals' efforts in processing information may be sensitive to the incentives. Such concerns about the external validity of experiments could be addressed, to some extent, by changes in the reward scheme, information parameters, decision options, the composition and size of the subject pool, and other features of experimental design.⁵ Nevertheless, experimental data should be viewed as supplementary to macroeconomic data rather than as a replacement.

◀ *Experimental data should be viewed as supplementary to macroeconomic data rather than as a replacement*

⁴ Chakravarty et al. (2011), Cornand and Heinemann (2014), and Duffy (2014) provide surveys of the experimental macroeconomics literature.

⁵ For example, Cheremukhin, Popova and Tutino (2011) find that subjects in the experiments differ dramatically in their ability to process information; Caplin and Dean (2014) show that subjects respond to higher incentives by spending more time and effort processing information.

A second limitation is that macroeconomic experiments often involve fewer than 10 participants, causing speculation about whether sample sizes are large enough to study economy-wide phenomena. Perhaps surprisingly, evidence indicates that they are. Macroeconomics experiments can study outcomes for a group of participants in a non-co-operative setting by choosing a group large enough to limit the impact of individual effects. Since in such a setting each participant is aware that his or her decisions do not affect the outcomes for the group as a whole, those outcomes can be given macroeconomic interpretation. Indeed, early experiments of market exchange show that, even with a small number of subjects, experimental outcomes are similar to those in the competitive market (Smith 1962).

Third, while the use of a simplified environment allows experiments to mimic the key features of the real world, simplicity is a double-edged sword, since it forces researchers to interpret their results with caution. If, for instance, participants in an experiment are found to form better inflation forecasts when the central bank switches from inflation targeting to price-level targeting, this result may not necessarily apply outside of the laboratory, since experiments are not able to capture or even identify all the features and uncertainties associated with the real world. Nonetheless, if the underlying experimental design is able to capture the key features of an economic issue, the experimental evidence may provide useful guidance for what we can expect to observe outside of the laboratory.

◀ *Even with a small number of subjects, experimental outcomes can be given macroeconomic interpretation*

Experimental Macroeconomics

Laboratory experiments addressing macroeconomics and policy issues have become increasingly popular over the past two decades. Experiments have provided a means to evaluate important assumptions embedded into modern macroeconomic models; study macroeconomic phenomena such as bank runs, currency attacks, asset bubbles, episodes at the zero lower bound, moral hazard in the banking sector and the importance of non-fundamental variables (sunspots); and examine the implications of different types of public policy.

Laboratory experiments have studied, for example, the importance of sunspots for determining aggregate outcomes.⁶ Duffy and Fisher (2005) design a market experiment in which buyers and sellers trade a commodity under two alternative market settings, observing transaction prices in real time or only at the end of trading. The sunspot variable, introduced at the beginning of trading, is an announcement of the market-price forecast, chosen at random between “the forecast is high” or “the forecast is low.” Duffy and Fisher find that the expectations of subjects regarding the market price—and therefore their supply and demand decisions—are more likely to be influenced by a sunspot variable in the market with less information. They therefore provide evidence that sunspots can play an important coordinating role when the ability to coordinate by other means is hindered by limited information.

In another example, Arifovic and Sargent (2003) study issues of credibility and time inconsistency within an experiment based on a model developed by Barro and Gordon (1983). In this experiment, private agents attempt to accurately forecast inflation. After seeing these forecasts, the policy-maker chooses the socially optimal inflation rate. As in Barro and Gordon’s

⁶ Lucas (1986) proposes using experiments to provide predictions for phenomena on which macroeconomic theory is silent, such as the nature of sunspots or outcomes of macro-coordination problems.

framework, the policy-maker has an incentive to create surprise inflation, because it leads to a lower level of unemployment. Forecasters, however, recognize the policy-maker's bias for inflation and anticipate higher and higher levels of inflation, leading to a situation of both high inflation and high unemployment (the Nash equilibrium). If, instead, the central bank can credibly commit to low inflation, the economy will experience a situation of low inflation and low unemployment (the commitment equilibrium). In most sessions of their experiment, Arifovic and Sargent observe that inflation is initially close to the Nash equilibrium; however, with a credible commitment to low inflation by the central bank, inflation gradually converges toward the commitment equilibrium, providing support for one of the key predictions of the Barro and Gordon model.

Other experiments have explored the effects of monetary policy as well as the ability of monetary policy and lending regulations to work together to stabilize asset markets.⁷ In addition, experiments have shed light on the aggregate effects of income taxation to finance unemployment insurance (Riedl and van Winden 2007) and public goods (Huber, Shubik and Sunder 2011).

Experimental Macroeconomics, Monetary Policy and Expectations Formation

In conducting monetary policy, central bankers face the difficult task of taking into account the complex nature of economic behaviour and uncertainty. A central element of this behaviour is how economic agents form their expectations about the future course of the economy. Boivin (2011) emphasized the importance for policy-makers to understand how expectations affect the conduct of monetary policy, and vice versa.⁸ Empirical evidence regarding the formation of inflation expectations is sparse, however, so researchers have applied experimental economics to help fill this important gap (see, for example, Pfajfar and Zakelj (2014a, 2014b) and Assenza et al. (2013)).

Original research on expectations formation involved predicting the path of a stochastic process for an asset price (Schmalensee 1976; Smith, Suchanek and Williams 1988). The objective is to elicit subjects' forecasts while presenting them with period-by-period information about the data-generating process. Typical findings from this approach are that forecast errors are biased and persistent, or correlated with other variables. Most of these early experiments, however, did not allow expectations of future outcomes to play any role in determining current outcomes—the so-called “self-referential” feature that is essential in modern macroeconomic models.

Starting with the innovative work by Marimon and Sunder (1993, 1994), the literature on expectations formation has incorporated the self-referential feature, letting subjects' expectations—usually in the form of their combined forecasts—feed directly into the experimental outcomes. This literature has yielded a variety of useful insights for monetary policy, to which we now turn.

Hommes et al. (2007) study forecasting behaviour in a supply-and-demand cobweb model. In their experiment, subjects predict market-equilibrium prices without knowledge of the process by which they are determined, relying mostly on past observations. Remarkably, the subjects' forecasts are correct, on average, although with a higher variance than predicted by the model. The work of Hommes et al. illustrates how individuals, given

◀ *Empirical evidence regarding the formation of inflation expectations is sparse, so researchers have applied experimental economics to help fill this important gap*

⁷ Bosch-Domènech and Silvestre (1997); Lian and Plott (1998); Fenig, Mileva and Petersen (2013); Petersen (2014).

⁸ Cunningham, Desroches and Santor (2010) take stock of work on inflation expectations.

sufficient time and a stationary environment, can learn to make fairly accurate forecasts, even without knowledge of the underlying economic structure.⁹

Adam (2007) conducts an experiment based on a standard two-equation New Keynesian model, asking participants to forecast inflation and output. Like Hommes et al., Adam finds that, over time, participants learn a reasonably efficient forecasting rule. Importantly, he finds that this forecasting rule differs from the “correct” econometric forecast specification, giving rise to unduly persistent movements in inflation and output. This example demonstrates that, among the key determinants of macroeconomic fluctuations—such as people’s preferences, firms’ technologies, resources and information—expectations are also important.

Aside from being a factor in macroeconomic outcomes, what makes expectations a focal point of monetary policy? In forming expectations, households and firms are not likely to blindly extrapolate their past experience into the future, behaving entirely in a backward-looking fashion. Rather, they combine past experience with their understanding of the economy to form a more accurate outlook for the economy, thus forming *forward-looking* expectations. An important element in forming such an outlook is the ability of individuals to anticipate future monetary policy actions and their effect on the economy. For example, when buying a house, a household takes into account the cost of a mortgage, which, in turn, depends on the future path of interest rates. Therefore, monetary policy that is predictable and transparent can affect economic decisions through expectations.¹⁰

Staff at the Bank of Canada have used experimental macroeconomics to shed light on important questions regarding the design of the monetary policy framework. One ongoing issue is the efficacy of price-level targeting relative to inflation targeting. For price-level targeting to deliver its noted benefits, private agents need to understand how price-level targeting works, believe the regime is stable and then incorporate these perceptions into their inflation expectations. In fact, if these conditions are not satisfied, price-level targeting may deliver results that are inferior to inflation targeting.¹¹

Since evidence regarding the formation of inflation expectations under price-level targeting is sparse, Amano, Engle-Warnick and Shukayev (2011) study, in an experimental laboratory, whether inflation expectations adjust in a manner that is consistent with price-level targeting. Their results indicate that inflation-forecasting behaviour changes across inflation-targeting and price-level-targeting regimes. In particular, in forming their inflation forecasts, subjects appear to shift from relying on the inflation target under inflation targeting to assuming that the price level will revert to its target under price-level targeting. Although this shift in expectations is in the right direction, subjects do not forecast optimally under price-level targeting, relying only partially on the target-reverting nature of the price level to generate their inflation forecasts.

◀ *Staff at the Bank of Canada have used experimental macroeconomics to shed light on important questions regarding the design of the monetary policy framework*

⁹ One branch of macroeconomic literature examines how individuals, given time and a stationary environment, can learn the correct econometric forecast specification. See Evans and Honkapohja (2001).

¹⁰ Woodford (2003) and Galí (2011) provide extensive reviews of theories of monetary policy and its interaction with economic expectations.

¹¹ See, for example, Kryvtsov, Shukayev and Ueberfeldt (2008).

This evidence suggests that, all else being equal, the benefits of price-level targeting would not be fully realized if a central bank implemented a price-level-targeting regime. It should be noted, however, that the shift to price-level targeting was explained only once to subjects in the experiments. In the real world, a central bank would likely undertake an ongoing communication strategy to explain and remind the public about the implications of price-level targeting, thereby helping agents to more accurately adjust their expectations in such a regime.

The work by Amano, Engle-Warnick and Shukayev (2011) points out that the extent to which expectations are forward-looking provides central bankers with an additional lever that can be used to keep inflation on target and stable. Yet, the work by Hommes et al. (2007) and Adam (2007) provides experimental evidence that, in forming expectations, individuals tend to rely on history without having an understanding of the future course of the economy or monetary policy; i.e., they form backward-looking expectations. So what is the relative importance of the forward- and the backward-looking components in expectations? And, given their relative importance, how much macroeconomic stabilization can be achieved by monetary policy through its influence on expectations?

Kryvtsov and Petersen (2013) design an experiment to answer these two questions. Unlike most previous experimental researchers, they provide subjects with detailed information about the data-generating model, including linkages between inflation, output and the interest rate; the monetary policy rule; the nature of the exogenous shock; and the full history of inflation, output and the interest rate. In each period, subjects observe the state of the economy and nominal interest rate, and then provide their forecasts for inflation and output in the next period, which are, in turn, used to calculate current inflation and output. The novelty of the Kryvtsov and Petersen set-up is that it allows them to estimate the extent to which expectations rely only on history (are backward-looking), as opposed to being driven by anticipation of future policy actions (forward-looking).

Kryvtsov and Petersen find that subjects' expectations contain a significant backward-looking component, attributing approximately half of the weight to history and the remaining half to anticipations of future monetary policy responses. The authors estimate that, without the forward-looking component of expectations, volatility in inflation and output would be twice as large as when the forward-looking component is present. Therefore, despite the sizable backward-looking component in expectations, monetary policy is found to be very potent in stabilizing inflation and output through its effect on the forward-looking portion of subjects' inflation expectations.

Experimental macroeconomics can also help to develop and refine our understanding of central bank communication. Engle-Warnick and Turdaliev (2010) conduct an experiment in which subjects play the role of central bankers by choosing the level of the nominal interest rate to stabilize fluctuations in inflation and output. They find that, despite limited knowledge of the underlying model or prior experience as central bankers, subjects made interest rate decisions that kept the economy stable. Thus, the basic principles of monetary policy may come naturally to the public and, therefore, may not be difficult to communicate.¹²

◀ *Despite the sizable backward-looking component in expectations, monetary policy is found to be very potent in stabilizing inflation and output through its effect on the forward-looking portion of subjects' inflation expectations*

¹² Carvalho and Nechio (2014) use data from the Thomson Reuters/University of Michigan Surveys of Consumers to show that some households are aware of the basic principles of monetary policy when forming their expectations about interest rates, inflation and unemployment.

Low interest rates in the post-crisis world have led central banks to expand their set of policy tools. For example, communication of future monetary policy, or forward guidance, has become more frequent (Carney 2012). In ongoing work, Arifovic and Petersen (2014) use experiments to study the effects of central bank communication at the zero lower bound. They find that forward guidance is more effective in shortening the duration of the zero lower bound than communicating only the inflation target. Kryvtsov and Petersen (2013) also explore the idea of providing the public with a central bank's conditional projection of future nominal interest rates. They observe that subjects initially coordinate their expectations with the central bank's announced future path of the interest rate. Over the duration of the experiment, however, if central bank interest rate projections are not consistently aligned with realized interest rates, subjects reduce the weight they place on subsequent central bank announcements. This result adds to the debate about whether a central bank should publish its forecast for future policy rates, as discussed in Svensson (2006).

Conclusion

The experimental macroeconomics literature, although relatively new, has provided useful insights into questions close to the hearts of macroeconomists and central bankers. The experimental approach has a clear niche in providing evidence on economic phenomena that cannot be observed directly or that are difficult to measure. Regarding monetary policy, initial experimental work has shed light on a number of important issues. Evidence suggests, for example, that it may be difficult to fully exploit the gains associated with a price-level-targeting regime relative to an inflation-targeting one. Moreover, research at the Bank of Canada that attempts to garner a better understanding of the formation of inflation expectations has found that the backward-looking component of expectations is not trivial, which has important implications for the conduct of monetary policy. Finally, it is not certain from recent work using experimental macroeconomics that more information about a central bank's actions and intentions is always beneficial.

◀ *The experimental approach has a clear niche in providing evidence on economic phenomena that cannot be observed directly or that are difficult to measure*

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Should Forward Guidance Be Backward-Looking?

Rhys Mendes and Stephen Murchison, Canadian Economic Analysis

- Constrained by the zero lower bound, several central banks have employed unconventional tools for lowering long-term interest rates and stimulating demand, including forward guidance with respect to the future level of short-term interest rates.
- In some cases, this guidance has included a threshold that must be met before short-term interest rates would be permitted to rise.
- As shown in model simulation results for Canada, forward guidance that is conditional on achieving a price-level threshold can theoretically boost demand and raise inflation expectations by significantly more than unemployment thresholds. This superior performance is attributable to the fact that the price-level threshold has a backward-looking or history-dependent element, since it depends on past inflation outcomes.
- In practice, history-dependent thresholds might, however, be more challenging for central banks to communicate and may be viewed as less credible by the public.

Faced with persistently weak demand and policy interest rates at or close to the zero lower bound (ZLB), central banks in several countries have been forced to explore unconventional tools for stimulating demand and avoiding deflation. These tools can be broadly classified into two categories: those that work primarily through private agents' expectations of the future level of the policy rate, such as forward guidance, and those that involve direct asset purchases by the central bank. This article explores the design and efficacy of forward guidance implemented through state-contingent thresholds, i.e., thresholds that are dependent on economic conditions.¹ Specifically, we use the Bank of Canada's projection and policy-analysis model, ToTEM (Terms-of-Trade Economic Model²), to compare the benefits of thresholds that incorporate history dependence, such as temporary targets for the

¹ For assessments of the effectiveness of forward guidance during the crisis and its aftermath, see Bernanke (2012), Swanson and Williams (2013), and Filardo and Hofmann (2014).

² See Dorich et al. (2013) and Murchison and Rennison (2006) for a description of ToTEM.

price level, with thresholds that are not history dependent, such as the unemployment threshold recently used by the U.S. Federal Reserve and the Bank of England.³

In normal times, central banks adjust their policy instrument, typically a very short-term interest rate, to achieve their objective (such as price stability or full employment). For example, the Bank of Canada adjusts its target for the overnight interest rate to maintain projected year-over-year consumer price inflation at the 2 per cent midpoint of the Bank's target range of 1 to 3 per cent.

If there is a sufficiently large negative shock, however, such as that experienced by many countries following the 2007–09 global financial crisis, the ZLB on interest rates may become a binding constraint for central banks. In other words, to achieve the central bank's policy objective, the appropriate level of the policy rate may be negative. Nevertheless, central banks may still be able to reduce *long-term* interest rates by issuing forward guidance that lowers market expectations of the future path of the policy rate. The perceived stimulative effect of guidance may cause expected inflation to rise, further reducing both short- and long-term rates in real, or inflation-adjusted, terms. Forward guidance can also decrease the level of uncertainty regarding the future path of the policy rate, which may boost household and business spending.

The Evolution of Forward Guidance

The challenge for a central bank is to find a simple and easy-to-understand way of conveying the most likely path of the policy rate (or how long it is expected to remain at its current level), and the degree of conditionality of that path on the state of the economy. Carney (2013) points out that one can view threshold-based guidance as the culmination of an evolutionary process in which guidance has become increasingly explicit and state contingent over time. In general, extraordinary guidance can be categorized as belonging to one of three generations: qualitative, time contingent and state contingent.⁴ The Bank of Japan pioneered qualitative guidance at the ZLB in 1999 when it indicated that rates would stay at zero until “deflationary concerns” were “dispelled” (Fujiki and Shiratsuka 2002). The Bank of Canada's conditional commitment in April 2009 heralded the second generation of guidance,⁵ while the unemployment thresholds used by the Federal Reserve and the Bank of England belong to the third generation.

All types of guidance at the ZLB aim to provide additional stimulus through one or both of the following channels: an increased period of time at the ZLB and reduced uncertainty about the path of short-term interest rates. Guidance has the potential to shift the perceived distribution of future short-term interest rates, such that the most likely outcome involves interest rates staying at the ZLB for longer than markets would have otherwise anticipated. All else being equal, this lowers the expected path of short-term rates, thereby lowering long-term rates.

◀ *Extraordinary guidance can be categorized as belonging to one of three generations: qualitative, time contingent and state contingent*

³ The price-level threshold is history dependent because the entire history of inflation influences the price level. Thus, reacting to the price level is akin to reacting to past inflation rates. The definition of history dependence is discussed in greater detail later in the article.

⁴ See Carney (2013) for examples of the different types of guidance.

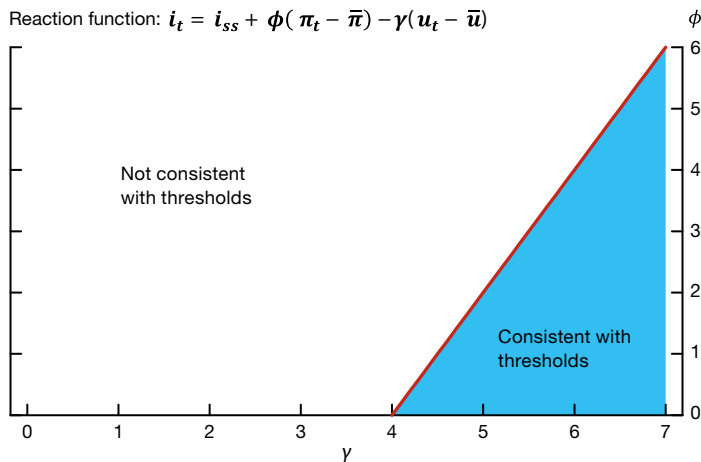
⁵ While often described as “time contingent,” all second-generation guidance involved some degree of explicit or implicit conditionality. In particular, the Bank of Canada's commitment was conditional on the outlook for inflation.

Reduced uncertainty regarding future monetary policy can also lower the expected path of short rates. One can think of this uncertainty as reflecting a combination of uncertainty about which economic variables influence the central bank’s monetary policy decisions (i.e., which variables enter the reaction function), uncertainty about the future evolution of those variables, as well as uncertainty about the weights assigned to each variable by the central bank. At the ZLB, uncertainty about interest rates is asymmetric—short-term interest rates can rise, but they cannot fall. As a result, the mean or expected path of short rates will tend 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 ZLB for an extended period, the expected path of short rates will typically lie above the ZLB over at least some of that period. This is important because long-term interest rates should depend on the expected (mean) path of short rates. By reducing uncertainty about the conditions under which the policy rate may rise, guidance can reduce the perceived probability of rate increases. This can lower the expected path of short rates for any given modal, or most likely, period of time at the ZLB.

For example, in December 2012, the Federal Reserve committed to keep rates at the lower bound at least until the unemployment rate fell below 6.5 per cent, unless projected inflation rose above 2.5 per cent. These conditions rule out the possibility that rates could rise with unemployment above 6.5 per cent and projected inflation below 2.5 per cent. The shaded region in **Chart 1** shows the coefficient values in a simple Taylor-type reaction function that would be consistent with the thresholds. In essence, in this illustrative example, the Fed told the private sector that the probability of the more hawkish reaction functions outside the shaded region was zero, which eliminated some uncertainty for private agents, permitting a more accurate assessment of the future path of interest rates.

State-contingent thresholds can also reveal important information about the economic variables that enter the central bank’s reaction function, which in turn helps markets to better understand the precise nature of the conditionality of forward guidance. Using the Federal Reserve’s unemployment

Chart 1: Taylor-type reaction function parameters consistent with thresholds for unemployment and inflation



Notes: The Taylor-type reaction function sets the nominal policy rate (i_t) as a function of its steady-state value (i_{ss}), the deviation of inflation from target ($\pi_t - \bar{\pi}$), and the deviation of the unemployment rate from its long-run value ($u_t - \bar{u}$). For illustrative purposes, we set $i_{ss} = 4$, $\bar{\pi} = 2$ and $\bar{u} = 5.5$. The thresholds convey information about the response coefficients, ϕ and γ .

threshold as an example, it is clear that any new data suggesting a longer period of time before the 6.5 per cent threshold is reached would automatically mean the policy rate would remain at the ZLB for longer. This is true not only because it will take longer to reach the threshold, but also because the level of rates will likely remain lower than they would have otherwise during the subsequent period in which rates are increasing. Thus, long-term interest rates will respond to news in a manner consistent with achieving the threshold, while the threshold itself remains unchanged. If the central bank publishes (and regularly updates) a projection for the unemployment rate, the market will have direct insight into how much longer the central bank believes the policy rate will have to remain at the lower bound. Importantly, the private sector can also come to its own assessment of when the threshold will be attained. If the private sector can forecast the unemployment rate more accurately than the central bank, it will also forecast more accurately the length of time that rates remain at the ZLB.

Analyzing Alternative Thresholds

To analyze the properties of alternative types of thresholds, we use the Bank of Canada's main macroeconomic model, ToTEM, to simulate a large and persistent negative demand shock.⁶ We assume that the central bank seeks to minimize the squared deviations of inflation from target and output from potential. This determines the optimal date for when interest rates should begin to increase—the “lift-off” date, conditional on returning to inflation targeting afterward.

We focus on the properties of two types of threshold (summarized in **Appendix 1** on page 22):

- (i) price-level path: closing the gap between the price level and a threshold path
- (ii) unemployment: closing the gap between the unemployment rate and a threshold level subject to an inflation knockout

Although both threshold types can be designed to implement the optimal lift-off date in the absence of additional shocks, there are important differences between them. In particular, they differ in terms of their degree of history dependence, which is a key determinant of their performance in the face of any future shocks that occur between when the threshold is adopted and when it is triggered.

History-dependent monetary policy has received a lot of attention over the past decade, from both academics and policy-makers, and represents an important potential mechanism for influencing private sector expectations. History dependence simply means that, in addition to current and expected future economic conditions, monetary policy responds to “past conditions even when they are no longer relevant to the determination of the current and future evolution of the variables that the [central] bank cares about” (Woodford 2003, 21). Policy will continue to respond to shocks, even after their impact on inflation and/or the output gap has fully dissipated. For example, if a shock initially causes inflation to fall below its targeted level, policy will continue to maintain interest rates below their neutral level until inflation moves above the target. Monetary policy essentially causes inflation to eventually overshoot the target when it is initially below target. This leads

◀ *History dependence simply means that, in addition to current and expected future economic conditions, monetary policy responds to past conditions*

⁶ Simulating state-contingent threshold policies at the zero lower bound in a large model such as ToTEM is both technically and computationally demanding. We are very grateful to Nicholas Labelle St-Pierre for providing invaluable assistance in running these simulations.

to higher inflation expectations in the face of larger or more persistent shocks, thus reducing real interest rates and stimulating the economy. The key insight from Woodford (2003) and others has been that, under certain circumstances, the benefits of stabilizing the economy following a shock are greater than the destabilizing effects associated with the eventual inflation overshoot. For an inflation-targeting central bank whose policy rate is already at the ZLB, the temporary adoption of a history-dependent policy would generally result in rates remaining lower for a longer period of time, since it would signal a willingness to accept such an inflation overshoot in the future.

But the performance of a history-dependent policy depends on it being credible and well understood by the public. In reality, history dependence may be less effective if private sector expectations are not fully forward-looking. Estimates for Canada from ToTEM suggest that about half of price-setting firms are not forward-looking, but rather update their prices through time using a simple rule of thumb based on past inflation and the inflation target. Consequently, our simulation results allow for a significant deviation from the ideal fully forward-looking environment.

Price-level and nominal GDP targeting are two important examples of history-dependent monetary policy, since both involve targeting a level rather than a growth rate (such as inflation). Research on the efficacy of price-level targeting as a permanent regime change (including an extensive body of work at the Bank of Canada (2011)), suggests small welfare gains relative to inflation targeting, even when the policy is well understood and credible. In addition, significant uncertainties are associated with how private sector expectations are formed, whether they would adjust to the new regime in the manner predicted by theory, and whether the regime would be considered credible over time.

These considerations may help to explain why no country since Sweden in the 1930s has adopted a price-level or nominal GDP target.⁷ However, the cost-benefit analysis may change when considering a temporary, rather than a permanent, switch, particularly at a time when the ZLB is binding. The stabilization benefits of history-dependent forward guidance, if successful, would be much higher at the ZLB precisely because the policy rate cannot be reduced to the level consistent with achieving the central bank's policy objective in a timely manner. For this reason, the hypothetical discussion of various forms of forward guidance that follows focuses on temporary policy measures when constrained at the ZLB.

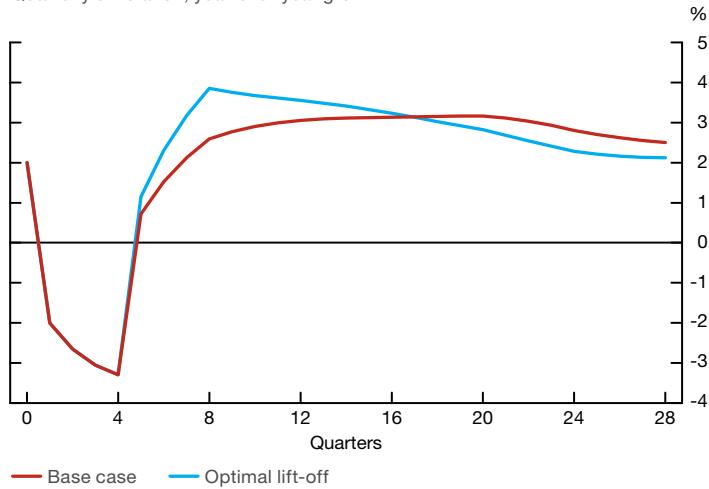
In our simulations, a large negative demand shock hits the economy in period 0. In the base case, we use a simple rule that sets the policy rate as a function of its own lag, expected inflation and the output gap.⁸ This simple rule causes the policy rate to remain at the ZLB for 12 quarters, in the absence of additional shocks. In contrast, if the lift-off date is chosen to minimize the sum of squared deviations of inflation from target and output from potential, then the policy rate remains at the ZLB for 20 quarters. With the policy that implements the optimal lift-off date, the recovery in real GDP growth is faster and stronger than in the base case (Chart 2). Similarly, CPI inflation takes almost five years to reach 2 per cent in the base case, compared with just over two years with the optimal lift-off policy (Chart 3).

⁷ For a discussion of the Swedish experience with price-level targeting, see Berg and Jonung (1999).

⁸ The simple rule exhibits a degree of history dependence because of the weight on lagged inflation. This rule is also used after the lift-off date in the simulations with thresholds.

Chart 2: Real GDP growth after a large negative demand shock

Quarterly simulation, year-over-year growth

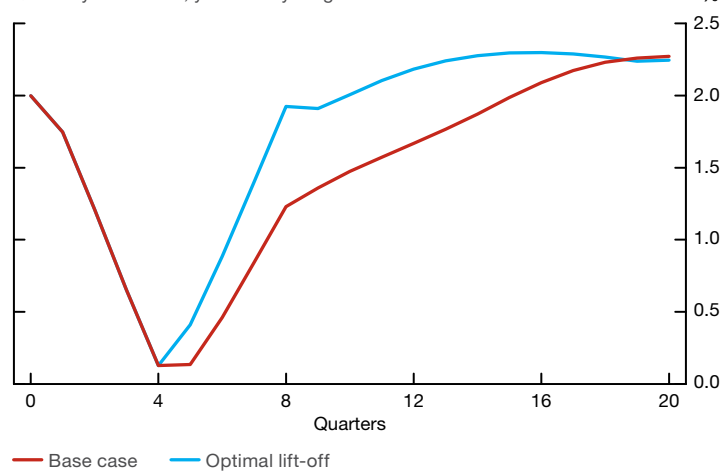


Note: GDP trend growth is assumed to be 2 per cent.

Source: Bank of Canada simulation

Chart 3: CPI inflation after a large negative demand shock

Quarterly simulation, year-over-year growth



Source: Bank of Canada simulation

We choose the parameters of the price-level and unemployment thresholds such that they are both initially consistent with the optimal lift-off date. Thus, if there are no further shocks after period 0, the two types of threshold imply identical economic outcomes. However, under the more realistic assumption that the economy is buffeted by shocks every period, the choice of threshold variable will influence how the lift-off changes in response to shocks. As we explain in greater detail below, the choice of threshold variable is important because different variables imply different degrees of history dependence in response to shocks that occur after the threshold is established.

Price-level-path threshold

A price-level-path threshold is essentially a temporary price-level target with drift. The central bank would commit to keep the policy rate at the ZLB at least until the gap between the actual level of CPI and an exponentially growing threshold path was closed. In practice, this would be

communicated by stating the current gap relative to the threshold along with the growth rate of the threshold. The growth rate of the threshold would typically be the target inflation rate. The choice of the initial gap is less straightforward. While it may seem natural to choose the initial gap as the deviation of the price level from some statistical trend, this will not generally be optimal. For example, if price shocks prevent weak demand from being fully reflected in the price level, it may be optimal to set the threshold above the statistical trend. However, if backward-looking private sector behaviour is important, it may be optimal to make up only part of the shortfall of the price level relative to the pre-shock statistical trend.⁹ In our simulations, the latter consideration causes the threshold path to be 1.2 per cent below the steady-state price-level path that prevailed before the initial shock.

In the hypothetical demand shock scenario, the key elements of the price-level-path threshold policy are the following:

- The threshold is initially set 0.6 per cent above the actual level of the CPI (i.e., the initial price-level gap is -0.6 per cent).
- The threshold grows at the target rate of inflation (2 per cent per year).
- The policy rate is maintained at the ZLB at least until the level of the CPI reaches the threshold.

The price-level-path threshold implied by these elements is shown in **Chart 4**. If no shocks were to hit the economy after the introduction of the threshold, the simulated price-level path would be consistent with the initial optimal lift-off date. The advantage of this approach is that it is clearly history dependent, since inflation by-gones are not by-gones; that is, while the threshold is active, periods of below-target inflation must be subsequently offset by periods of above-target inflation.¹⁰

To illustrate the implications of history dependence, consider a shock that occurs after the threshold is established and causes the size of the price-level gap to increase. The larger gap will signal the need for greater policy stimulus in the future (relative to that originally announced) in order to make up for the shortfall in inflation. As with a conventional, non-history-dependent inflation target, some additional stimulus will be needed to return inflation to target. However, in order to close the price-level gap, inflation would have to overshoot the target. Achieving this overshooting will require the central bank to provide even more stimulus than is needed to simply return inflation to target.

In order to quantify the implications of history dependence, we allow for the possibility of additional random shocks after the threshold is established.¹¹ This is intended to capture key features of the real world, including the fact that additional shocks may cause the threshold to be breached sooner or

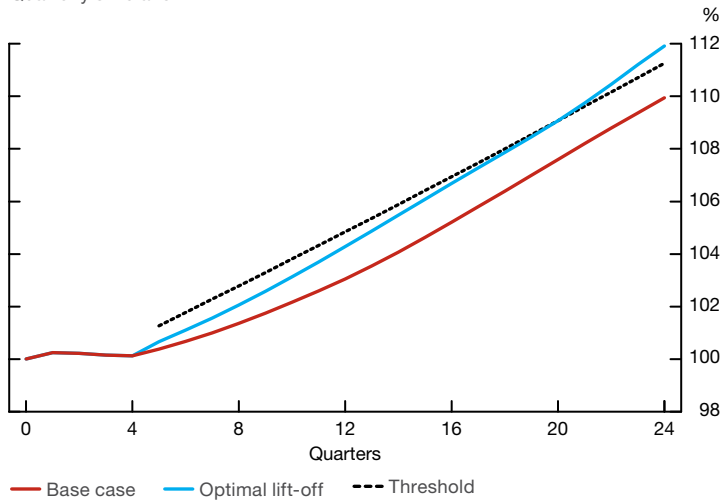
⁹ Backward-looking behaviour necessitates a longer period of excess demand (output greater than potential) in order to close a given price-level gap. Since we assume that the squared deviations of output from potential enter the central bank's loss function, greater backward-looking behaviour raises the costs associated with closing a given price-level gap.

¹⁰ History dependence is not an all-or-nothing proposition. Since the price level reflects the cumulative effects of all past inflation, the price-level threshold discussed above would make monetary policy contingent upon the average of all past inflation. However, a threshold could be based on, say, a three- or five-year average of inflation—longer than a conventional inflation target but shorter than the infinite window implied by the price-level threshold. Such average inflation thresholds would imply an intermediate degree of history dependence. Another alternative involves thresholds that keep rates at the lower bound at least until the price level (or the level of nominal GDP) reaches some time-invariant threshold level.

¹¹ For each period, we randomly draw a set of shocks from the distribution of historical shocks to the Canadian economy implied by ToTEM.

Chart 4: Price-level-path threshold and the consumer price index

Quarterly simulation



Source: Bank of Canada simulation

Table 1: Average losses following additional shocks (relative to base case)

Threshold	Variance of output gap	Variance of inflation	Loss function
Price-level path	0.80	0.68	0.78
Unemployment	0.92	0.89	0.92

Notes: Values less than 1 reflect variances or losses that are lower than in the base case. The loss function is defined as the sum of the variance of the output gap and the variance of inflation. All variables are relative to their respective base-case values. As a consequence, although the loss function is the sum of the absolute variances, the relative variances in the table do not sum to the relative loss.

later than the initial optimal lift-off date. In this stochastic simulation, the high degree of history dependence causes the price-level-path threshold to yield the lowest expected loss (Table 1).

Nevertheless, a price-level-path threshold may entail significant communication challenges. The price level may be an unfamiliar concept to many, since most people are accustomed to thinking in terms of inflation. The fact that the threshold for the price level is a moving target adds an additional layer of complexity. Experimental economics provides one avenue for exploring the importance of these issues. While the Bank has not conducted experimental work on forward guidance, the results reported in Amano, Kryvtsov and Petersen (this issue) indicate that people do, to some extent, understand the difference between inflation targeting and price-level targeting as permanent regimes. This suggests that it may be possible to effectively communicate a temporary price-level-path threshold, though further work would be required to confirm this.

Unemployment threshold

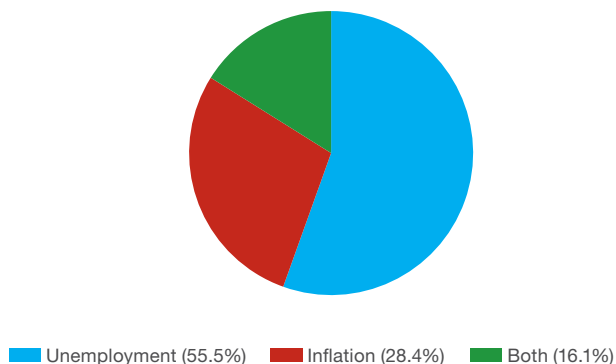
Both the Federal Reserve and the Bank of England have used thresholds for the unemployment rate together with an upper limit for expected inflation. In the context of our hypothetical scenario, the key elements of an unemployment threshold are the following:

- An unemployment threshold of 6.5 per cent.
- The policy rate remains at the ZLB at least until the unemployment rate declines to the threshold level, provided that the rate of inflation one to two years ahead is projected to be no more than 1 percentage point above target.
- If projected inflation rises more than 1 percentage point above target, it is assumed to knock out the threshold policy.

The 6.5 per cent unemployment threshold implements the initial optimal lift-off date in the absence of shocks after the threshold is established. This type of threshold can be breached if either or both of the unemployment and inflation conditions are violated. Our stochastic simulation results suggest that close to three quarters of all breaches would occur with the unemployment rate falling below its threshold level (Chart 5). Thus, in most cases, the unemployment threshold succeeds in fostering a recovery without causing inflation expectations to rise above the threshold level, resulting in the unemployment threshold outperforming the base-case rule (Table 1). However, this type of threshold is not history dependent. If inflation turns out to be weaker than projected by the central bank at the time the threshold was announced, there is no impetus for the central bank to offset this weaker inflation with higher inflation in the future. The unemployment threshold therefore underperforms the highly history-dependent price-level-path-threshold when faced with shocks.

Nevertheless, an unemployment threshold has several attractive features. This type of policy places an absolute limit on the level of projected inflation that could be obtained without a policy response and is therefore stricter than the price-level-path threshold in this respect. Moreover, it is based on variables—inflation and unemployment—that are familiar to the public, and thus avoids the need to communicate potentially confusing concepts such as a time-varying price-level threshold.

Chart 5: Causes of threshold breaches in the simulation of an unemployment threshold



Conclusion

Simulation results presented in this article suggest that there may be material economic benefits to incorporating explicit history dependence when designing forward guidance at the ZLB in general and when employing state-dependent thresholds more specifically. Indeed, the two

thresholds considered in this article differ mainly in terms of the degree of history dependence they impose on monetary policy during the period in which the threshold is in effect.

However, there are several ways in which the simulation results may overstate the relative benefits of history-dependent thresholds. In reality, the price-level and unemployment thresholds would differ in terms of their ease of communication. One of the key assumptions underlying the model results is that agents in the economy understand the threshold and what it implies for the path of the policy rate under different economic conditions. One of the appealing aspects of the thresholds used by the Federal Reserve and the Bank of England relative to the price-level-path threshold is that they are stated in terms of a variable most people are familiar with and can relate to—unemployment—and they are easy to understand and remember.

A second way in which our results may exaggerate the benefits of history-dependent thresholds is what is known as the dynamic inconsistency problem. In the model simulations, commitments to future policy actions are fully credible insofar as agents base their own behaviour on a belief that the central bank will keep its promises. In reality, a central bank that normally targets inflation would have an incentive to eventually renege on any promise that involves inflation overshooting the target at some future date. In other words, to minimize its loss function, a central bank would be better off by initially committing to an inflation overshoot in the future in order to realize the near-term benefits of stronger demand and inflation, and then reneging on that commitment once the economy has strengthened and inflation has returned to the level that the central bank normally targets.

Another potential problem with history-dependent thresholds is, in essence, the opposite of the dynamic inconsistency problem. Once it fulfills its commitment to cause inflation to overshoot the target, the central bank may find it difficult (or undesirable) to bring inflation back down to its target if expectations become unanchored and rise with actual inflation.

The benefits of history dependence, and forward guidance more generally, depend importantly on forward-looking private sector expectations and how future actions by the central bank affect economic behaviour today. A related issue is the extent to which private sector expectations regarding the evolution of the economy, even if forward looking, align with those of the central bank. For instance, the central bank may regard its choice of the level of a threshold, such as an unemployment threshold of 6.5 per cent, as implying a different lift-off date than the private sector would. In such an instance, the announcement of this threshold may have a smaller impact on the level of long-term interest rates, not because forward guidance is ineffective or not credible, but simply because the economic forecasts of the central bank and those of the private sector differ.

These considerations suggest that the results of model-based simulations, such as those discussed in this article, should be regarded as best-case scenarios. However, two points from the article merit repeating. First, expectations in ToTEM represent a mixture of purely forward-looking, rational expectations and simple rules of thumb, and the relative weight on each has been econometrically estimated using Canadian data. Second, these results omit any benefits associated with reduced uncertainty regarding the future path of the policy rate.

◀ *The benefits of history dependence, and forward guidance more generally, depend importantly on forward-looking private sector expectations and how future actions by the central bank affect economic behaviour today*

Appendix 1

Summary of Types of Threshold

Type	Threshold	History dependence	Pros	Cons
Price-level path	CPI gap ≥ 0 where gaps are defined relative to a trend that grows at a constant rate	<ul style="list-style-type: none"> Fully history dependent Initial gap chosen to account for any past shortfall in inflation Gap automatically adjusts to make up for any additional shortfalls if inflation turns out weaker than originally projected 	<ul style="list-style-type: none"> The most history-dependent option Limits average rate of inflation 	<ul style="list-style-type: none"> May require optimistic assumptions regarding initial gap in order to implement optimal lift-off policy The return to a desired price-level path may be more difficult for the general public to understand than an unemployment threshold
Unemployment	Unemployment \leq threshold with an upper-limit (knockout) condition on inflation: inflation projection $>$ knockout	<ul style="list-style-type: none"> Not history dependent But automatically makes up shortfalls in real growth (in order to hit unemployment threshold) Does not make up inflation shortfalls; equivalent to inflation targeting 	<ul style="list-style-type: none"> Based on familiar variables, therefore simplest to communicate Places absolute limit on level of inflation 	<ul style="list-style-type: none"> Not history dependent

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Spillover Effects of Quantitative Easing on Emerging-Market Economies

Robert Lavigne, Subrata Sarker and Garima Vasishtha, International Economic Analysis

- The effects on emerging-market economies (EMEs) of unconventional monetary policies implemented by some advanced economies have been a focus of debate among academics and policy-makers.
- The available evidence suggests that quantitative easing (QE) likely increased capital flows to EMEs and put somewhat unwelcome upward pressure on asset prices and exchange rates. However, the overall impact of QE on EMEs was likely positive because of the beneficial trade and confidence effects stemming from stronger economic activity in the countries adopting QE.
- There could be episodes of volatility in global financial markets when advanced economies begin to normalize monetary policy. For EMEs, the best defence against capital-flow volatility, and the potential financial and economic instability that could ensue, is likely to be further improving their macroeconomic and financial policy frameworks as well as developing their financial sectors so that they can intermediate capital flows in a stable and efficient manner.
- For central banks in advanced economies, clear and effective communication strategies will play a crucial role in promoting stability as they begin to normalize their monetary policies in line with the strengthening recovery.

The introduction of unconventional monetary policies (UMPs) and the eventual exit from these policies by some advanced economies have sparked a vigorous, ongoing debate among policy-makers and academics about the spillover effects of these policies on emerging-market economies (EMEs).¹ This article reviews the debate and assesses the evidence of spillovers from quantitative easing (QE), which, in this context, are the overall external

¹ Although UMPs include quantitative easing (QE), forward guidance, and credit and liquidity facilities, in this article we focus on the Federal Reserve's large-scale asset purchase programs that were introduced in 2010 and 2012. These programs are often referred to as QE2 and QE3, respectively. We do not consider the unconventional measures undertaken in other advanced economies, such as Japan, the euro area and the United Kingdom.

effects of QE, including real and financial impacts. However, this article pays particular attention to capital flows, since they are the vehicle through which cross-border financial effects are transmitted.

Some policy-makers in emerging markets have argued that the U.S. Federal Reserve's large-scale asset purchase (LSAP) programs, otherwise known as QE, may have fostered undue risk taking and larger-than-normal capital inflows to EMEs, contributing to excessively loose financial conditions in these countries.² Some emerging-market policy-makers also complained about the upward pressure on exchange rates and loss in competitiveness resulting from QE policies. Moreover, they have been concerned about the risk of a disruptive capital withdrawal from EMEs once the process of monetary policy normalization in advanced economies commences.

Reflecting these concerns, the Group of 20 has put QE spillovers on its policy agenda (G-20 2013), with some members advocating a greater internalization of global spillover effects in the Federal Reserve's monetary policy decisions (Rajan 2014). However, the extent of the surge in capital flows generated by QE remains an open question. At the same time, some observers have argued that the overall impact of QE on EMEs may not be very different from that of conventional monetary easing and thus does not deserve special consideration. Moreover, there are positive effects on EMEs from QE policies, such as stronger emerging-market exports (Bernanke 2013). While acknowledging that talk of tapering the QE program triggered some short-lived financial market volatility in the summer of 2013, some proponents of this view argue that underlying vulnerabilities in certain EMEs were at the core of the problem (see Murray (2013), for example).

This article first describes the different channels through which QE can affect capital flows, asset prices, interest rates, financial market conditions and economic activity in EMEs.³ It then briefly summarizes the recent literature on QE spillovers, including possible "spillbacks" from emerging markets to advanced economies. The following findings are supported by the literature:

- QE has likely increased capital flows to EMEs, but these were also supported by the relatively strong fundamentals in emerging markets.
- The overall impact of QE on EMEs was likely positive because of the beneficial trade and confidence effects stemming from stronger economic activity in the countries adopting QE, which then spilled over to the rest of the world.
- Talk about potential tapering in May and June 2013 had a disruptive impact on capital flows to EMEs;⁴ however, after the initial impact subsided, there is some evidence that markets discriminated among countries according to fundamentals.

² EMEs differ significantly in terms of both exchange rate regime and capital account openness. In this article, we refer mostly to EMEs with relatively flexible exchange rate regimes and at least partially open capital accounts. EMEs that have a fixed exchange rate regime and a closed capital account, such as China, are not included in our sample.

³ QE spillovers are not limited to EMEs. In principle, similar cross-border effects will operate in advanced economies as well. But owing to institutional features as well as financial market imperfections, capital-flow volatility and the consequent economic and financial instability risks have historically been a major concern for EMEs.

⁴ In testimony before the Joint Economic Committee of the U.S. Congress on 22 May 2013, former Federal Reserve Chairman Ben Bernanke first hinted at the possibility of scaling back the LSAPs. For further details, see <http://www.federalreserve.gov/newsevents/testimony/bernanke20130522a.htm>.

- Given the rising trend toward financial and trade integration, spillovers have likely increased between advanced economies and EMEs, underscoring the importance of communication among central banks to create a shared understanding of their policies and a better discussion of potential impacts.

Quantitative Easing and Spillovers to Emerging-Market Economies: Transmission Channels

QE may affect cross-border capital flows, asset prices and economic activity through several channels that are not mutually exclusive, since some may be at play simultaneously:⁵

- (i) Portfolio-balance channel: QE involves the purchase of longer-duration assets such as government bonds and mortgage-backed securities. These purchases reduce the supply of such assets to private investors, compressing the term premium, which, in turn, increases the demand for all substitute assets, including emerging-market assets, as investors turn to riskier assets in search of higher expected risk-adjusted returns.⁶ Such portfolio rebalancing lowers risk premiums, boosts asset prices and lowers yields in EMEs, effectively easing their financial conditions.
- (ii) Signalling channel: If QE is taken as a commitment by the Federal Reserve to keep future policy rates lower than previously expected, the risk-neutral component of bond yields may decline.⁷ Large interest rate differentials with respect to EMEs will be expected to persist, which, in turn, prompts carry trades and capital flows into EMEs.⁸
- (iii) Exchange rate channel: The portfolio flows discussed above could result in a depreciation of the U.S. dollar. This would act as a drag on U.S. demand for foreign-produced goods and services relative to those produced domestically. Consequently, emerging-market exports could be negatively affected.
- (iv) Trade-flow channel: QE would boost the demand for emerging-market exports, since it supports domestic demand in the United States. This may fully or partially offset the negative effect from the exchange rate channel on emerging-market exports.

The effects of QE on cross-border capital flows work through channels similar to those of conventional monetary policy. More work is required to assess whether unconventional and conventional monetary policies have, at least in principle, similar cross-border effects on asset prices and economic activity. However, the spillover effects of QE may have been amplified by the differences in the macroeconomic and financial conditions of advanced economies and EMEs in the period following the global financial crisis of 2007–09.⁹

◀ *The spillover effects of quantitative easing may have been amplified by the differences in the macroeconomic and financial conditions of advanced and emerging-market economies*

⁵ Fratzscher, Lo Duca and Straub (2013), Chen et al. (2012), Kozicki, Santor and Suchanek (2011), and Santor and Suchanek (2013) provide summaries of the various channels of transmission.

⁶ A number of studies have highlighted this as the central transmission channel through which QE affects cross-border capital flows (Gagnon et al. 2010; D'Amico and King 2010; Hamilton and Wu 2012). In contrast, some have expressed skepticism about the empirical significance of this channel (for example, Cochrane (2011)).

⁷ The risk-neutral component of bond yields is defined as the average level of short-term interest rates over the maturity of the bond. In other words, it is the interest rate that would prevail if all investors were risk neutral. Bauer and Rudebusch (2013b) stress the importance of the signalling channel for Federal Reserve announcements since 2008, and show that this channel was as important as the portfolio-balance channel.

⁸ Federal Reserve actions may also provide new information about the current state of the economy, which in turn can influence asset prices and portfolio decisions by altering the risk appetite of investors.

⁹ Glick and Leduc (2013); IMF (2013b); Moore et al. (2013); Rosa (2012); Wu and Xia (2014).

Empirical Evidence of the Spillovers from Quantitative Easing

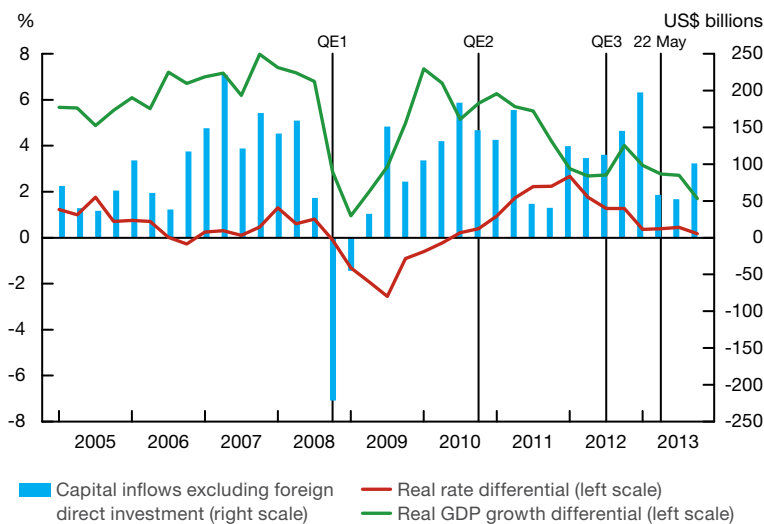
Spillovers during QE episodes

Gross capital inflows (excluding foreign direct investment) to EMEs rose steadily during the years before the crisis, peaking at about \$660 billion in 2007. Inflows turned to outflows during the crisis, reaching \$221 billion in the fourth quarter of 2008; however, they recovered quickly, averaging nearly \$112 billion per quarter in inflows between the second quarter of 2009 and the fourth quarter of 2013. While this recovery took place at the same time as QE was implemented by the Federal Reserve and other advanced economies, several country-specific “pull” factors were also at play during the period. In particular, interest rate and growth differentials supported flows to EMEs in the years following the crisis (Chart 1), when the economic performances of advanced economies and EMEs differed significantly.

Several empirical studies have attempted to distinguish among the various channels through which QE affects EMEs. However, it is difficult to draw clear inferences, since experience with these unconventional measures is very limited. Lim, Mohapatra and Stocker (2014) examine gross financial flows to developing countries between 2000 and 2013, with a particular focus on the potential effects of QE. They find evidence that QE operated through portfolio-balancing, signalling and liquidity

Chart 1: Capital inflows to emerging-market economies, and interest rate and growth differentials

Quarterly data



Notes: Capital inflows include portfolio investments and other investments. The interest rate differential is calculated as the difference between PPP-weighted real interest rates of EMEs and advanced economies. The GDP growth differential is calculated as the difference between PPP-weighted real GDP growth of EMEs and advanced economies (PPP = purchasing-power parity). EMEs include Argentina, Brazil, Bulgaria, Chile, Colombia, Czech Republic, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Peru, the Philippines, Poland, Romania, Russia, South Africa, Thailand, Turkey, Ukraine and Venezuela. Advanced economies include Australia, Canada, France, Germany, Italy, Japan, the United Kingdom and the United States.

Sources: International Monetary Fund and national sources

Last observation: 2013Q4

channels.¹⁰ Episodes of QE were accompanied by increases in inflows to developing countries over and above these observable channels. In a similar vein, Fratzscher, Lo Duca and Straub (2013) find that bond-purchase policies under QE2 triggered some modest portfolio rebalancing across EMEs and the United States. They also find that while the Federal Reserve's policies were enacted to counter the U.S. business cycle, the capital flows that were prompted by these policies were procyclical from an EME perspective. This finding, however, needs to be weighed against the fact that, without QE, EMEs might have experienced weaker demand for their exports.

Other studies, however, do not find any special or exaggerated effects of QE beyond those of conventional easing. Ahmed and Zlate (2013) examine the determinants of net private capital flows to EMEs and find that growth and interest rate differentials, as well as global risk appetite, are important determinants of net private capital inflows. They do not find statistically significant positive effects of QE on net emerging-market inflows, although there seems to be a change in composition toward portfolio inflows. Bowman, Londono and Saprizza (2014) find that the Federal Reserve's UMPs might not have had outsized effects on asset prices in emerging markets once each country's time-varying vulnerability is taken into account. In other words, their evidence suggests that, as an EME's financial or macroeconomic conditions deteriorate, UMPs might have unexpected, and sometimes unwelcome, effects on domestic asset prices. This highlights how correcting obvious vulnerabilities is key to reducing negative spillovers. Finally, there is also little or no evidence of QE having a different spillover effect on the exchange rate than conventional policies. Currency depreciation is simply an inevitable consequence of monetary easing (Santor and Suchanek 2013). Glick and Leduc (2013) show that QE had the "same 'bang' per unit of surprise" on the U.S. dollar as the reduction in policy rates prior to hitting the zero lower bound.

These various studies are, however, silent on whether such spillovers are net positive or negative, since the potentially negative effects of procyclical capital flows, such as asset bubbles, risks of sudden stops or loss of export competitiveness, need to be weighed against the positive effects of QE, such as stronger aggregate demand, improved confidence and more favourable global financial conditions. The net effects of QE have been studied to some extent by the International Monetary Fund (IMF), which finds that the overall impact on EMEs was generally positive (IMF 2013a).¹¹ Positive spillovers from stronger demand in advanced economies, as well as lower costs of capital, cheaper sovereign financing and higher equity prices, outweighed the negative effect of currency appreciation. In this context, the Great Depression of the early 1930s can provide a useful historical comparison. For example, without the appropriate monetary responses in advanced economies to shocks in the 1930s, Latin America suffered large losses in output (IMF 2013c).¹²

Ongoing research at the Bank of Canada evaluates the international spillover effects of LSAPs using a two-country dynamic stochastic general-equilibrium model with portfolio balance effects (Alpanda and Kabaca forthcoming).

◀ *The net effects of quantitative easing on emerging-market economies were generally positive*

¹⁰ Lim, Mohapatra and Stocker (2014) refer to the signalling channel as the confidence channel. The liquidity channel operates primarily through bank lending, which we do not explicitly identify in our measure of capital flows.

¹¹ Estimates of the net effects of QE reported by the IMF (2013a) do not account for potential financial stability risks. Work is under way at the IMF to develop a model that accounts for these risks (IMF 2013b).

¹² This was further aggravated by the adherence to fixed exchange rates, which impeded the needed external adjustment.

When calibrated to the United States and the “rest of the world,” the model suggests that LSAPs can lower both domestic (i.e., U.S.) and foreign long-term yields, and stimulate both domestic and foreign activity, while generating appreciation pressures on the foreigners’ currency. Note, however, that the model does not include EMEs explicitly, but only within the heterogeneous “rest of the world” block, and abstracts from some of the potential positive and negative effects of QE on EMEs mentioned above.

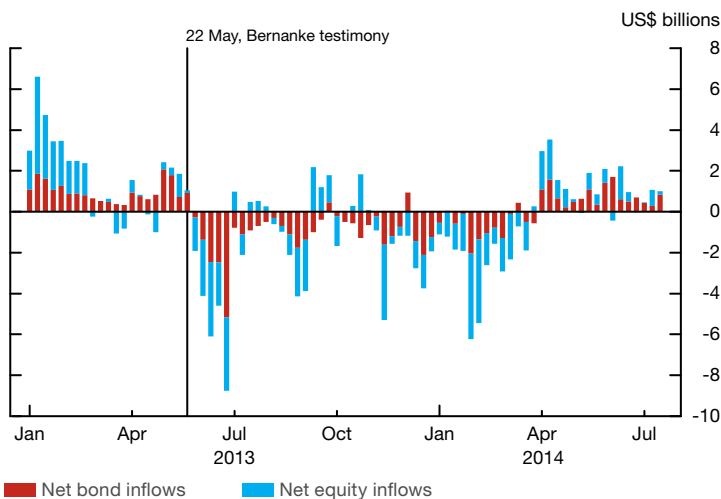
Spillovers after the tapering announcement

The initial hints of tapering by former Chairman Bernanke, on 22 May 2013, surprised market participants, leading them to advance the date at which they expected the Federal Reserve to actually begin tapering and the timing of the eventual increase in the federal funds rate (Bauer and Rudebusch 2013a). These changes in policy expectations likely reduced market participants’ tolerance for risk and triggered a reassessment of the risk-adjusted returns from investing in EMEs. As global long-term interest rates rose abruptly, many EMEs experienced a sharp withdrawal of private capital inflows and increased financial market volatility (Chart 2). However, after an initial widespread withdrawal of capital from EMEs in June and July 2013, capital flows became more differentiated: the size of capital outflows appeared to be related to a country’s macroeconomic fundamentals, reflecting, to some extent, the policies that countries pursued during the years immediately following the global financial crisis.

A few recent studies have analyzed the impact of news about tapering on EMEs, producing disparate results. Mishra et al. (2014) find that countries with stronger fundamentals, deeper financial markets, and a tighter stance toward capital flows and macroprudential policies before tapering

Chart 2: Net portfolio flows to emerging-market economies

Weekly data



Notes: Bond and equity inflows are the sum of the respective inflows to the following countries: Argentina, Brazil, Bulgaria, Chile, Colombia, Czech Republic, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Peru, the Philippines, Poland, Romania, Russia, South Africa, Thailand, Turkey, Ukraine and Venezuela. The database contains weekly portfolio investment (net) flows by equity and bond funds. Although the database represents less than 20 per cent of the market capitalization in equity and bonds for most countries, it is regarded as closely matching portfolio flows in the balance of payments data and is being increasingly used in academic research on capital flows. The vertical line representing Chairman Bernanke’s testimony on 22 May 2013 corresponds to that week on the x-axis.

Source: EPFR Global

Last observation: 16 July 2014

experienced smaller currency depreciations and smaller increases in bond yields. At the same time, however, there was less differentiation in the behaviour of stock prices across EMEs based on fundamentals.

Ongoing research at the Bank of Canada also explores the effects of U.S. monetary policy normalization on EMEs. Using an event-study approach, Rai and Suchanek (forthcoming) examine the effects on financial variables within a two-day window around four key Federal Reserve/Federal Open Market Committee announcement dates related to tapering. Their results suggest that EMEs with strong fundamentals (such as faster growth, smaller current account deficits, lower debt and higher productivity growth) experienced relatively fewer disruptions to capital flows and currency depreciation following the Federal Reserve's communication on tapering. In another study, Dahlhaus and Vasishtha (forthcoming) use a vector autoregressive (VAR) approach to assess the potential effects of the normalization of U.S. monetary policy on portfolio flows to a sample of 23 EMEs. The authors define a "policy normalization shock" as a shock that increases both the yield spread of U.S. long-term bonds and monetary policy expectations, as derived from federal funds futures contracts, while leaving the policy rate per se unchanged. Their results indicate that the impact on portfolio flows (as a share of GDP) of a normalization of U.S. monetary policy is expected to be small.

In a similar vein, Lim, Mohapatra and Stocker (2014) use a VAR model to generate a scenario where unconventional monetary policy normalizes over the course of 2014–16. Simulation results show that, relative to the status quo of no change in QE,¹³ capital flows contract by a modest 0.6 per cent of aggregate GDP in developing countries by the end of 2016, regardless of the pace of monetary policy normalization.¹⁴ While these estimates are quantitatively small, they can still be economically relevant. The experience of the summer of 2013 has shown that changes in capital flows of a similar magnitude were associated with significant financial turmoil in EMEs.

There are, however, dissenting views based on empirical findings. Eichengreen and Gupta (2014) examine the movements in exchange rates, equity prices and foreign reserves between April and August 2013, and find that strong fundamentals (a low budget deficit and public debt, and a high level of reserves and GDP growth) did not provide insulation, and that flows were largely driven by the size of the country's financial market. It is not immediately clear why there are such contrasting results in the literature. The use of different countries and time periods, as well as a partial versus general-equilibrium approach, may be among the reasons.

"Spillbacks" from Emerging-Market Economies to Advanced Economies

Some policy-makers in emerging markets have argued that the negative effects of QE on their economies would ultimately "spill back" to advanced economies (Rajan 2014). Indeed, since EMEs represent a large and rising share of the global economy, there is growing evidence of spillbacks from

◀ *The experience of the summer of 2013 has shown that changes in capital flows were associated with significant financial turmoil in emerging-market economies*

¹³ The authors define the status quo of no change in QE as a scenario in which the flow of asset purchases continues at the same pace as that before the start of tapering by the Federal Reserve.

¹⁴ The results in Dahlhaus and Vasishtha (forthcoming) and Lim, Mohapatra and Stocker (2014) are subject to certain caveats and thus should be interpreted with caution. First, the results in both studies partly reflect average relationships prior to the global financial crisis and may not fully capture the dynamic adjustment of capital flows to financial market variables during the crisis period. Second, the analysis in Dahlhaus and Vasishtha (forthcoming) does not incorporate the role of emerging-market macroeconomic fundamentals in driving capital flows to EMEs.

EMEs to advanced economies, primarily through trade, financial and commodity-price channels. Specifically, weak economic activity in EMEs may lead to softer demand for advanced-economy exports, as well as lower equity and commodity prices. Preliminary analysis conducted by the IMF suggests that spillback effects from EMEs tend to be modest, but could be larger in crisis periods. In addition, the effects are larger for countries or regions with greater trade exposure to EMEs, such as Japan and the euro area (IMF 2014). Moreover, major advanced-economy commodity exporters, such as Canada and Australia, may be negatively affected by lower prices for commodities due to slowing growth in EMEs that are major consumers of commodities.

Citing these concerns about spillovers and associated spillbacks, some observers have stressed the need for central banks to factor in the effects of their policies on other countries and have argued for greater coordination of international monetary policy. However, the Federal Reserve has noted that it does pay attention to the global spillover effects of its policies and associated spillbacks within the context of its domestic mandate.¹⁵ Considerable information sharing also occurs among central banks at various international forums, such as the G-20 and the Bank for International Settlements, which helps to create both a shared understanding of the need for such policies and a discussion of their potential impacts. Beyond this, it is not obvious what coordination among central banks (which must follow domestic policy mandates) would look like in practice or how it would lead to a different policy path for the Federal Reserve or any other central bank engaging in QE.

Another important consideration associated with spillbacks is the emerging markets' policy reactions to QE, such as an increase in sterilized foreign exchange rate intervention, stricter macroprudential measures and a greater use of capital controls. So far, there has been little research on the spillback from such policies, although some observers, such as Murray (2013), have argued that there might have been less need for unconventional policies were it not for such restrictive measures impeding necessary adjustment in real exchange rates.

Conclusion

Given the available evidence, QE appears to have increased capital flows to EMEs, although there is no convincing proof that the overall effects are significantly different from conventional monetary easing. Moreover, diverging fundamentals between advanced economies and EMEs were likely at least as important. Overall, the benefits of QE appear to outweigh the costs, especially if advanced economies withdraw exceptional monetary easing in an appropriate fashion as economic conditions improve.

Nevertheless, there could be instances of volatility in global financial markets, particularly in EMEs, when advanced economies begin to normalize monetary policy, highlighting the need for policy-makers in both EMEs and advanced economies to remain vigilant. For central banks in advanced economies, recent experience underlines the importance of ensuring that monetary policy normalization be communicated as effectively as possible in order to appropriately shape market expectations.

Even if the exit is well managed, a certain amount of capital-flow reversal and higher borrowing costs are likely in some EMEs. Higher bond yields will prompt portfolio rebalancing, the effects of which could be amplified in the presence

◀ *Considerable information sharing among central banks at international forums helps to create both a shared understanding of the need for unconventional monetary policies and a discussion of their potential impacts*

¹⁵ See the comments by Federal Reserve Chair Janet Yellen in the "Inaugural Michel Camdessus Central Banking Lecture," at the IMF in Washington, D.C. (2 July 2014), at <http://www.imf.org/external/np/seminars/eng/2014/camdessus/>.

of market imperfections. The effects of policy normalization on EMEs will thus depend on their resilience and the extent of their vulnerabilities. EMEs with strong fundamentals and sound macroeconomic and financial policies will likely be better able to insulate themselves from any excessive negative spillovers as the monetary policy of advanced economies normalizes.

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Firm Strategy, Competitiveness and Productivity: The Case of Canada

Lori Rennison, Farid Novin and Matthieu Verstraete, *Canadian Economic Analysis*

- The strategies that firms pursue to achieve a competitive advantage—through investment, innovation and productivity improvements—influence potential growth, i.e., the rate at which an economy can grow without a buildup in inflationary pressures. In the aftermath of the Great Recession and against a number of transformative global trends, the medium-term competitiveness strategies that Canadian firms are following are of particular interest for the conduct of monetary policy.
- The findings of the Bank of Canada's 2013 *Firm Strategy Survey* suggest that, in a slow-growth environment amid strong competition and uncertainty regarding the timing of a strengthening in demand, Canadian firms have generally placed more emphasis on defensive competitiveness strategies, aimed at reducing cost structures or differentiating existing products to help retain customers, than on measures targeting expansion or longer-term competitiveness.
- Firms that are the most entrepreneurial or agile in the way in which they combine capital and labour report generally better innovation outcomes and have a more favourable view of their ability to improve their competitive position relative to global best practices.

Insights into what businesses are anticipating and planning, and how they are adjusting to shocks and changing economic conditions, serve as an important input into the Bank of Canada's economic outlook. The combination of forces influencing Canadian businesses over recent years has been profound. These forces include the Great Recession, higher levels of connectivity and mobility worldwide, the rise of disruptive innovations, more-complex global supply chains and the growing prominence of emerging economies. The Bank's regional offices conducted the *Firm Strategy Survey* (FSS) to gain insights into the adjustments that businesses are making against this backdrop and the factors affecting their strategies to be competitive over the coming three to five years, in order to inform the Bank's outlook for exports, investment and productivity growth.

The 2007–09 financial crisis and recession represented a major shock for Canadian businesses, particularly exporters. Some businesses closed, net firm creation slowed and firms were forced to adjust to survive (Poloz 2013). The Canadian economy recovered, supported by monetary and fiscal stimulus. Five years after the start of the recovery, however, signs of sustained strengthening in the momentum of global and domestic economic growth have been slow to materialize. Quarterly business surveys suggest that conditions of prolonged uncertainty have led firms to favour shorter-term, more-reversible capital outlays over recent 12-month horizons, or targeted upgrades or replacement of existing capital, resulting in modest aggregate growth in business investment.¹

At the same time, import penetration into Canada has increased over recent years and data show a loss of market share abroad among Canadian exporters (Macklem 2011; de Munnik, Jacob and Sze 2012). The Canadian dollar appreciated over much of the past decade, in the face of persistently weak productivity growth, contributing to a loss of Canadian competitiveness. Canada has trailed on a number of indicators that are known to increase productivity, including investment in information and communications technology and research and development.² Studies point increasingly toward organizational capital as a promising area to focus on to better understand the determinants of productivity (see Bloom et al. (2014), for example).

Organizational capital, defined as the accumulation of firm-specific knowledge (Atkeson and Kehoe 2005), along with software, technological know-how, and research and development, is part of a firm's intangible capital. It affects a firm's choices about desired levels of capital and labour, subject to its external environment (i.e., competition, market, industry, and cultural and institutional factors). It includes strategic planning, management practices and other organizational competencies, as well as investment to redesign or reconfigure existing products or to promote brand equity in order to maintain or gain market share (Corrado, Hulten and Sichel 2009).³ Taken together, investments in intangible capital are important drivers of profitability at the firm level and of productivity at the economy-wide level.

Recent studies have focused on investments in intangible capital that promote firm “agility” (i.e., the ability to surpass rivals by spotting opportunities early and adapting in real time to environmental and technological shifts) as a way to increase competitiveness in dynamic and uncertain environments.⁴ While studies approach the issue of agility from various perspectives, common features include simultaneously implementing strategies to create demand through innovation; enhancing operating efficiency relative to competitors through the adoption of new technologies; and maximizing organizational learning through intense use of knowledge, information and networks. In other words, productivity-enhancing behaviours are integrated throughout various

◀ *At the aggregate level, the more widespread productivity-enhancing strategies and behaviours are across firms, the more favourable the prospects for the macroeconomic outlook and growth in potential output*

1 See the Bank of Canada's *Business Outlook Survey* from 2012 to 2014. These reactions are in line with predictions of models regarding firm investment behaviour during periods of elevated uncertainty (Bloom 2009).

2 The World Economic Forum's 2014–15 *Global Competitiveness Report*, for example, shows that Canada's competitiveness ranking slipped from 10th to 15th place over the past five years, reflecting deterioration in the areas of technological adoption, innovation, business sophistication and infrastructure (Schwab 2014).

3 See Baldwin, Gu and Macdonald (2012) for an analysis of the contribution of intangibles to labour productivity growth in Canada. At present, only a limited portion of investment in intangibles is capitalized in Canadian national accounts data.

4 See, for example, EIU (2009); Madhok and Marques (2014); McGrath (2013); Sherehiy, Karwowski and Layer (2007); and Zhang (2011).

aspects of the organization. At the aggregate level, the more widespread such strategies and behaviours are across firms, the more favourable the prospects for growth in investment, productivity, exports and potential output.

This article summarizes the results of a survey designed to explore these issues. After a brief description of the survey, results are presented in three sections. The first assesses the changes in the competitive environment over the previous five years that are pertinent to understanding firm strategy. The second section discusses the competitiveness objectives of Canadian firms and the focus of investment plans over the medium term (three to five years). The third section aggregates responses to provide insights on the organizational agility features of Canadian businesses. The final section discusses macroeconomic implications.

The Survey

The theoretical framework underpinning the questionnaire is one in which the representative firm formulates strategy in order to maximize expected profit or value, subject to its information set and various constraints, including implied opportunity costs, over its planning horizon. This optimization is influenced by competitive conditions and the economic environment. It may lead a firm to rationally choose a more defensive cost-minimization strategy during certain periods, and a more aggressive strategy to create its own demand through innovation or speed to market during others.

The survey questions were divided across the key drivers of profitability at the firm level: external factors (i.e., competition, market structure, constraints); organizational capital (i.e., competitiveness objectives, organizational competencies, processes for strategy formulation, extent of adjustment to recent technology, nature of participation in export markets); innovation behaviour; and tangible and intangible investment strategy.⁵ The questions for each driver can be divided into two categories: *action-based* (relating to recent actions taken by the firm) and *vision-based* (questions that required firms to evaluate statements and choose the one that best described their strategic organizational objectives). The wording of questions was selected to align as closely as possible with concepts tested in the literature and to provide a link to macroeconomic variables of interest to the Bank.

Senior economics staff in the Bank's regional offices conducted the survey between September and December 2013, through face-to-face interviews with senior executives at 151 companies who were able to speak about the overall strategy of the firm.⁶ The survey used a quota-sampling framework that is broadly representative of the Canadian economy, providing a range of views across regions, sectors and firm size (see **Table 1** for summary statistics).⁷

⁵ For more details on the survey, see Rennison, Novin and Verstraete (forthcoming).

⁶ Respondents were the chief executive officer, president, chief financial officer, chief operating officer or treasurer.

⁷ Specific sample targets by sector, region and firm size were selected in accordance with the quota-sampling procedure used for the *Business Outlook Survey* (de Munnik, Illing and Dupuis 2013), with the exception of regulated utilities, which were excluded. The proportion of exporters in the sample is larger than their share in the overall population of businesses to ensure reasonable coverage among those exposed to global conditions. The manufacturing sector is also oversampled relative to its share of business sector GDP in recognition of its extensive linkages to other sectors of the economy.

Table 1: Summary statistics on the 151 firms in the *Firm Strategy Survey* sample

Sector	% ^a	Region	% ^a	Size and other information	%
Primary	13	Atlantic	14	Small	23
Manufacturing	26	Quebec	20	Medium	38
Construction, information and transportation services	15	Ontario	26	Large	39
Wholesale and retail trade	13	Prairies	20	Exporter ^b	64
Finance, insurance and real estate	15	British Columbia	21	Intense exporter ^c	32
Commercial, personal and business services	19			Publicly traded company	32

a. Percentages may not add to 100 because of rounding.

b. Firms with any international sales or indicating export potential

c. Firms with more than 50 per cent of their sales in international markets

The Results

Evaluating the competitive landscape

The FSS evaluated the Canadian competitive landscape from three perspectives: (i) changes in the number of direct competitors, (ii) firms' adjustment to changing market conditions, and (iii) barriers to entry.

Changes in the number of direct competitors

On balance, firms selling solely to the Canadian market reported facing a greater number of direct competitors in the primary market for their main product (good or service) than five years before.⁸ Many saw greater foreign competition as driving the increase, as well as advances in mobility and connectivity, and changes in technology that have enabled the establishment of more Internet-based businesses and new product development. Changing consumer tastes have resulted in demand for more variety, providing scope for new competitors to enter their main market.

Firms with some exposure to export markets, in contrast, reported little change in the number of direct competitors relative to five years before. Those with the greatest export exposure (50 per cent or more of sales to international customers) reported a net decline in the number of direct competitors. Many exporters witnessed the exit or takeover of weaker competitors, as foreign demand fell sharply during the recession, or the merger or consolidation of other exporters.

Firms' adjustments to changing market conditions

Firms' accounts of the strategies they followed in the aftermath of the Great Recession provide insights into how competitive pressures were evolving. Most surviving firms were focusing on rationalizing cost structures (Chart 1). This was particularly true for exporters.⁹ Some saw their market become dominated by a few low-cost producers. While there were fewer traditional competitors in their primary market, some cited more competition in secondary markets as other businesses diversified in an effort to find untapped sources of demand. At a time when foreign demand was slow to recover, the combination of shifting

◀ *Domestic firms reported a greater number of direct competitors than five years ago, stemming from foreign entrants, advances in technology and changing consumer tastes...*

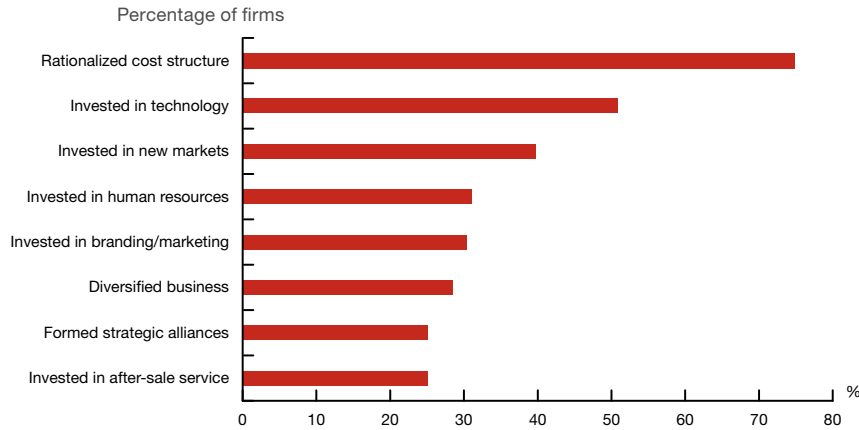
◀ *...while many exporters witnessed the exit or takeover of weaker competitors, as foreign demand fell sharply during the recession*

◀ *In the aftermath of the Great Recession, most surviving firms were focusing on rationalizing cost structures*

⁸ The share of firms reporting that they were facing more direct competitors than five years before exceeded the share reporting that they faced fewer.

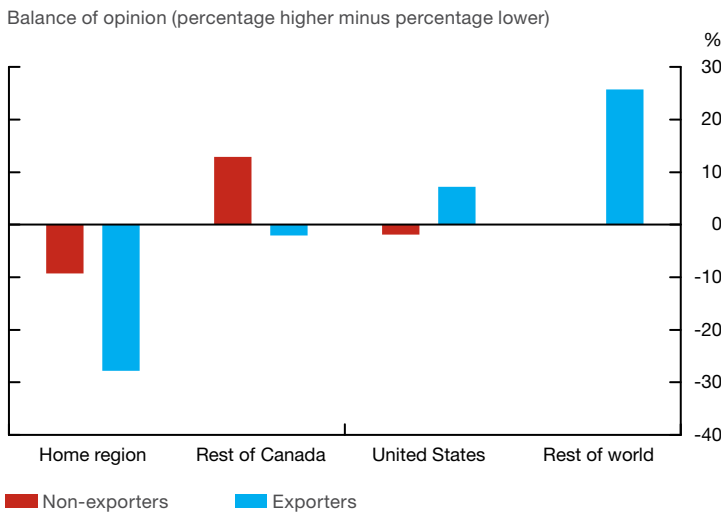
⁹ Eighty per cent of exporters reported that they have reduced their cost structure since the recession, compared with 65 per cent of domestic firms.

Chart 1: Most-common firm strategies following the Great Recession



Notes: Firms were asked to provide an account of the strategies they followed in the aftermath of the Great Recession, in terms of externally directed actions (i.e., related to their market) or internally directed actions (i.e., directed toward changing structure, processes, systems or resource use within the organization). Multiple responses were allowed. Responses shown are those actions cited by at least 25 per cent of firms.

Chart 2: Comparison with sales five years before



Notes: Survey question: Please indicate whether the approximate percentage of your total sales in each of the following markets is notably higher, lower or about the same as it was five years ago. Exporters are firms with any international sales or indicating export potential.

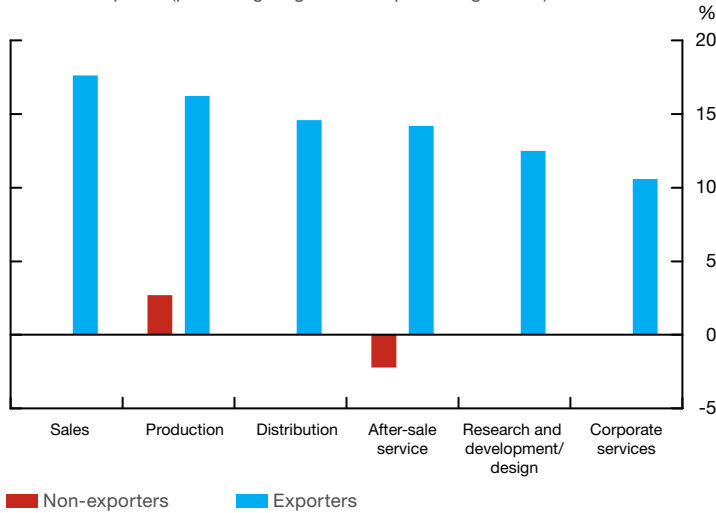
global trade patterns, more-complex global supply chains and greater digital trade (e-commerce) raised the intensity of competition for exporters, even though the number of direct competitors did not increase.

In addition to efforts to rationalize cost structures, firms reported investing in technology, new markets (particularly exporters) and in skills development. Investments in branding or marketing and after-sale service were used to promote customer loyalty and retention.

Overall, domestic and export-oriented firms reported that sales outside their home region accounted for a greater share of their sales base than five years earlier (Chart 2). As well, the corporate activities of exporting firms became somewhat less concentrated within Canada across all functions (Chart 3), as a number of firms shifted or added resources outside Canada, mainly to be closer to demand.

Chart 3: Change in resources allocated to owned facilities outside Canada

Balance of opinion (percentage higher minus percentage lower)



Notes: Those reporting that the proportion of their corporate activities taking place in owned facilities outside Canada has increased over the past five years versus those reporting that it has decreased. Exporters are firms with any international sales or indicating export potential.

Barriers to entry

Nearly all firms (92 per cent) believe that there are barriers to entry that restrict new firms from entering their industry, either in the form of a structural barrier (scale of production, regulation, access to resources or access to financing) or a strategic barrier (related to knowledge or a strong brand name). Over half of firms characterize the barriers to entry as significant. Firms in the resource and manufacturing sectors were most likely to indicate that barriers to entry allow competitive advantage in the industry to be sustained over long periods. A number of manufacturers more heavily engaged in new product development, however, noted that new products are quickly copied, and advantages from these efforts tend to be short-lived. As well, firms in the services sector noted that competitors can quickly catch up to any gains in cost efficiency. Many of these firms indicated that competitive advantage can be preserved only by offering highly customized products, which can mitigate efforts to improve productivity.

◀ Nearly all firms believe that there are barriers to entry that restrict new firms from entering their industry

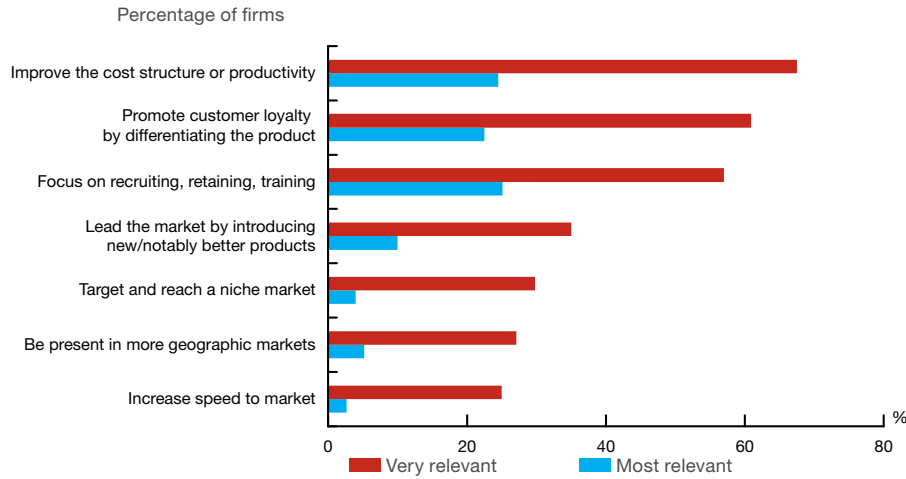
Strategies for competitiveness

Against the backdrop of this competitive landscape, firms' top three strategies for competitive advantage¹⁰ over the coming three to five years were to obtain a cost advantage (improve their cost structure or productivity); to achieve a differentiation advantage (improve customer loyalty by customizing offerings or differentiating their product); and to focus on skills (recruiting, retaining, training or creativity-building) (Chart 4). Very few firms selected growth-related strategies such as innovation advantage (leading the market by introducing completely new or notably better products) or the advantage of geographic presence (being present in more geographic markets) as "most relevant" for their market share over the next three to five years.

◀ Few firms selected leading the market through innovation as the most relevant competitiveness strategy for the next three to five years

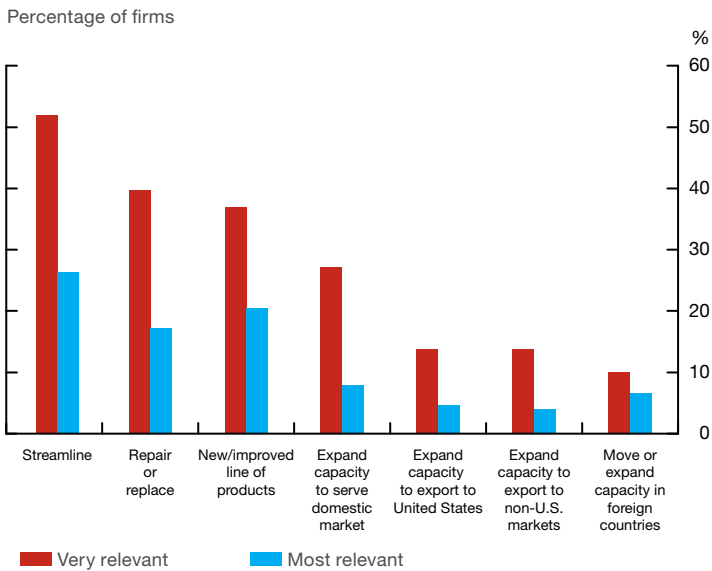
¹⁰ The response categories offered to firms can be grouped into supply-side objectives (related to costs or labour) or demand-side objectives. The latter group includes strategies related to the elasticity of demand (to target a specific segment of the market, or niche, that is not currently being met by competitors, or by differentiating one's product to attract customers from competitors in existing markets), as well as strategies to create one's own demand through completely new or notably better products, or to get new products to market more quickly than rivals.

Chart 4: Strategy for competitive advantage over the coming three to five years



Notes: Survey question: How would you rate the relevance of the following strategies for your competitive position and market share over the next three to five years (very relevant, somewhat relevant, not relevant)? If more than one strategy is considered “very relevant,” please also indicate which strategy is the most relevant. The chart shows responses for very and most relevant only.

Chart 5: Objective for investment spending over the coming three to five years



Notes: Survey question: How would you rate the relevance of the following objectives for your investment spending over the next three to five years (very relevant, somewhat relevant, not relevant)? If more than one objective is considered “very relevant,” please also indicate the most relevant. The chart shows responses for very and most relevant only.

Firms reported that they are targeting investment mainly at streamlining production, at repairing or replacing existing equipment or facilities, or at differentiating current product offerings (Chart 5). Few reported that they are targeting investment at expanding longer-term capacity to serve either domestic or international markets. Exporters generally reported shorter desired payback periods on investment in machinery and equipment than firms focusing on the domestic market, suggesting a shorter-term focus for investment plans in the current environment.

Table 2: Examples of characterization by firms of their way of working

Number of firms: 151

Aspect of organizational capital	Choices given to respondents	%
Innovation in our organization tends to be...	An ongoing and central element of our strategic plan	58
	Generally encouraged and occurs when conditions are right	36
	Relatively rare	5
We are most likely to consider or introduce organizational innovations...	Under conditions of slack demand or when facing competitive or financial pressures	17
	When demand is strong or improving	12
	Whenever necessary to support our overall strategy for competitiveness, regardless of the state of demand	67
Over the past three years, our business processes changed in response to advances in ICT ^a and increased connectivity:	To a great extent	41
	To some extent	47
	Not at all	7
	Expect to adjust over the next few years	5
Our organizational capabilities are most closely geared toward...	Discovering entrepreneurial opportunities	12
	Continuously developing new competitive advantages	19
	Maintaining and extending our existing competitive advantages	70
Our organizational structure and processes are generally set up to...	Encourage staff to demonstrate creativity and take risks, even if doing so raises the likelihood of failure	20
	Encourage staff to take calculated risks, based on an evaluation of alternatives, with a goal to minimize the chance of failure	80
Capital budgets are developed...	In cycles of two to three years, or longer	27
	Annually	56
	Quarterly or on a rolling basis	15
If you are an exporter, which statement best describes your participation in export markets? ^b	We move in and out of export markets in response to economic circumstances.	24
	We prefer to maintain a continuous presence in our export markets regardless of changes in economic conditions.	62
	Don't know	14
Which factors have the greatest impact on your strategy formulation?	Vision and objectives of the leader or leadership team	87
	Opportunities in the market	57
	Feedback from customers, supply chain or employees	42
	Internal analysis using strategic management instruments	31
	Competitors	21
	Advice and initiative of external consultants	10
Over the past three years, has your firm introduced new ways of measuring and monitoring in any of the following areas?	Communication and the exchange of information	35
	Employee/management performance	51
	Efficiency and quality of our products and processes	54
	Customers' experience	44
	Competitors' practices	19
	Did not introduce new ways	19

a. ICT = information and communications technology

b. Only exporters (n = 97) are considered when computing these percentages.

When choosing among statements related to their organization's way of working, the statements that are most closely associated with innovation, adoption of new technology or organizational learning were generally not the most prevalent (Table 2). For instance, while many firms considered innovation to be an ongoing and central part of their strategic plan, the majority viewed their organizational capabilities as most closely geared toward maintaining and extending existing competitive advantages rather than generating new advantages. A considerable share of firms reported that their business had changed only "to some extent" in response to advances in information technology.¹¹ Regarding their use of information and organizational learning, firms described organizational structures and processes as generally set up to favour analysis over experimentation. Few firms indicated

◀ *The majority of firms viewed their organizational capabilities as most closely geared toward maintaining and extending existing competitive advantages rather than creating new ones*

¹¹ Firms were asked to characterize the extent to which their business processes, product or service design, marketing, or organizational structure had changed in response to advances in information and communications technology and increased connectivity/mobility (cloud computing, big data, etc.) over the past three years.

that they are developing capital budgets in short cycles or on a rolling basis. Many firms have introduced new metrics related to monitoring efficiency and quality, employee/management performance, or customer experience over the previous three years, yet considerably fewer have added ways to monitor competitors’ practices or consider competitors’ actions to have a strong impact on their process for formulating strategy.

The next section aggregates these strategic and organizational capital indicators with other survey indicators of investments in intangible and tangible capital to evaluate whether firms demonstrating behaviours associated with agility, growth and longer-term competitiveness perform differently than their counterparts.

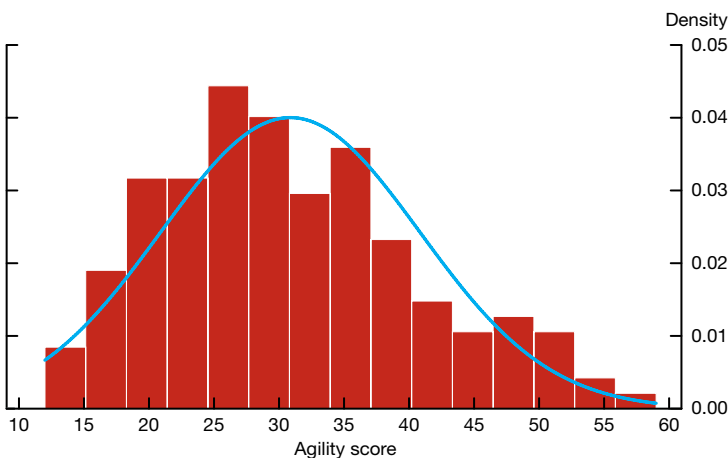
Aggregating signals of organizational agility

Agility relates to a firm’s ability to respond to unpredictable changes in a timely and profitable manner, and in a way that allows it to sustain above-average growth. At the micro level, agility can be achieved through heterogeneous strategies, but the common elements include a focus on creating demand through innovation, enhancing operating efficiency with new technology, and maximizing organizational learning through the use of knowledge, information and networks.

To construct an aggregate measure of agility using signals from the survey, firms were scored on the number of responses that correspond most closely to key features of a representative agile firm based on the theoretical and empirical literature.¹² Points were allocated to response categories for which, if selected by the firm from a series of alternatives, the balance of probabilities would indicate a greater degree of organizational agility. A histogram of the total scores is shown in **Chart 6**. The distributions of scores across sectors, firm size and other firm characteristics were also examined and statistical tests conducted to determine whether firms in the top score

Chart 6: Distribution of agility scores

All observations, maximum possible value = 100



¹² Scoring was used as a tool to facilitate analysis of a large collection of observations on a relatively small sample of firms. Response options across 22 questions were evaluated on the basis of the strength of the signal for agility. The questions selected were those that provided information on investments in innovation (technology and research and development) and other intangible assets, as well as those pertaining to organizational cultures valuing innovation, flexibility and learning. A simple two-value scoring system of one and two points was used in cases for which a specific behaviour would be consistent with situation-specific agility and unconstrained agility, respectively. No points were given if the response did not offer sufficient information to assess agility. Fifty-five response categories were identified, with a maximum achievable score of 100.

Table 3: Comparison of responses to indicators of performance by the top and bottom agility score quartiles

Performance measure	Agility quartile		Total sample (n = 151) %
	Bottom (n = 39) %	Top (n = 41) %	
Share of firms reporting strong growth over past three years ^a	28	27	31
Introduction of new or significantly improved <i>goods</i>	23	59	40
Introduction of new or significantly improved <i>services</i>	23	68	48
Introduction of new or significantly improved <i>processes</i>	59	88	75
Mean percentage change in sales from <i>goods</i> innovations	1	8	5
Mean percentage change in sales from <i>service</i> innovations	3	7	5
Mean percentage change in sales from <i>process</i> innovations	2	10	7
Balance of opinion on expectation for future productivity performance relative to the <i>domestic</i> competition ^b	48 (15)	70 (10)	58 (13)
Balance of opinion on expectation for future productivity performance relative to the <i>global</i> competition ^b	41 (56)	58 (20)	53 (32)

a. Responses are not found to be statistically different between the bottom and top quartiles.

b. The balance of opinion equals the percentage expecting improvement minus the percentage expecting deterioration. (For the purposes of the statistical tests, the balance of opinion is calculated using only those firms that were able to evaluate how they expect their productivity to evolve relative to the competition. The percentages of firms that were unable to provide a view were excluded from the calculation and are shown in parentheses. Including firms that were unable to provide a view results in a considerably lower balance of opinion for the bottom quartile relative to the top quartile, especially in the case of the comparison with the global competition.)

quartile had different responses than those in the bottom quartile to other survey questions related to firm performance. Survey indicators of firm performance are defined as (i) the firm’s characterization of sales growth over the past three years; (ii) whether or not goods, service or process innovations were introduced, and the firm’s estimate of the sales gain resulting from these innovations; and (iii) the firm’s self-assessment of its recent and expected future productivity performance relative to the domestic and global competition.

Three interesting features emerge from the analysis. First, as expected, the distribution of organizational agility scores shows considerable dispersion across firms, with a relatively thin right tail of firms exhibiting the most agile features. Sectoral distributions vary but are generally overlapping, confirming the view that agility features are not sector-specific; firms in any sector can demonstrate high or low agility.

Second, as would be expected, relative to those in the bottom quartile, firms in the top quartile of agility scores were more likely to have innovated over the previous three years (introduced new or significantly improved goods, services or processes) and to report a higher percentage increase in sales because of those innovations (Table 3).¹³ Firms in the top quartile also had more favourable expectations regarding their forward-looking productivity performance relative to their domestic and global competition over the coming three years, and were generally more aware of global best practices (only 20 per cent of firms in the top agility score quartile could not provide a

◀ *Firms in any sector can demonstrate high or low agility*

◀ *As expected, firms in the top quartile of agility scores reported better innovation outcomes than those in the bottom quartile*

¹³ This result was robust to a range of alternative scoring methodologies.

view on the expected evolution of their productivity relative to that of the global competition, compared with 56 per cent of firms in the bottom quartile).

Studies suggest that agile firms are able to sustain above-average growth over extended periods. However, the most and least agile firms in the sample reported similar profiles of sales growth over the previous three years (in terms of the share reporting strong, moderate, weak or negative growth). This may reflect the economic environment of the period, or that a greater degree of agility than demonstrated by the top quartile of Canadian firms is required to generate sustained, strong growth. Worley and Lawler (2010), for instance, argue that “the ‘new normal’ requires organizations to have an amazing amount of agility just to survive, let alone thrive.”

Third, differences in agility scores along various firm characteristics provide interesting insights. The literature suggests that small and medium-sized firms have more scope for agile behaviour than larger firms owing to their greater flexibility and entrepreneurial orientation, but larger firms may have more access to resources needed to launch new products or expand geographically. In the survey, mean agility scores were found to rise with firm size.¹⁴ Agility scores among smaller firms may be lower than would otherwise be the case given the slow recovery in firm creation since the recession, which has resulted in limited entry of new start-ups with high entrepreneurial orientation.

The literature also suggests that exporting firms are relatively more capital-intensive, knowledge-intensive, information-intensive and productive than non-exporters. Outside of having initially entered an export market, however, exporting firms did not have statistically different organizational agility scores than domestic firms.¹⁵ This result suggests two influences. First, domestic market conditions have evolved in such a way that, with increased import competition and technological advances, domestically oriented firms have faced incentives to invest in agility to compete. Second, amid a prolonged period of uncertainty regarding the nature and timing of a strengthening in global demand in the aftermath of the recession, incentives for many exporters have favoured strengthening their ability to absorb the demand shock and survive, rather than investing in their agility.¹⁶

◀ *There are signs that a prolonged period of uncertainty regarding the nature and timing of a strengthening in global demand has led exporters to focus on resilience rather than investing in their agility*

Macroeconomic Implications of the Results

Overall, the FSS results suggest that the near-term growth expectations of Canadian firms are modest. Facing greater competitive pressures in both domestic and export markets, firms have been planning largely defensive uses for their capital budgets, aimed at further reductions in their cost structure or at ways to differentiate their product offerings. Firms following strategies to reduce their cost structure generally expect to improve their productivity performance relative to their domestic and global competitors over the next three years. Others were focusing on enhancing customer loyalty to obtain a competitive advantage, through customization or

¹⁴ Size is defined as the number of employees of the firm.

¹⁵ This is based on a test of the distributions of agility scores between exporters and domestic firms after the removal of the points given to the nature and speed of the initial entry into export markets and preferences for continuity of participation in the face of changes in demand. According to the Wilcoxon rank-sum test result, the null of no difference between distributions is not rejected at the 20 per cent level.

¹⁶ Sull (2009), for example, describes how companies can focus on agility to spot and exploit changes in the market in certain conditions or stages of their life cycle. During others, they can rely on strengthening their resilience to withstand market shifts, notably during shocks and when strategic or structural barriers to entry are perceived to be sufficient to provide some protection from competition.

differentiation of their product offerings (while acknowledging that these efforts can raise costs and lead them to forgo some productivity gains). All else being equal, these strategies should help support exports and domestic output over the short term.

A key issue for the macroeconomic outlook is determining when Canadian firms' confidence will rise to the point of shifting focus toward investments that would push the production possibility frontier outward. One can envisage two possible scenarios: (i) global growth begins to gain momentum, or (ii) a slow pace of growth persists.

In the first scenario, amid less uncertainty and improving demand, the strategic orientation of firms would be expected to shift, in aggregate, from a focus on fine-tuning existing strengths toward more entrepreneurial strategies to seek out new growth opportunities and to expand longer-term capacity to serve domestic and export markets. The FSS finds that firms that have invested the most in organizational agility generally report better innovation outcomes. At the aggregate level, investing in agility-enhancing activities can trigger a process of innovative supply that creates its own demand.

The second scenario—that a slow pace of growth will persist and uncertainty will lead to further delays in investment—may lead firms to continue to rely on more-defensive strategies, which could hold back the rotation in Canadian aggregate demand toward exports and investment. The fact that most firms perceive some or significant barriers to entry in their industry suggests that imperatives for innovation and long-term productivity enhancements may not appear that pressing. A prolonged period in which firms postpone investment and follow strategies for incremental reductions in costs that are not accompanied by investment in new technology would undermine the longer-term competitive advantages of the Canadian business sector, particularly if net firm creation remains slow to recover. A sustained failure to invest would imply a lower rate of potential output growth.

Under either scenario, the emergence of new and non-traditional competitors, more demanding consumers, the growing volume of big data, and further advances in information and communications technology are expected to continue to challenge traditional business models over the coming years (EIU 2009, 2014; McGrath 2013; PwC 2014). As firms worldwide seek ways to respond to evolving global forces and maintain or improve their market share, the nature of the agility and strategic decisions of Canadian firms will continue to be an important area of study.

◀ *A key issue for the macroeconomic outlook is determining when Canadian firms' confidence will rise to the point of shifting focus toward investments that would push the production possibility frontier outward*

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The Use of Financial Derivatives by Canadian Firms

Teodora Paligorova and Rhonda Staskow, Financial Markets Department

- Corporations use financial derivatives to reduce the volatility of their earnings stream by hedging exposures to interest rate, exchange rate and commodity price risks.
- In Canada, about one-third of publicly listed firms use financial derivatives. The use of derivatives is widespread across all sectors of the economy and increases during periods of greater uncertainty.
- Non-financial firms that use derivatives are typically larger and more profitable and have lower volatility of earnings than those that do not use derivatives. Overall, the firm characteristics of Canadian hedgers seem to be consistent with those found in other jurisdictions.

Financial derivatives such as forwards, futures, options and swaps allow corporations to protect themselves from unpredictable changes in exchange rates, interest rates and commodity prices, thereby reducing the degree of financial risk to which they are exposed. While financial corporations are the most significant participants in derivatives markets, non-financial Canadian corporations are also important; for example, they are counterparties to around 15 per cent of the turnover in foreign exchange (FX) derivatives in Canada.¹ This article provides stylized facts about the use of financial derivatives by Canadian publicly listed firms from 2006 to 2013.

This topic is currently important because during the 2009–13 period, commodity prices and the Canadian dollar fluctuated significantly compared with earlier periods. Such fluctuations can result in unpredictable profit margins and losses for corporations. In turn, holding all else equal, profit volatility can increase firms' probability of distress and impair their ability to access external funding.² To the extent that the Canadian economy relies on export revenues, hedging through the use of financial derivatives can

¹ Using information from the Canadian Foreign Exchange Committee (CFEC 2014), we calculate the share held by non-financial customers of the total turnover of outright forwards, swaps, currency swaps and over-the-counter options as of April 2014.

² Responses to a survey by Export Development Canada (2009) indicate that 69 per cent of the surveyed firms have been significantly affected by currency fluctuations, and that their primary objective is to manage foreign exchange risk.

smooth income from exports and ultimately enhance domestic welfare. Knowing the extent to which Canadian firms use derivatives and whether the reliance on them has changed over time can be particularly useful for gauging the potential impacts of large fluctuations in interest and exchange rates on the economy.³ For example, the use of exchange rate hedges may shield a firm from a temporary exchange rate shock, and thus forestall a pass-through of the temporary exchange rate volatility to import prices. However, if the exchange rate shock is persistent or permanent, exchange rate hedges can only delay the pass-through. The general consensus in the pass-through literature is that exchange rate hedges may slow the pass-through for the length of the average maturity of the hedging instruments (Ihrig, Marazzi and Rothenberg 2006). Analysis of the use of hedging instruments has proven to be difficult because of the lack of available data on firms' use of derivatives.⁴ We collected derivatives data at the firm level, which allows us to shed light on whether and how hedgers differ from non-hedgers in terms of various firm characteristics.

The Use of Financial Derivatives by Canadian Non-Financial Corporations

Hedging with derivatives can transform financial risks by essentially offsetting (taking equal but opposite) positions in the derivatives market and/or the spot market for the purpose of shielding the revenue stream against adverse price movements.

Let us consider the following hypothetical example. A Canadian exporter expects to receive US\$100 million in six months. Suppose that the current foreign exchange rate for the U.S. dollar is Can\$1.20. If the value of the U.S. dollar falls by 10 per cent over the next six months, the exporter will lose Can\$12 million. To hedge such foreign exchange risk, the exporter can sell a six-month U.S.-dollar forward to lock in the current forward rate. If the forward rate is Can\$1.18, the exporter is certain to receive Can\$118 million at maturity. Bank dealers who act on behalf of clients willing to hedge need to assess the credit risk of their counterparty.

We collected data on the use of derivatives for a sample of firms listed on the Toronto Stock Exchange (TSX) for the following contracts: interest rate swaps, as well as foreign exchange futures, forwards, swaps and options.⁵ Excluding financial firms and utilities, we obtained information for the use of derivatives contracts for 1,522 non-financial firms over the 2005–13 period.

The portion of Canadian firms that relies on derivatives contracts is significant. In total, 33 per cent of the firms in our sample use at least one of the contracts listed above; 18 per cent use interest rate swaps and 24 per cent use at least one type of foreign exchange contract. Of the firms that use FX contracts, 25 per cent use FX swaps, 54 per cent use FX forwards and 46 per cent use either FX futures or FX options.

◀ *In total, 33 per cent of the firms in our sample use derivatives contracts*

³ Firms can use alternative mechanisms to hedge their risk exposures. For example, Canadian manufacturing firms that rely to some extent on imported inputs adjust their Canadian-dollar prices in response to changes in the Can\$/US\$ exchange rate (Bank of Canada 2014). Some firms may use natural hedges against exchange rate fluctuations by producing and selling in the same (foreign) currency. Natural hedging can be effective at reducing a company's foreign exchange risk, but it can take time to implement.

⁴ Box 1 provides definitions of these instruments. We use the term "derivatives" to refer to all contracts analyzed in this article; the legal definition of derivatives sometimes excludes swaps and forwards.

⁵ To confirm whether the firm is using certain derivatives contracts, we relied on the 2006, 2009 and 2013 annual reports of the firms in our sample downloaded from SEDAR (the System for Electronic Document Analysis and Retrieval). Although firms choose to report different details of their hedging activities, they all have to disclose whether they use derivatives.

Box 1

Definitions of Derivatives Contracts

A **foreign exchange (FX) forward contract** is a contract to buy or sell a currency at a future delivery date with a rate adjustment to account for the yield differential between the two currencies. This is the most common type of FX hedging contract traded over the counter. It is customized in terms of size, quality and delivery date.

A **foreign exchange (FX) swap** is a contract to buy or sell a currency at a future delivery date (can be at spot) and then to reverse this position by selling or buying the same currency at a later date. For example, if a forward contract comes due but the foreign funds have not been received or the foreign funds are not yet due, the client can use the new swap to offset the maturing contract at the current delivery date, only to re-establish the desired position at a later time for a new delivery date.

Foreign exchange (FX) options give the right, but not the obligation, to buy or sell a currency with another currency at a specified exchange rate for a specified period. These contracts are traded on the over-the-counter derivatives market. They help to lock in the exchange rate but without the obligation to honour the contract. For example, if the

U.S. dollar is expected to depreciate against the Canadian dollar, Canadian investors in U.S. assets can hedge currency risk by buying a put option on the U.S. dollar, since the value of the options should increase if the U.S. dollar falls.

Foreign exchange (FX) futures are standardized cash-settled exchange-traded contracts between two specific currency pairs, although they can be exchanged for physical currencies. These contracts are traded on futures exchanges.

Interest rate swaps are agreements traded over the counter between two parties to exchange one stream of interest payments for another over a specific time period. The most commonly traded interest rate swaps are known as “vanilla” swaps, which exchange fixed-rate payments for floating-rate payments. The party that receives a fixed rate and pays a floating rate is the “receiver,” and the party that receives a floating rate in exchange for a fixed rate is the “payer.” Interest rate swaps help corporations manage their floating-rate debt liabilities by allowing them to lock into paying the prevailing fixed rate and receive payments that match their floating-rate debt, or vice versa.

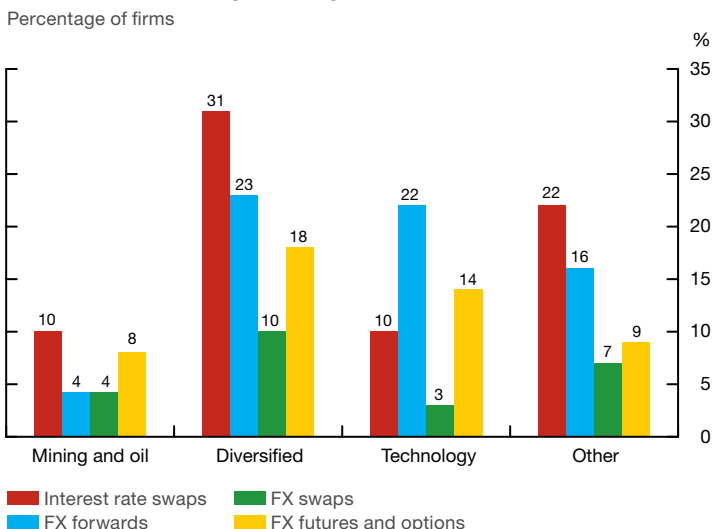
The use of financial derivatives is widespread across all sectors of the economy. For example, 24 per cent of firms in mining and oil, 37 per cent in diversified industries, 14 per cent in technologies and 24 per cent in all other sectors (communications and media, forest products, and life sciences) use at least one of the above-mentioned derivatives contracts. Interest rate swaps are the most common type of derivatives used in mining and oil and in diversified industries (**Chart 1**). FX forwards, followed by FX futures and options, are the most prevalent instruments in technologies.

The use of financial derivatives increases during periods of greater uncertainty. The use of derivatives was slightly more prevalent in the 2008–10 crisis period than in the 2005–07 pre-crisis and 2011–13 post-crisis periods for both large and small firms (**Chart 2**).⁶ The use of interest rate swaps was higher in the 2008–10 period compared with the other two periods, because firms most likely wanted to lock in their lower cost of debt in the environment of low interest rates and somewhat elevated uncertainty about the outlook for the economy. With the expectation of an increase in interest rates, the reliance on interest rate swaps would allow firms to pay fixed interest rates while the underlying debt payment remains variable but hedged.

◀ *The use of financial derivatives is widespread across all sectors of the economy*

⁶ The use of interest rate swaps by small firms increased from 4 per cent in the pre-crisis period to 8 per cent during the crisis. A similar trend emerges for large firms—interest rate swaps were more popular during the crisis than in the periods either before or after it.

Chart 1: Use of derivatives, by industry sector, 2005–13



Note: Sectors are defined according to the Toronto Stock Exchange classification. The “Diversified” category includes mostly manufacturing firms. The “Other” category consists of communications and media, forest products, and life sciences.

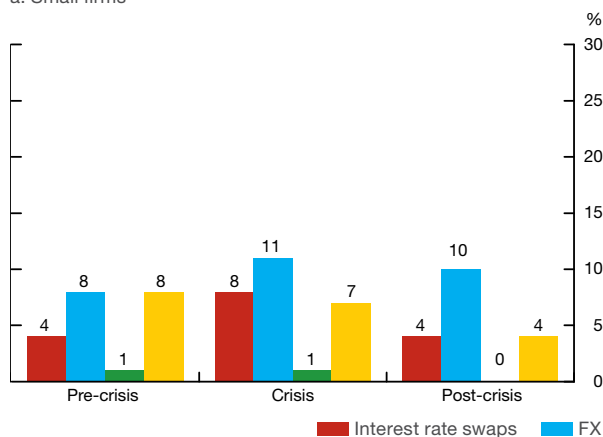
Source: Authors’ calculations

Last observation: December 2013

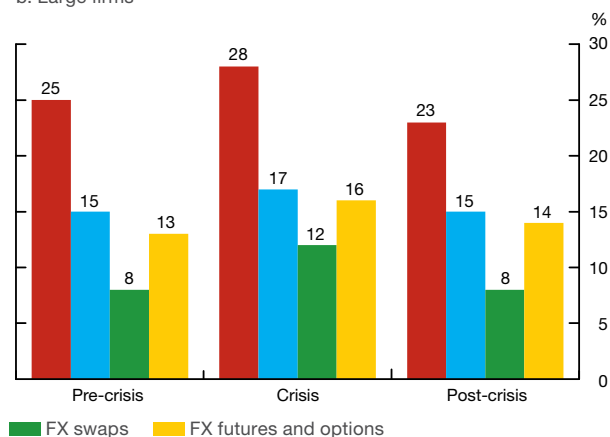
Chart 2: Use of derivatives before, during and after the financial crisis

Percentage of firms

a. Small firms



b. Large firms



Note: The pre-crisis period refers to the years 2005–07; the crisis period covers 2008–10; and the post-crisis period is 2011–13.

Source: Authors’ calculations

Last observation: December 2013

FX derivatives (swaps, forwards, futures and options) used by large firms were also more prevalent in 2008–10 than in the other periods.⁷ The 2008–10 period was also characterized by higher exchange rate volatility compared with the other two periods—the standard deviation of daily exchange rates for the 2008–10 period was 8.4 per cent, while it was 4 per cent for 2011–13. Hedging activities typically intensify in times of volatile market conditions because the revenue streams of corporations become exposed to more adverse price movements and, in response, firms become more eager to rely on derivatives.

⁷ The total use of foreign exchange derivatives during the crisis period by large firms was 45 per cent. In Chart 2, this is the sum of FX forwards, FX swaps and FX futures/options for the 2008–10 period. The usage rate of FX derivatives was 36 per cent and 37 per cent during 2005–07 and 2011–13, respectively.

In addition, the results of the Bank of Canada’s Survey on Canadian Foreign Exchange Hedging indicate that Canadian companies used more derivatives in the period of relatively more volatile exchange rates.⁸ In the survey, Canadian firms report that the change in volatility in foreign exchange markets has been the primary driver for the shift in hedging activity.⁹

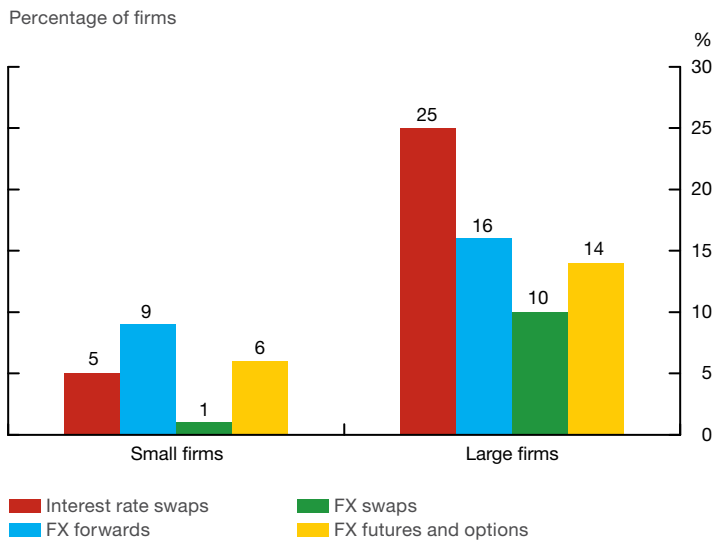
Firm Characteristics and Hedging

Modern financial theory implies that, in the absence of market imperfections, financial decisions such as hedging do not affect the value of the firm (Modigliani and Miller 1958).¹⁰ However, financial markets are not perfect and hedging can affect firm value through a number of channels. In this section, we provide some stylized facts about the characteristics of hedging and non-hedging firms.

First, firms that hedge tend to be large and mature corporations. Based on our data set, the use of derivatives is more pronounced for large firms than for smaller ones (Chart 3). Large firms are defined as those with higher market values than the sample median, which is Can\$250 million. For example, 25 per cent of all large firms use interest rate swaps, while only 5 per cent of small firms do; only 1 per cent of small firms use FX swaps, while 10 per cent of large firms report using this contract. Moreover, firms that hedge tend to be more mature, with an average age of 20 years, as opposed to 12 years for

◀ *The use of derivatives is more pronounced for larger and more mature firms*

Chart 3: Use of derivatives, by firm size, 2005–13



Note: “Small firms” are defined as firms with market values that are lower than the sample median.

Source: Authors’ calculations

Last observation: December 2013

⁸ The Bank of Canada Survey on Canadian Foreign Exchange Hedging is a qualitative survey conducted annually among banks to assess their clients’ activities in Canadian foreign exchange hedging since 2004. The survey participants are banks that are active in Canadian FX markets. A summary of the results is available at www.bankofcanada.ca/2013/11/summary-2013-survey-canadian-foreign-exchange-hedging/.

⁹ The survey also shows that more than 40 per cent of exporters decreased their forward hedging activity for the 2010–11 period, owing to the strength of the currency. They preferred to cover most of their transactions in the spot market as they came due, based on their expectations that the currency level would decrease in the future. In contrast, over the same period, 35 per cent of importers not only increased their hedges, but, according to anecdotal reports from banks, many of them also established hedges for a longer duration than the typical contract of three to six months.

¹⁰ If capital markets are perfect, shareholders (investors) possess enough information about a firm’s risk exposures to achieve any desired risk profile by relying on a portfolio strategy that does not use derivatives and pays the same return as the derivatives at maturity.

non-hedgers. The observation that large and more mature Canadian firms tend to hedge more is consistent with patterns found for other countries (Bartram, Brown and Fehle 2009).

This finding is not surprising, given that the development of hedging strategies requires fairly sophisticated financial management and long-term investment, which large and mature firms are more likely to have in place or to devote resources to. It is also highly likely that large firms have better access to derivatives markets because of the availability of their credit ratings. When entering a derivatives contract, a bank needs to assess the credit risk of the firms and allocate an appropriate credit line, which may need to be collateralized depending on the underlying credit risk of the firm. Since large and mature firms are more likely to have credit ratings on their debt, it would be easier for banks to enter a derivatives contract with them.

Second, firms that hedge tend to have higher profit and lower volatility in their income stream. In our data on Canadian hedgers and non-hedgers, we find that hedgers are more profitable with a return on assets that is 10 percentage points higher than that of non-hedgers; and volatility in their earnings, measured by the volatility of return on assets, is much lower compared with non-hedgers (Table 1).¹¹ This is consistent with findings for other countries. Using an international sample of firms, Bartram, Brown and Conrad (2011) show that derivatives use is associated with lower cash-flow volatility, lower standard deviation of stock returns, lower systematic risk and slightly higher market values.¹²

◀ *Firms that hedge tend to have higher profit and lower volatility in their income stream*

Table 1: Mean differences between firm characteristics of corporate users of derivatives (corporate hedgers) and corporate non-users (corporate non-hedgers)

	Corporate hedgers (1) Mean	Corporate non-hedgers (2) Mean	(1) – (2) Difference
ROA (%)	5.9	-5.3	11.2
Volatility ROA (%)	1.8	3.3	-1.5
Cash holdings (%)	10.9	22	-11.1
Debt ratio (%)	20	10.9	9.1
Market capitalization (mean) (Can\$ millions)	4,008	1,316	2,692
Market capitalization (median) (Can\$ millions)	437	122	315
Firm age (years)	20.30	12.37	7.93
Number of observations	343	719	

Notes: ROA is the annual return on assets, defined as the ratio of the annual firm operating income to total assets. Volatility ROA is the standard deviation of quarterly ROA over 20 quarters. Debt ratio is the ratio of debt to total assets; cash holdings are the ratio of cash and short-term investments to assets. Firm age is the difference between the analysis year and the year a firm was founded. The mean differences in the last column are statistically significant at the 1 per cent level, based on statistical tests for comparisons of means. A corporate hedger is defined as a firm that uses at least one derivatives instrument. We use only firms that stayed in the sample for the entire period to avoid a change in the composition of firms.

Source: Authors' calculations

¹¹ In this article, a "hedger" is defined as a non-financial firm that uses at least one of the following derivatives instruments: interest rate swaps, FX swaps, FX forwards and FX futures/options. We rely on such an aggregated measure for the purpose of easier exposition. All findings reported in Table 1 hold for each derivatives instrument.

¹² As a result of reduced cash-flow volatility, some firms may derive benefits from the decreased cost of financial distress resulting from hedging. Typically, smaller and younger firms that are more likely to face the risk of failure may find it more important to use derivatives to decrease their probability of distress and the costs associated with it, holding all else equal (Huyhn, Petrunia and Voia 2010).

By reducing the volatility in the income stream, hedging can improve firms' capital-raising capabilities and, consequently, their investment decisions. Lower cash-flow volatility can increase firms' creditworthiness and, hence, their debt capacity, which is expected to be reflected in the terms of debt contracts, including lower interest rates and fewer investment restrictions attached to debt obligations. There is strong empirical evidence based on U.S. data that hedging leads to a lower cost of debt and to debt contracts with fewer investment restrictions, which together lead to significantly higher investment levels (Campello et al. 2011). Géczy, Minton and Schrand (1997) also find that firms reduce fluctuations in cash flows to be able to raise capital for growth opportunities. In a similar spirit, Froot, Scharfstein and Stein (1993) argue that firms that hedge are more likely to have stable operating cash flows and are thus less likely to face unexpected cash shortfalls, which improves long-term capital investment planning.¹³

Third, firms that hedge tend to use more external financing and have more sophisticated balance-sheet management. We observe that hedgers make greater use of bank loans and bonds to finance their investments. As shown in **Table 1**, the ratio of total debt to assets is 20 per cent for hedgers and 10 per cent for non-hedgers. Together with higher profitability and lower riskiness, the use of external financing by Canadian hedgers is consistent with the explanation that hedging has potentially increased their debt capacity and ability to access bank and capital market financing. It seems that hedgers are better at optimizing their capital structure to achieve higher profit. This is consistent with the empirical finding that increased debt capacity has a positive impact on the value of the hedging firms (Bartram, Brown and Fehle 2009). We also note that the average Canadian hedger holds less cash as a share of total assets than the average non-hedger. This could imply that hedging reduces a firm's need to hold precautionary cash; it could also imply that hedgers actively manage their balance sheets to finance profitable investment opportunities.

Conclusion

Firms use financial derivatives to smooth their earning streams. Over the period from 2006 to 2013, one-third of the Canadian firms in our sample used interest rate swaps, FX forwards, FX futures, FX swaps or FX options. The use of derivatives is widespread across all sectors and it is slightly more prevalent in a crisis period. On average, corporate hedgers have some different characteristics from non-hedgers. Our evidence indicates that hedging may be value-enhancing, since hedgers typically have higher profit and lower earnings volatility than non-hedgers. Hedgers appear to actively manage their balance sheet by holding less cash and to access external financing in capital markets, both of which may be the result of the efficient use of derivatives contracts.

¹³ It is worth noting, however, that establishing a true causal effect of hedging activity on profitability and its volatility is a challenging empirical task because the endogenous relationship between hedging behaviour and firm risk has to be taken into consideration. This is an area for further research.

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