

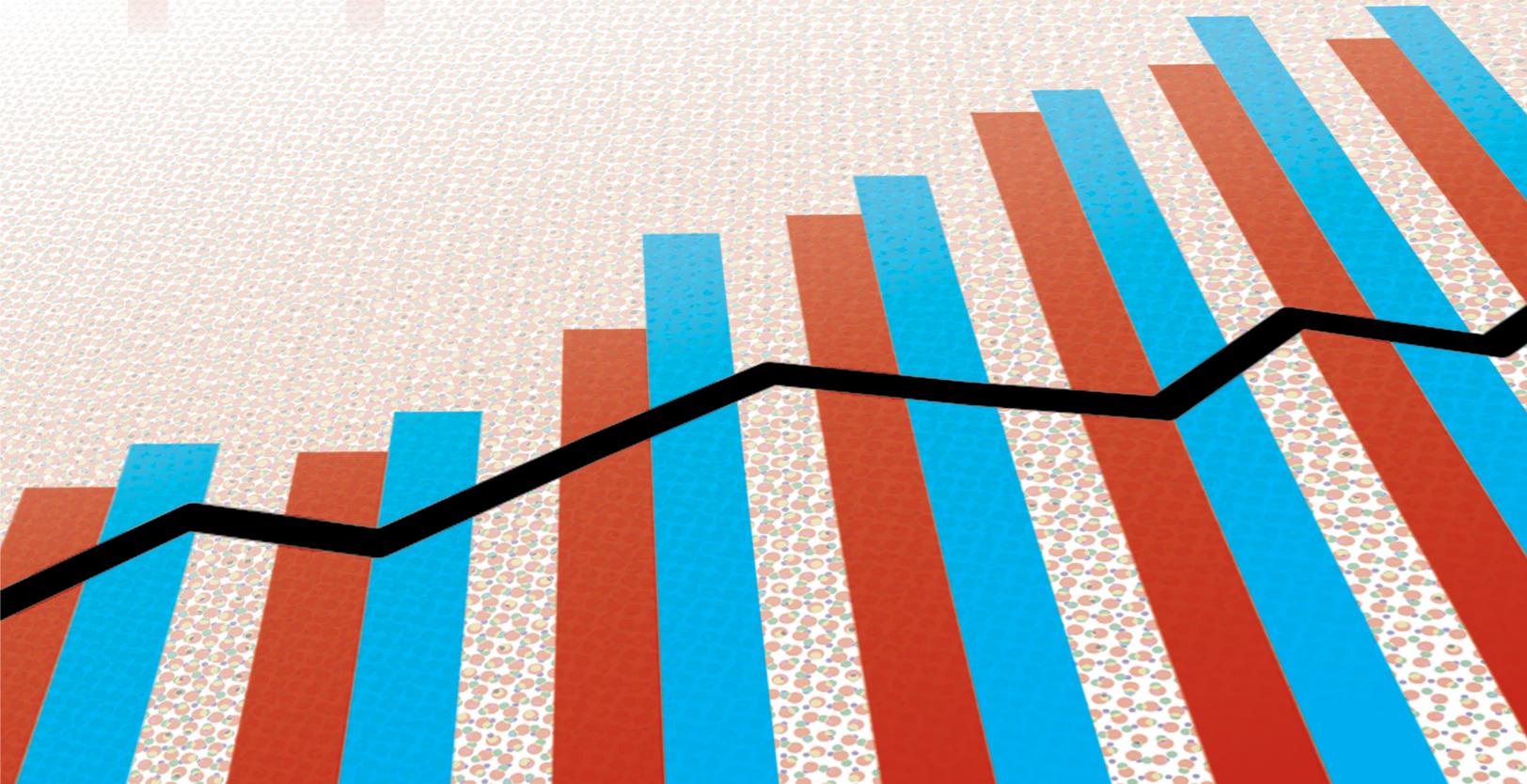


BANK OF CANADA  
BANQUE DU CANADA

# FINANCIAL SYSTEM REVIEW

December 2014

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# Financial System Review

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December 2014

The Assessment of Vulnerabilities and Risks section is a product of the Governing Council of the Bank of Canada: Stephen S. Poloz, Carolyn A. Wilkins, Timothy Lane, Agathe Côté, Lawrence Schembri and Lynn Patterson.

This report includes data received up to 3 December 2014.

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# Contents

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|  |     |
|--|-----|
| Preface.....   | iii |
| Overview .....   | 1   |
| Assessment of Vulnerabilities and Risks .....  | 5   |
| <b>Macrofinancial Conditions</b> .....   | 5   |
| <b>Key Vulnerabilities in the Canadian Financial System</b> .....                                  | 9   |
| Vulnerability 1: Elevated Level of Household Indebtedness.....                                     | 9   |
| Vulnerability 2: Imbalances in the Housing Market .....  | 15  |
| Vulnerability 3: Investor Risk Taking and Illiquidity in Financial Markets ...                     | 19  |
| <b>Key Risks</b> .....   | 22  |
| Risk 1: Household Financial Stress and a Sharp Correction<br>in House Prices .....                 | 22  |
| Risk 2: A Sharp Increase in Long-Term Interest Rates .....   | 24  |
| Risk 3: Financial Stress from the Euro Area.....   | 25  |
| Risk 4: Stress Emanating from China .....  | 27  |
| <b>Potential Emerging Vulnerabilities and Risks in the Canadian<br/>    Financial System</b> ..... | 29  |
| <b>Safeguarding Financial Stability</b> .....  | 31  |
| Reports  |     |
| Introduction.....  | 35  |
| <b>Exchange-Traded Funds: Evolution of Benefits,<br/>    Vulnerabilities and Risks</b> .....       | 37  |
| <i>Ian Foucher and Kyle Gray</i>   |     |
| <b>Cyber Security: Protecting the Resilience<br/>    of Canada’s Financial System</b> .....        | 47  |
| <i>Harold Gallagher, Wade McMahon and Ron Morrow</i>   |     |

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# Preface

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A stable and efficient financial system is essential for sustained economic growth and rising living standards. The ability of households and firms to channel savings into productive investments, allocate the associated risks, and transfer financial assets with confidence is one of the fundamental building blocks of our economy. Financial stability is defined as the resilience of the financial system to unanticipated adverse shocks that enables the continued smooth functioning of the financial intermediation process.

As part of its commitment to promote the economic and financial welfare of Canada, the Bank of Canada actively fosters a stable and efficient financial system. The Bank promotes this objective by providing central banking services, including the various liquidity and lender-of-last-resort facilities; overseeing key domestic clearing and settlement systems; conducting and publishing analyses and research; and collaborating with various domestic and international policy-making bodies to develop and implement policy. The Bank's contribution complements the efforts of other federal and provincial agencies, each of which brings unique expertise to this challenging area in the context of its own mandate.

The *Financial System Review* (FSR) is one avenue through which the Bank of Canada seeks to contribute to the longer-term resilience of the Canadian financial system. It brings together the Bank's ongoing work in monitoring developments in the system with a view to identifying potential risks to its overall soundness, as well as highlighting the efforts of the Bank, and other domestic and international regulatory authorities, to mitigate those risks. The focus of this FSR, therefore, is an assessment of the downside risks rather than the most likely future path for the financial system. The context for this assessment is our baseline view of the evolution of the global and domestic economies, as well as the risks to this outlook. Economic and financial stability are interrelated, so the risks to both must be considered in an integrated fashion. Thus, the FSR's presentation of the risks to the Canadian financial system takes into account the macroeconomic environment presented in the Bank of Canada's *Monetary Policy Report*.

The FSR also summarizes recent work by Bank of Canada staff on specific financial sector policies and on aspects of the financial system's structure and functioning. More generally, the FSR aims to promote informed public discussion on all aspects of the financial system.

# Overview

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The *Financial System Review* (FSR) summarizes the judgment of the Bank of Canada's Governing Council on the main vulnerabilities and risks to the stability of the Canadian financial system. The review begins with an examination of overall macrofinancial conditions to provide context for the domestic vulnerabilities and the assessment of the financial system risks for Canada.

A modest pickup in global economic growth is expected in 2015 and 2016 as the headwinds coming from private and public deleveraging, as well as the uncertainty around future conditions, gradually diminish. Prospects are, however, uneven across the major economies. The U.S. economy has clearly strengthened and is expected to lead the improvement in global economic growth. In contrast, growth in much of the rest of the world will continue to face considerable challenges, leading authorities in some regions to deploy further policy stimulus.

A number of important downside risks to the global economic outlook remain. Concerns about a sharper slowdown in growth and the risk of deflation weigh upon Japan and the euro area. Increased geopolitical tensions, as well as concerns regarding Russia's economy, also loom. In China, the interactions among the ongoing correction in real estate markets, highly indebted local governments and the financial sector continue to pose a significant downside risk. The recent sharp drop in the prices of oil and some other commodities, should it become persistent, will weigh on the Canadian economy and those of other commodity-producing countries.

Economic activity in much of the world, including Canada, continues to be highly dependent on stimulative monetary conditions. Exceptional monetary policy in many advanced economies has resulted in long-term interest rates near historical lows, some equity indexes near all-time highs, and a reduction in risk premiums and volatility in financial markets. An inevitable consequence, however, is the buildup of certain vulnerabilities in the financial system that could be more pronounced than in previous cycles.

However, today's global financial system is stronger than it was before the financial crisis, owing to ongoing reforms to ensure that banks are well capitalized, financial markets are more resilient and financial market infrastructures are supporting core activities of financial markets.

The Bank is currently monitoring three key financial system vulnerabilities in Canada.

### 1. Elevated level of household indebtedness

- Low interest rates and steady income growth have helped keep the household debt-to-income ratio broadly stable and near a historical high. Household vulnerabilities are increasing at the margin, however, as strong competition among financial entities is promoting riskier borrowing by some households.

### 2. Imbalances in the housing market

- Imbalances in the housing market are edging higher, with a pickup in both resale activity and in the growth of house prices. A soft landing in the housing market has not yet materialized, in part because mortgage rates have declined further over the past year.

### 3. Investor risk taking and illiquidity in financial markets

- Exceptional monetary stimulus continues to create incentives for increased risk taking in financial markets, both globally and in Canada. Although anecdotal evidence suggests that highly leveraged positions remain limited in domestic markets, greater risk taking could increase volatility in times of market stress.

Vulnerabilities in the Canadian financial system could be exposed by a trigger, which could then cause a risk to materialize. The assessment of each risk reflects a qualitative judgment as to the probability that the risk will occur and the expected impact on Canada's financial system and economy if it does.

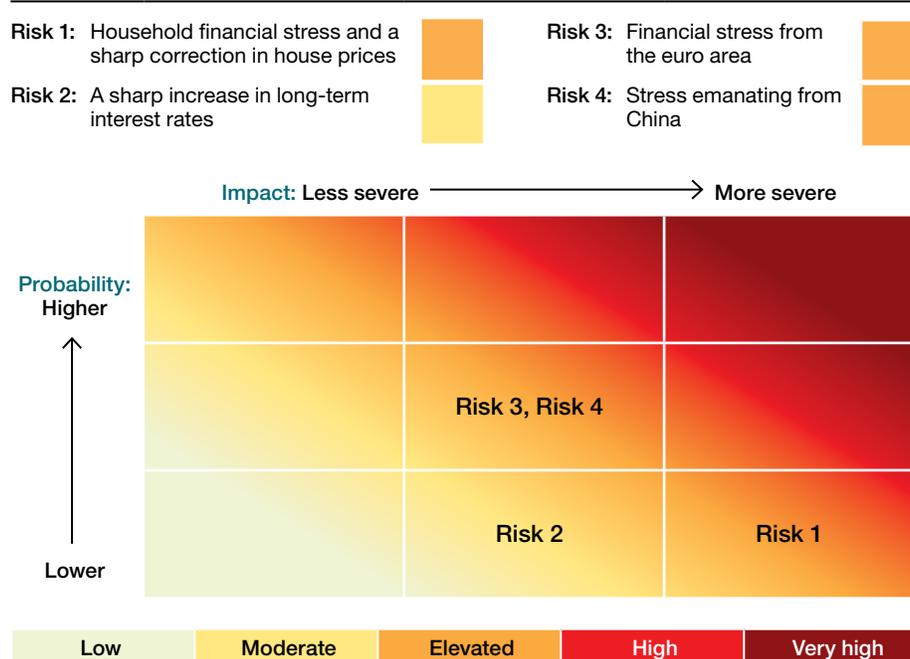
The four key risks to the Canadian financial system are the same as those outlined in the June 2014 FSR.

1. A large, negative shock to the incomes of Canadians reduces the ability of highly indebted households to service their debts and triggers a sharp correction in the housing market.
  - The impact of this risk, should it materialize, would be slightly larger than anticipated at the time of the June FSR, owing to an increase in household and housing market vulnerabilities.
  - Encouraging U.S. and Canadian data suggest that the likelihood of an adverse shock occurring has declined.
  - Overall, the rating for this risk is "elevated," unchanged from the June FSR.
2. A sudden shift in market expectations about U.S. monetary policy leads to a spike in global term premiums and long-term interest rates that is transmitted to Canada through its strong links to global financial markets.
  - The relatively mild market reaction to the end of the Federal Reserve's program of asset purchases, announced on 29 October, suggests that near-term adjustments in U.S. monetary policy may not have outsized outcomes. Hence, the probability of a sharp increase in long-term rates continues to be low.
  - The current rating for this risk is "moderate," unchanged from the June FSR.

3. A sizable negative shock to real economic activity or an escalation of stress related to Russia could trigger a financial crisis in the euro area.
  - On balance, offsetting developments since the June FSR—namely, positive outcomes from the review of the European banking sector, counterbalanced by increasing concerns about the strength of economic activity and the risk of increased tensions in Ukraine or Russia—have kept the probability of significant stress in the euro area at a medium level.
  - The current rating for this risk is “elevated,” unchanged from the June FSR.
  
4. A financial disruption in China that leads to a significant slowdown in Chinese economic growth. The repercussions on global economic growth and on already-low commodity prices would cause economic and financial stress in Canada.
  - The probability of a financial disruption in China is unchanged, although some vulnerabilities have intensified. In particular, entities linked to the property sector, as well as local governments and smaller banks, continue to face financial challenges.
  - The current rating for this risk is “elevated,” unchanged from the June FSR.

A summary of the key risks to the Canadian financial system and their current ranking are presented in Table 1.

**Table 1: Key risks to the stability of the Canadian financial system**



# Assessment of Vulnerabilities and Risks

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This section of the *Financial System Review* (FSR) outlines the Governing Council's evaluation of the key vulnerabilities and risks to the Canadian financial system. After a brief overview of macrofinancial conditions, vulnerabilities in the Canadian financial system that could amplify and propagate shocks are identified and assessed. The principal risks to the Canadian financial system that may arise in the context of those vulnerabilities are then examined.

The objective of the FSR is not to predict the most likely outcomes for the financial system but to raise early awareness of key vulnerabilities, potential triggers and key risks, and to promote actions that reduce the likelihood of these risks materializing or their impact if they do occur.

## Macrofinancial Conditions

### *The U.S. economy is expected to lead a modest pickup in global economic growth*

A modest pickup in global economic growth is expected in 2015 and 2016 as the headwinds coming from private and public deleveraging, as well as the uncertainty around future conditions, gradually diminish. The pickup will be led by the strengthening U.S. economy, which will support Canada's exports. In contrast, stalled growth in Japan and the euro area will act as a drag on the global recovery. The recent sharp drop in the prices of oil and some other commodities, should it become persistent, will weigh on the Canadian economy and those of other commodity-producing countries.

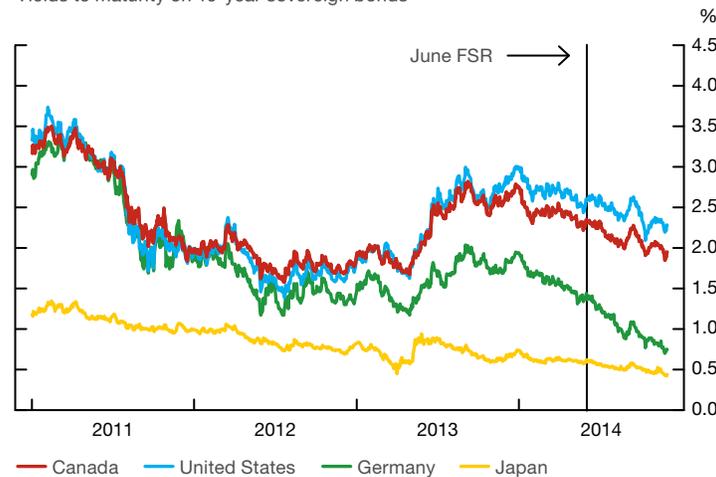
Canada's economy is showing signs of a broadening recovery. Stronger exports are beginning to be reflected in increased business investment and employment, suggesting that the hoped-for rotation of growth away from a reliance on household spending may finally have begun.

### *Financial market conditions remain supportive of economic activity*

The unexpectedly slow global recovery has meant that monetary conditions in advanced economies, including Canada, have been very stimulative for much longer than envisioned in the aftermath of the financial crisis. Interest rate expectations and yields on long-term government bonds in advanced economies have continued to fall since June (**Chart 1**), reaching near-historical lows in Japan and the euro area, as the Bank of Japan (BoJ) and the

**Chart 1: Yields on long-term government bonds have continued to fall**

Yields to maturity on 10-year sovereign bonds

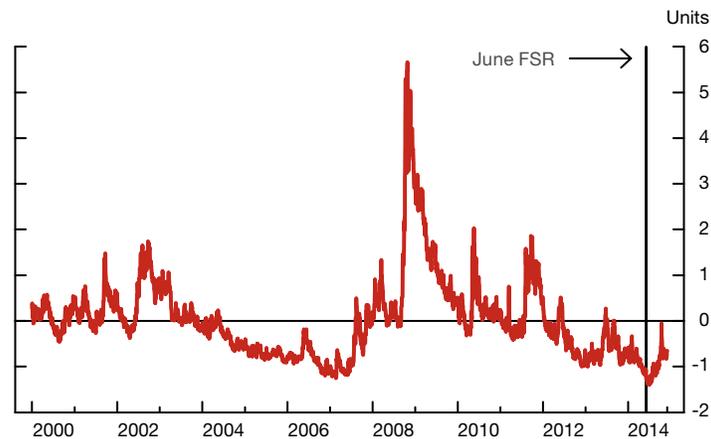


Source: Reuters

Last observation: 3 December 2014

**Chart 2: Implied volatility in financial markets remains relatively low**

Average of standardized values of MOVE, VIX, VSTOXX, VXY and EM-VXY indexes



Note: Implied volatility measures consist of U.S. Treasuries (MOVE), U.S. equities (VIX), European equities (VSTOXX), G-7 currencies (VXY) and emerging-market currencies (EM-VXY).

Sources: Bloomberg and Bank of Canada calculations

Last observation: 3 December 2014

European Central Bank (ECB) continue to inject exceptional liquidity.<sup>1</sup> Market rates suggest that the first rise in U.S. policy rates has been pushed back to the second half of 2015, in part reflecting concerns about spillovers to the United States from weakened growth prospects elsewhere in the world.

One of the objectives of the monetary policy actions taken by many advanced-economy central banks was to reduce monetary policy uncertainty. As a result, implied volatility is lower in a number of asset classes (Chart 2). However, volatility spiked briefly in mid-October, owing in part to a shift in market expectations regarding the global economic recovery, as well as some repositioning by market participants. The BoJ's announcement of

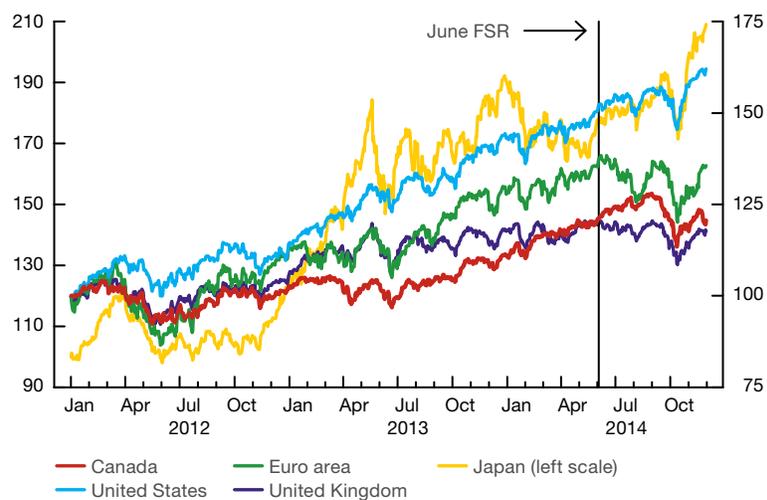
<sup>1</sup> Since the publication of the June 2014 FSR, the Bank of Japan and the European Central Bank have undertaken further easing of monetary policy. The ECB cut its key interest rates by an additional 10 basis points in September, and began purchases of covered bonds in October and asset-backed securities in November. The BoJ bolstered its Quantitative and Qualitative Monetary Easing program in October, increasing the pace of annual purchases to ¥80 trillion from ¥60–¥70 trillion previously, and making an open-ended commitment to continue with the measures for “as long as it is necessary.”

additional quantitative easing, as well as increased expectations of further policy action from the ECB, contributed to the partial reversal in implied volatility for most asset classes.

Global equity indexes in several countries remain near all-time highs (Chart 3). Most credit spreads remain relatively low, although some widening has recently occurred, especially in the high-yield sector. The combination of high equity prices, low bond yields and low volatility reflects not only low risk premiums, driven by prolonged exceptional monetary policy stimulus, but also market expectations of lower equilibrium real interest rates.<sup>2</sup> The relative importance of these two forces will have implications for the eventual normalization of monetary policy in the advanced economies, as well as the degree of financial system vulnerability that has built up over recent years.

**Chart 3: Equity indexes in several advanced economies are near all-time highs**

Equity indexes (3 January 2012 = 100)



Source: Bloomberg

Last observation: 3 December 2014

### *Canada has been affected by weaker global economic growth*

Global commodity prices have declined significantly, with the Bank's commodity price index (BCPI) down by about 25 per cent since the June FSR. Most notable is the fall in the price of Brent crude oil, which has dropped to below US\$70 per barrel, its lowest level since 2009, largely reflecting stronger-than-expected global supply but also slower growth in demand.

Lower commodity prices have important ramifications for the domestic economy and the financial system. All else being equal, lower commodity prices lead to a decline in Canada's terms of trade and cause Canadian income, wealth and GDP to fall. Lenders are also exposed through their commodity-related loans and securities holdings. Financial institutions with a concentration of activities in commodity-producing regions or sectors are particularly vulnerable. Lower commodity prices could also lead to a depreciation of the Canadian dollar, which would provide some offsetting benefits to the economy.

<sup>2</sup> See "Monetary Policy and the Underwhelming Recovery," speech by Bank of Canada Senior Deputy Governor Carolyn Wilkins to the CFA Society Toronto, 22 September 2014 (<http://www.bankofcanada.ca/2014/09/monetary-policy-underwhelming-recovery/>).

Yields on Canadian long-term government bonds have followed their foreign counterparts: 10-year yields have declined by about 35 basis points since the June FSR and are now only about 35 basis points off their all-time lows (Chart 1). In addition, yields on provincial government bonds have also declined to near-historical lows.

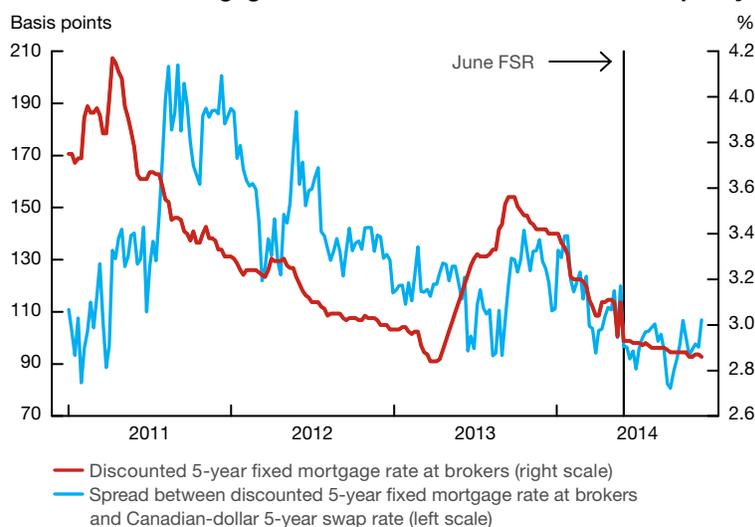
### *Financing conditions for Canadian businesses and households continue to ease*

Corporate bond yields remain historically low, as fairly heavy issuance has been met by very strong investor demand.<sup>3</sup> Overall business lending conditions have also continued to ease, owing to strong competition among financial institutions and capital markets. The Bank's 2014Q3 *Senior Loan Officer Survey* pointed to a further easing in price conditions for business borrowers that began in 2009. This was also reflected in the Bank's autumn 2014 *Business Outlook Survey*, in which a majority of firms describe credit as easy or relatively easy to obtain.

Borrowing costs for Canadian households remain at very low levels. Interest rates on 5-year mortgages have declined further over the past year, owing to both lower funding costs—proxied by the Canadian-dollar 5-year swap rate—and a 30-basis-point reduction in implied spreads (Chart 4).

The Canadian securitization market remains a stable source of funding, where issuance has been generally steady, albeit below pre-crisis levels. Despite very low default rates across most types of securities, the underlying quality of loans has deteriorated in some cases; for example, in securitized auto loan pools, where lending terms have lengthened and average credit scores have decreased. The overall size and complexity of the Canadian private-label securitization market have continued to decrease, in large part because of the redemption of restructured asset-backed commercial paper (ABCP), a legacy of the financial crisis.

**Chart 4: Canadian mortgage rates have declined further over the past year**



Sources: Bank of Canada and websites of various Canadian mortgage brokers

Last observation: 27 November 2014

<sup>3</sup> One notable exception has been in “lower-rated” Canadian energy producers, where spreads have increased by about 240 basis points since the June FSR.

### *The balance sheets of Canadian banks remain solid*

Despite compressed margins and slowing credit growth, Canadian banks have reported strong earnings throughout 2014. In addition, banks have been increasing their capital positions and continue to benefit from their preferred status in global funding markets. As of the end of October, the average Basel III common equity Tier 1 (CET1) capital ratio for Canadian domestic systemically important banks (D-SIBs), weighted by assets, was 10 per cent, well above the 2016 target of 8 per cent set by the Office of the Superintendent of Financial Institutions (OSFI).

As outlined in the June FSR, the foreign claims of the Big Six banks remain at almost 40 per cent of their total assets. Claims of the Canadian banking sector on the United States, the United Kingdom and emerging-market economies (EMEs), excluding China, make up a significant share of the total, and are important because they can channel external shocks back to Canada. Direct claims of the Big Six banks related to peripheral Europe, Russia and China are very limited.

## Key Vulnerabilities in the Canadian Financial System

The Bank is monitoring three key areas of vulnerability in the Canadian financial system:

- the elevated level of household indebtedness;
- imbalances in the housing market; and
- investor risk taking and liquidity conditions in financial markets.

### Vulnerability 1: Elevated Level of Household Indebtedness

Low interest rates and steady income growth have helped keep the ratio of household debt to income broadly stable and near a historical high. In this context, mortgage arrears and credit card delinquency rates remain low and are declining. However, vulnerabilities could be increasing at the margin, as strong competition among financial entities is promoting riskier borrowing by some households.

#### *Household leverage remains high*

The growth of household credit has picked up since the June FSR but remains close to the levels seen over the past few years (**Chart 5**). Mortgage credit growth has moved higher on the strength of recent resale activity. In contrast, consumer credit growth is relatively unchanged, as credit card balances have dropped, while auto lending has kept up a solid pace, consistent with the strength in auto sales.<sup>4</sup>

As a result, the ratio of aggregate household debt to disposable income remains broadly stable and near its historical peak. In addition, the share of household disposable income allocated to required payments on mortgage debt has not declined over the past several years, despite historically low interest rates (**Chart 6**).<sup>5</sup>

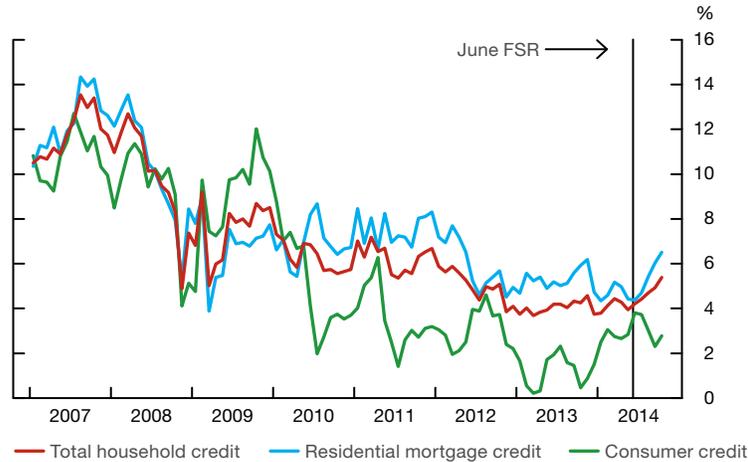
The proportion of highly indebted households is also elevated. About 12 per cent of households have a total debt-to-income ratio above 250 per cent, and although this percentage has been steady over the past

<sup>4</sup> Note that about 15 per cent of consumer credit is composed of auto loans, whereas about 40 per cent is composed of home equity lines of credit (HELOCs). In recent years, there has been little growth in HELOCs as borrowers have shifted more toward mortgages, likely because of limits applied to HELOCs under OSFI's Guideline B-20, which took effect in 2012, as well as continued low mortgage rates.

<sup>5</sup> Estimated payments related to mortgage debt include mortgage interest, as well as a conservative estimate of the required repayment of the principal. The latter is based on the assumption of refinancing each year at a 25-year amortization, given the current outstanding mortgage balance.

**Chart 5: The growth of household credit has picked up**

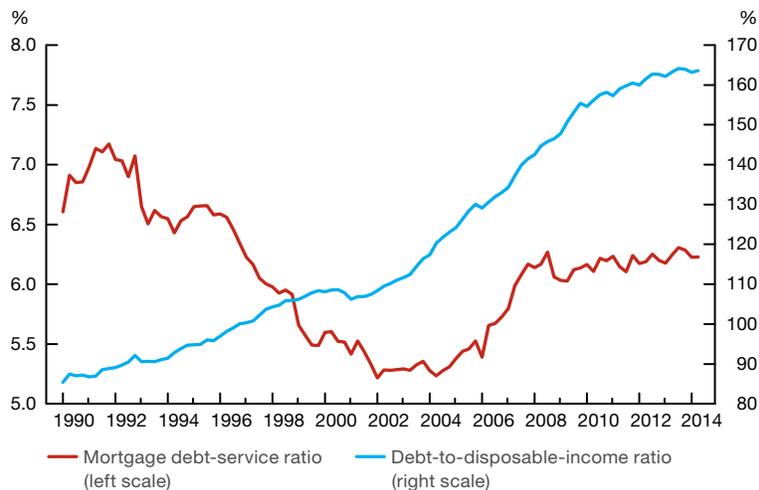
Annualized 3-month growth rates



Source: Bank of Canada

Last observation: October 2014

**Chart 6: The debt burden of Canadian households has been relatively stable**



Note: The mortgage debt-service ratio is mortgage interest plus an estimate of the required principal repayment relative to income.

Sources: Statistics Canada and Bank of Canada calculations

Last observation: 2014Q2

few years, it is almost double its level in 2000. These highly indebted households carry about 40 per cent of overall household debt (Chart 7).<sup>6</sup>

**Demographic factors can influence the degree of vulnerability to negative shocks**

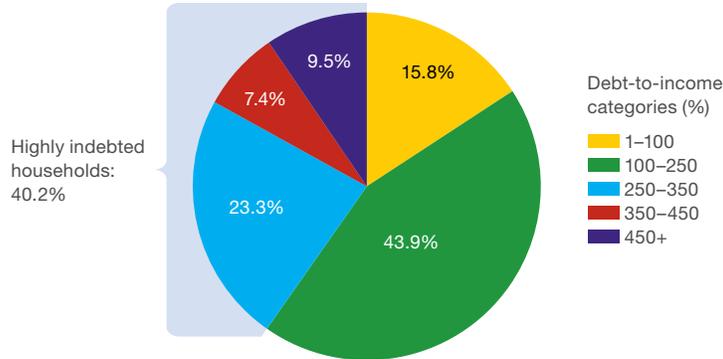
The share of aggregate debt held by younger households is greater than their share of the population, consistent with the standard life-cycle model of savings and consumption.<sup>7</sup> Younger households also tend to be more

<sup>6</sup> Note that about one-third of Canadian households have no debt at all, and this proportion has been relatively constant over the past decade.

<sup>7</sup> According to the standard life-cycle model, individuals try to smooth consumption over their lifetime. Typically, this means that they would borrow relatively more in their younger adult years before paying off debt and saving for their retirement. Households headed by someone under 35 years of age are considered to be young and represent about 20 per cent of all Canadian households. However, they also make up about 30 per cent of households with a debt-to-income ratio of 250 per cent or more and hold about 30 per cent of aggregate household debt.

**Chart 7: Highly indebted households carry a large share of overall household debt**

Share of aggregate household debt held by various debt-to-income categories



Source: Ipsos Reid

Last observation: 2014Q2

vulnerable to economic downturns than the average household. For example, in the last three economic downturns since the early 1980s, the unemployment rate for workers under 35 years of age increased by one and a half times more than it did for workers above the age of 35.

Among the current generation of young households, those who own homes carry more mortgage debt relative to income than previous generations did at the same age. The growth in house prices has accounted for most, but not all, of this intergenerational growth in mortgage debt. As a result, this generation of younger homeowners has become even more vulnerable to negative shocks to income and to higher interest rates than would be suggested by the rise in the average household debt-to-income ratio.

***Strong competition among financial entities may be supporting excessive risk taking by borrowers***

Low interest rates may not only encourage some households to take on high levels of debt, but they may also encourage some financial entities to lend to riskier borrowers.

Over the past several years, certain federally regulated financial institutions have increased their activities in riskier segments of household lending. Although only limited data are available on the activities of other financial entities, they also appear to be expanding in these areas. With increased competition, there may be greater incentives to underprice risk, which would leave lenders, as well as households, more vulnerable to negative economic shocks.<sup>8</sup>

The Bank is monitoring two trends in particular. First, strong auto sales in Canada have been accompanied by significant growth in auto lending by both banks and non-banks, and borrowers with low credit scores now account for about one-quarter of new loans. At the same time, riskier loan characteristics, such as longer loan terms and higher loan-to-value ratios, have become more common. While auto lending has grown rapidly, this business line remains a relatively small proportion of the overall loan portfolios of federally regulated banks and makes up only about 7 per cent

<sup>8</sup> In accordance with international requirements under Basel Pillar 2, OSFI sets capital targets that are tailored to the individual risk profiles of federally regulated financial institutions. Common equity Tier 1 capital ratios continue to increase for smaller deposit-taking institutions as well as for D-SIBs.

of overall household credit. Nonetheless, the recent changes in the auto financing landscape warrant continued monitoring in the context of already-high household indebtedness, particularly if the debt is being incurred by borrowers who are already stretched financially (**Box 1**).

Second, uninsured residential mortgage originations by all lenders have grown markedly in recent years.<sup>9</sup> With the increase in homeowner equity brought about by higher house prices, existing homeowners may be able to finance their new homes with a larger down payment that does not require the purchase of mortgage insurance. On the other hand, low interest rates may be creating stronger incentives for some homebuyers to supplement their down payments through additional borrowing, thereby allowing for lower monthly payments, because they can avoid mortgage insurance premiums and obtain longer amortizations. In the latter case, financial system vulnerabilities related to household leverage and indebtedness are increased.<sup>10</sup>

A more worrisome aspect of this trend is that a sizable proportion of new, uninsured mortgages are being issued to riskier borrowers. For example, about 35 per cent of new, uninsured mortgages by smaller federally regulated banks since the end of 2012 could be considered non-prime (**Chart 8**).<sup>11</sup> Other financial entities, including those that are less regulated, are also engaging in non-prime lending.<sup>12</sup> Even for those lenders that traditionally cater to non-prime clients and, as such, have experience underwriting and managing riskier loans, there is a possibility that risk-management practices (including pricing and provisioning for potential losses)<sup>13</sup> may not be sufficient to compensate for the increase in default rates during periods of stress.<sup>14</sup>

Competition in the insured mortgage market also remains strong, as evidenced by the continued growth in outstanding mortgage credit extended by less-regulated lenders (**Chart 9**), particularly since adjustments to the National Housing Act Mortgage-Backed Securities (NHA MBS) program were introduced by the Canada Mortgage and Housing Corporation (CMHC) in 2013.<sup>15</sup> The changes have ensured that all lenders have equal access

<sup>9</sup> Since 2010, uninsured mortgage lending by D-SIBs and smaller banks has shown average annual growth rates of 10 per cent and 16 per cent, respectively. In comparison, insured mortgage lending has grown by about 5 per cent for both groups of institutions over the same period. There is anecdotal evidence that originations of uninsured mortgages by other lenders have also followed this pattern in recent years. Uninsured mortgages encompass those loans with a higher down payment (lower loan-to-value ratio), which are not necessarily risky.

<sup>10</sup> While hard evidence of such additional borrowing is difficult to obtain, anecdotal evidence suggests that this practice is becoming more common in the context of a reduction in the maximum amortization period for insured mortgages from 40 to 25 years, and as premiums for mortgage insurance rise. However, entities involved in such lending would likely not be federally regulated, since underwriting guidelines for federally regulated lenders do not permit borrowed funds to qualify for a down payment.

<sup>11</sup> Non-prime borrowers are generally characterized as having less capacity to make debt payments, weaker documentation of income and an imperfect credit history. On the basis of available data, we consider non-prime uninsured mortgage borrowers to be those who have a credit score below 650.

<sup>12</sup> Less-regulated lenders include those that are not subject to prudential regulation at the federal or provincial level.

<sup>13</sup> Current accounting rules stipulate that loan-loss provisioning should be based on a backward-looking, incurred-cost model. Such an approach accentuates procyclical and riskier lending behaviour by underprovisioning for potential future losses. This weakness is being addressed through changes in accounting standards, both internationally and in Canada. See <http://www.ifrs.org/Alerts/PressRelease/Pages/IASB-completes-reform-of-financial-instruments-accounting-July-2014.aspx> and <http://www.osfi-bsif.gc.ca/Eng/fi-if/rg-ro/gdn-ort/adv-prv/Pages/freifrs9.aspx>.

<sup>14</sup> During the recent financial crisis, mortgage delinquency rates at smaller lenders that are more focused on non-prime borrowers were, on average, four times higher than those at D-SIBs.

<sup>15</sup> Starting in August 2013, CMHC applied limits on the amount of new guarantees of market NHA MBS (and Canada Mortgage Bonds) and adjusted the allocation methodology. As of January 2014, all issuers of these securities are initially entitled to an equal share of the total capacity, set per quarter. In addition to their initial share allocation, any unused capacity is then made available to remaining issuers on an equal basis. These limits are being carried over to 2015. For more information, see <http://www.cmhc-schl.gc.ca>.

## Box 1

## Recent Developments in Auto Lending

Lending related to auto purchases has increased significantly over the past few years, substantially outpacing the growth in other forms of household credit.<sup>1</sup> This can be explained in part by strong auto sales, and also by important structural changes in the market for auto financing. In particular, there has been a broad shift from lease financing to loan financing since the financial crisis, and banks are taking a more prominent role (**Chart 1-A**).

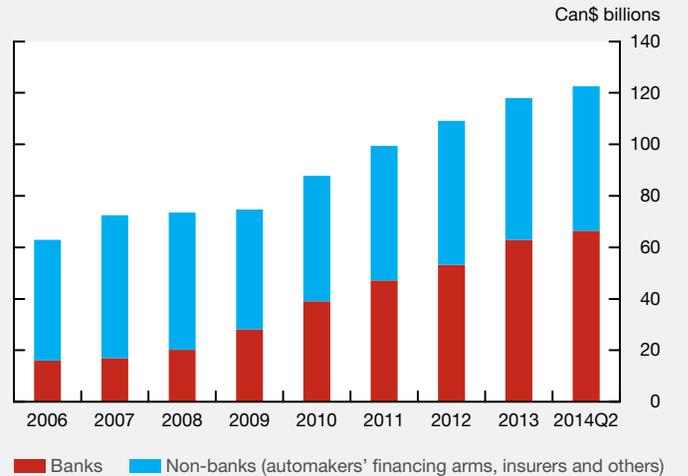
During the crisis, the Canadian financing arms of automakers, which at that time were the dominant providers of auto financing, experienced funding problems as a result of the freeze in the market for asset-backed commercial paper (ABCP)<sup>2</sup> and the financial challenges faced by their parent companies.<sup>3</sup> With their relatively strong balance sheets, banks were able to expand their auto financing activities in the years that followed (in some cases purchasing the financing subsidiaries of automakers) and gain significant market share. More recently, the strong growth in auto lending has attracted other new entrants, including credit unions, insurance companies, foreign financial institutions and unregulated entities.

Industry estimates suggest that, following the pullback from automakers' financing arms, the share of leasing in auto financing has declined to below 30 per cent from a peak of 66 per cent in 2007.<sup>4</sup> Instead, auto loans have become more "lease-like," as innovations such as longer amortizations serve to lower regular monthly payments.<sup>5</sup> These features, which have become increasingly popular, involve greater risk taking on the part of both the lender and the borrower.<sup>6</sup>

The issuance of asset-backed securities (ABS) and ABCP related to auto financing in Canada remains well below

**Chart 1-A: Auto lending has shown steady growth**

Auto loan balances



Note: "Non-banks" does not include credit unions, since data are not available.

Sources: Bank of Canada and Equifax

Last observation: 2014Q2

pre-crisis levels. This partly reflects the increase in banks' market share: while securitization is the key funding source for auto financing subsidiaries, banks tend to retain auto loans on their balance sheets.

In the United States, regulators have recently raised concerns about the growth of riskier loan features to which they attribute increases in the average loss on defaulted loans over the past two years.<sup>7</sup> Moreover, the share of subprime auto lending in the United States has nearly recovered to pre-crisis levels, supported by a resurgence in the subprime auto ABS market. A subprime auto ABS market does not exist in Canada. However, the share of loans to borrowers with low credit scores has increased since the crisis. As of the second quarter of 2014, the non-prime share of total auto loans outstanding in Canada was about 25 per cent.<sup>8</sup>

The recent developments in auto lending raise only modest concerns, given its small share of overall household debt and the limited exposure of banks (less than 3 per cent of their total loans). Nevertheless, continued monitoring is warranted.

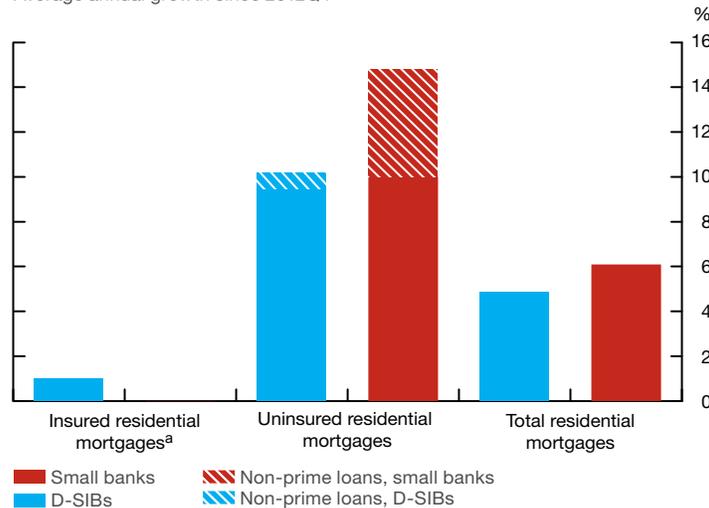
- 1 Since 2011, auto lending in Canada has grown at an average annual rate of about 9 per cent, compared with about 4 per cent for total household credit.
- 2 Demand for Canadian ABCP declined markedly starting in 2007, as part of broader investor concerns globally about asset-backed securities that were triggered by the worsening performance of subprime mortgages in the United States. For more information on the events during this period, see L. Zorn, C. Wilkins and W. Engert, "Bank of Canada Liquidity Actions in Response to Financial Market Turmoil," *Bank of Canada Review* (Autumn 2009).
- 3 General Motors and Chrysler, in particular, declared bankruptcy and required government bailouts in 2009 as part of a court-ordered restructuring process.
- 4 See "Retail Auto Securitization in Canada: Annual Update," DBRS, May 2014.
- 5 The Bank Act prohibits Canadian chartered banks from providing lease financing on consumer goods such as autos.
- 6 Loans with longer amortizations and lower down payments leave the borrower in a negative equity position (i.e., the loan value is more than the value of the vehicle) over a protracted period, because the vehicle often depreciates faster than the borrower can repay the loan's principal. A negative equity position reduces a lender's recovery rate of the loan in the case of default.

7 See "Semi-Annual Risk Perspective," Office of the Comptroller of the Currency, Washington, D.C., Spring 2014.

8 Non-prime auto loans are defined as loans to borrowers with a credit score below 680. However, the specific threshold for non-prime can vary, depending on the data source. While no comparable figures are available for the United States, Equifax reported that 31 per cent of new auto loans in the first half of 2014 were to borrowers with credit scores below 640.

**Chart 8: Non-prime residential mortgage lending is growing more at small banks**

Average annual growth since 2012Q4



a. Lending by small banks in this category is negligible and therefore not visible in the chart.

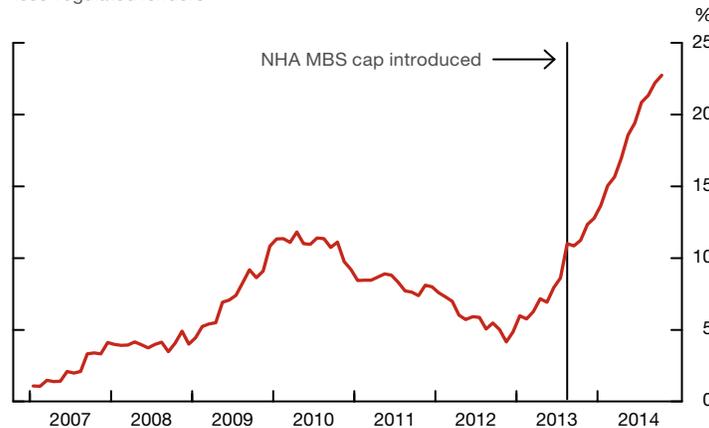
Note: “D-SIBs” are domestic systemically important banks. “Small banks” are the remaining federally regulated domestic deposit-taking institutions.

Source: Regulatory filings of Canadian banks

Last observation: 2014Q3

**Chart 9: Mortgage credit growth at less-regulated entities continues to be strong**

Estimated share of year-over-year growth in insured residential mortgage loans by less-regulated lenders



Sources: Canada Mortgage and Housing Corporation and Bank of Canada Last observation: October 2014

to the program and have increased the amount of NHA MBS and eligible pools of underlying insured residential mortgages that could be issued by smaller lenders. This should not be a concern, provided these mortgages are compliant with sound underwriting principles.<sup>16</sup> However, competition is continuing to exert downward pressure on mortgage rates, and to push lenders to engage in riskier lending.

The changes to NHA MBS allocations that provide greater access to relatively inexpensive funding may also be facilitating a significant buildup in

<sup>16</sup> In 2012, OSFI published Guideline B-20, which sets out expectations for the prudent underwriting of residential mortgages originated or acquired by federally regulated financial institutions. In November 2014, OSFI issued Guideline B-21, which includes principles similar to those outlined in B-20 and covers all residential mortgage loans insured by federally regulated mortgage insurers, regardless of the entity that originates the loans. Full implementation of B-21 is expected in June 2015.

leverage for certain less-regulated lenders that are not subject to the capital and other prudential regulations imposed on federally regulated financial institutions. Higher leverage, in combination with a reliance on potentially less-stable sources of funding, such as brokered deposits, would make these entities more vulnerable to adverse shocks.<sup>17</sup> Although less-regulated lenders account for only a small share of overall lending in Canada, stress experienced by one or several of these entities could have adverse financial and economic spillover effects.

## Vulnerability 2: Imbalances in the Housing Market

The highly stimulative monetary conditions that have supported economic activity in Canada since the onset of the financial crisis have had an important effect on the housing sector. In order to limit the potential buildup of excesses in the housing market and promote its long-term stability, a variety of policy changes have been put in place.<sup>18</sup> Nonetheless, a soft landing in the housing market has not yet materialized, in part because mortgage rates have continued to decline over the past year and also because regional factors have affected housing demand and supply. Indeed, on a national basis, imbalances in the housing sector appear to be edging higher, with a noticeable pickup in both resale activity and in the growth of house prices.

### *House price increases are outpacing income growth*

Growth in house prices has continued to strengthen since the second half of 2013. House prices have risen by 5 to 6 per cent in 2014, outpacing income growth and reigniting concerns about the potential overvaluation in housing markets. While it is difficult to know for certain, the wide range of estimates, including new research done at the Bank of Canada, suggest that there is some risk that housing markets are overvalued (Box 2).

### *Housing market activity has picked up*

The further decline in mortgage rates over 2014 has supported housing activity. Sales of existing homes have picked up noticeably from the weather-related weakness at the beginning of the year and now exceed their 10-year average (Chart 10). Housing starts have been broadly in line with demographic demand.

### *Housing market dynamics have, however, become increasingly uneven across the country*

The national picture continues to mask important differences across regional markets. The growth of house prices and housing activity has remained strong in some of the major cities in southern Ontario and Western

<sup>17</sup> The business models of certain less-regulated lenders are typically built on originating mortgages, both insured and uninsured, to sell to other entities, and this is often done within 30 days of origination. For more information on less-regulated entities and non-traditional funding outside of retail deposits, see Box 2 in the December 2013 FSR and Box 2 in the June 2014 FSR.

<sup>18</sup> Between 2008 and 2012, the Minister of Finance tightened mortgage insurance rules on four occasions to support the long-term stability of the mortgage and housing markets. This included tightening amortization periods, loan-to-value limits for new mortgages and debt-service qualification criteria (see Box 2 in the December 2012 FSR). At the same time, supervision was strengthened. OSFI issued Guideline B-20 in 2012 and Guideline B-21 in 2014. In addition to these policy initiatives, CMHC has made a number of changes that may have also helped to slow the growth of housing market imbalances. For example, it has reduced its annual issuance of portfolio insurance; raised mortgage insurance premiums by 15 per cent; and eliminated products inconsistent with its mandate, such as mortgage insurance for homes with a purchase price higher than \$1 million and for second homes, as well as for self-employed applicants without third-party income validation.

## Box 2

## Assessing Potential Overvaluation in Canadian Housing Markets

There is considerable uncertainty associated with identifying and estimating a benchmark model of house prices. Therefore, any single measure of valuation should be interpreted with caution. In practice, two main approaches have been used, the first based on very simple indicators and the second on more elaborate econometric models of the housing market.

The first approach calculates simple ratios such as the average price of houses relative to the average level of income or rents. Significant deviations from historical averages or from trend are considered to be a rough sign of either over- or undervaluation. This methodology is popular, since the ratios are simple to construct and can be used to compare across countries. However, the ratios are misleading in a number of respects. For example, both the price-to-rent ratio and the price-to-income ratio mask the considerable variation in house prices over time that arises from changes in interest rates. In addition, cross-country comparisons could be misleading, owing to differences in data definitions, demographic factors and regulation.

The second approach is to construct a more formal econometric model and to compare actual prices with those implied by the model evaluated at current fundamentals (e.g., the current level of interest rates and incomes).<sup>1</sup> When a persistent gap emerges between the actual and fitted values, this is interpreted as an under- or overvaluation. This approach has the advantage of providing a consistent framework for assessing the potential determinants of house prices and quantifying their impact. However, it also has drawbacks. For example, many of the existing models ignore the supply-side factors (e.g., the availability of land), which may affect long-run variations in house prices, as is the case in such cities as Hong Kong or Vancouver (see footnote 1). In addition, if the estimation is performed on data from a single country, it may yield imprecise estimates, because there are few housing cycles in a given country during the sample period when house price data are available.<sup>2</sup>

A number of organizations have produced estimates of the degree of overvaluation in Canadian housing markets using these two approaches. Naturally, the differing methodologies lead to a wide range of estimates, reflecting the considerable

challenges associated with this exercise. Some of the estimated values are quite modest (e.g., less than 10 per cent). For example, the Canada Mortgage and Housing Corporation assesses that there is only a “moderate degree of overvaluation.”<sup>3</sup> Both the International Monetary Fund (IMF) and TD Bank estimate that Canadian house prices are overvalued by 10 per cent.<sup>4</sup> Other studies, however, find a greater degree of overvaluation: Fitch Ratings suggests 20 per cent, while *The Economist* suggests a figure of about 30 per cent.<sup>5</sup>

Bank staff have developed a new model of house price determination that adds to the available estimates.<sup>6</sup> The model is designed to address some of the problems noted above by incorporating data on house prices in 18 OECD countries from 1975 to the present.<sup>7</sup> There are 43 major house price cycles in this sample, which allows the estimation method to obtain more precise estimates of the model’s parameters. However, like other models, it suffers from a number of shortcomings. For instance, house price fluctuations in each country are determined solely by changes in demand conditions (i.e., real, per capita disposable income and a long-term government bond yield). The supply side is not explicitly modelled. Constant cross-country differences are captured by country-specific intercept terms, but differences that vary over time are not included.

**Chart 2-A** shows the estimated amount of overvaluation in Canadian housing markets based on 95 per cent confidence intervals (i.e., the lower and upper estimates of overvaluation from the model). The large degree of uncertainty inherent in the model suggests a wide range of estimated overvaluation, running from 10 to 30 per cent, which is within the range of

(continued...)

1 See B. Petersen and Y. Zheng, “Medium-Term Fluctuations in Canadian House Prices,” *Bank of Canada Review* (Winter 2011-12) for some previous Bank of Canada work on the relationship between house prices and fundamentals.

2 To precisely identify the impact of different factors on house prices, it is useful to have sufficient explainable variation in house prices over the sample.

3 See “Housing Now Canada,” Canada Housing and Mortgage Corporation, November 2014.

4 The TD analysis was conducted in mid-2014; see [http://www.pat.td.com/document/PDF/economics/special/QuarterlyRegionalHousing\\_Feb2014.pdf](http://www.pat.td.com/document/PDF/economics/special/QuarterlyRegionalHousing_Feb2014.pdf). The IMF analysis was from the third quarter; see International Monetary Fund, *World Economic Outlook*, October 2014.

5 See Fitch Ratings, “The Weekly Wire” 21 July 2014, and <http://www.economist.com/blogs/dailychart/2011/11/global-house-prices?fsrc=nlw|newe|1-09-2014|5356cd65899249e1ccc8f94c>, respectively.

6 See G. H. Bauer, “International House Price Cycles, Monetary Policy and Risk Premiums,” Bank of Canada Working Paper No. 2014-54.

7 The real house price indexes of the OECD countries used in the analysis were supplied by the Federal Reserve Bank of Dallas. Their national house price index for Canada is a combination of prices from the Canadian Real Estate Association and Royal LePage. This index is used to maintain consistency with the other countries in the analysis.

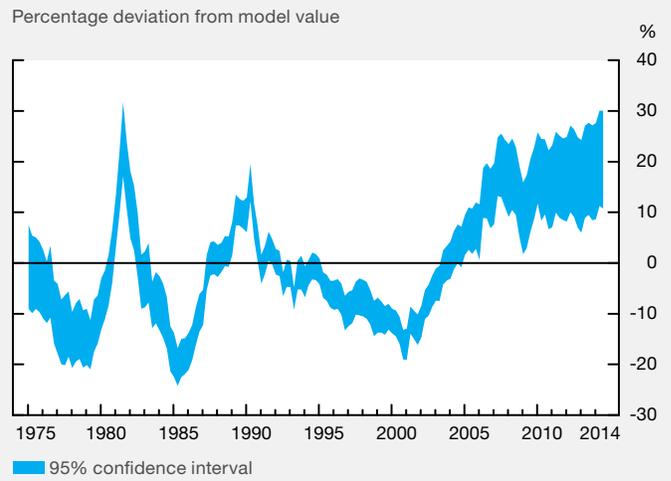
Box 2 (continued)

the external estimates outlined above.<sup>8</sup> It is also similar to overestimations suggested by the model in 1981 and 1990, both of which preceded significant corrections in house prices. However, in both of those previous episodes, house prices were rising very rapidly prior to the downturn, which is often considered a symptom of overheating. Indeed, both the 1982 and 1991 downturns were accompanied by rising interest rates and a recession; in both cases, tighter monetary policy was leaning against rising inflation pressures, of which housing was one component. In the current setting, in contrast, house prices have been rising relative to fundamentals for more than a decade while inflation has remained low. Indeed, according to the model, the Canadian housing market has been overvalued by more than 10 per cent since at least 2007, and has exhibited only a modest degree of upward creep since 2009. This supports the view that a soft landing is the most likely way forward: a stronger Canadian economy

will continue to support the housing market, while household imbalances gradually diminish.

While it is difficult to know for certain, the wide range of estimates, including new research done at the Bank of Canada, suggests that there is some risk that housing markets are overvalued.

**Chart 2-A: Bank of Canada staff estimate of house price overvaluation**



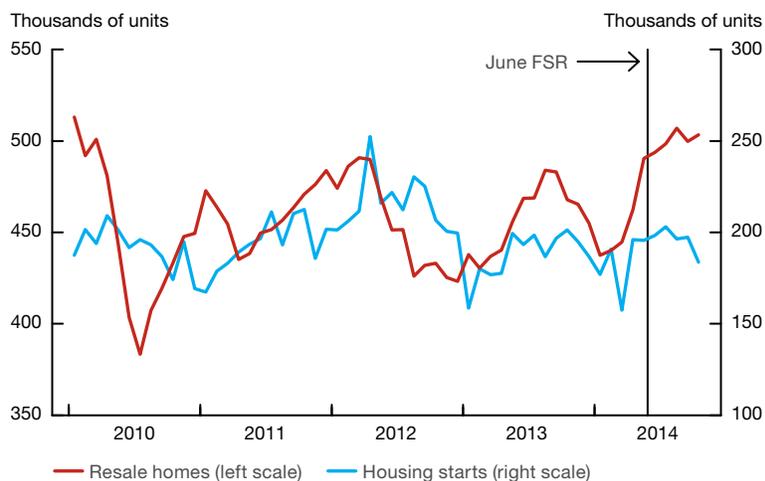
Source: Bank of Canada calculations

Last observation: 2014Q3

<sup>8</sup> It is noteworthy that the degree of the estimated overvaluation in Canadian housing markets is comparable to that of two other countries in the sample, Australia and New Zealand. In the aftermath of the financial crisis, all three financial systems were resilient and able to transmit the stimulative monetary policy measures taken to offset the weakness in exports. See Lawrence L. Schembri, "Housing Finance in Canada: Looking Back to Move Forward," *National Institute Economic Review*, No. 230, National Institute of Economic and Social Research, November 2014.

**Chart 10: Resale activity has picked up**

Seasonally adjusted at annual rates



Sources: Canadian Real Estate Association and Canada Mortgage and Housing Corporation

Last observation: October 2014

Canada (Chart 11). In contrast, low price increases and housing activity, as well as a buildup of inventories, suggest that a soft landing may be taking place in Eastern Canada.

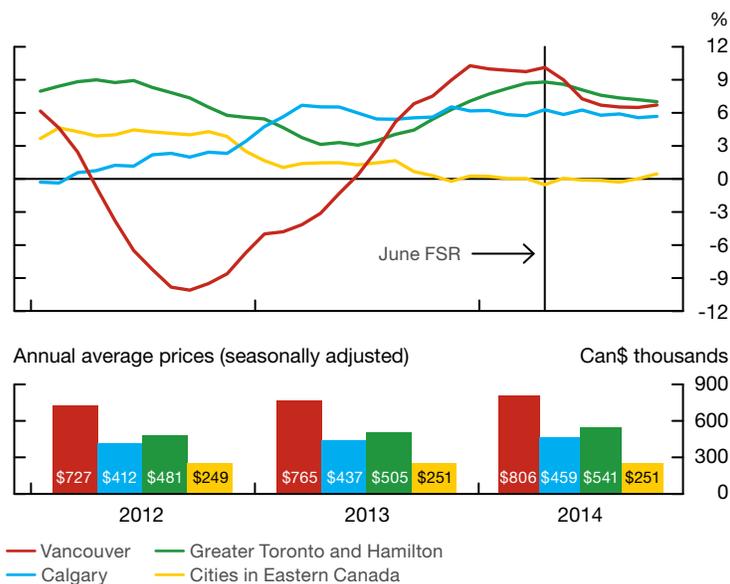
For some cities in southern Ontario and Western Canada, this could reflect, at least in part, demand that is driven by underlying economic fundamentals—for example, international immigration to Toronto and Vancouver and the expansion of the energy sector in Calgary over the past decade. Fundamentals, however, can change quickly. For example, the recent downturn in oil prices could slow Alberta’s real estate market if it were to persist.<sup>19</sup>

In Toronto, the elevated level of units under construction suggests the risk of an impending overbuild, particularly in multiple-unit dwellings. Investors have played a large role in the Toronto condominium market,<sup>20</sup> but the exceptional growth in rental prices that occurred between 2011 and 2013 has dropped off significantly, reducing its attractiveness.<sup>21</sup>

Strong price growth in some of the major cities in southern Ontario and Western Canada has not been restricted to housing markets. Commercial real estate valuations have also risen dramatically in these urban centres since the crisis and are now at post-2000 highs (Box 3).

**Chart 11: The growth in house prices is uneven across the country**

6-month moving average of year-over-year growth in seasonally adjusted average prices



Note: “Cities in Eastern Canada” consists of all real estate markets in Quebec, Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland and Labrador. Average prices for 2014 are calculated from January to October.

Source: Canadian Real Estate Association (CREA)

Last observation: October 2014

<sup>19</sup> Truly localized Canadian house price cycles, both in terms of the factors behind the boom as well as the correction, have typically not spilled over to other regions. For example, the 1991 to 1997 Vancouver house price cycle, which was closely tied to developments in Asia, showed no sign of spilling over into regional housing markets. The Canadian historical experience suggests that a national correction in house prices would be more likely to occur if there were a significant adverse national macroeconomic shock, such as sharply higher interest rates or a broad-based recession, as in 1982 and 1991.

<sup>20</sup> The influence of foreign investors in the Toronto housing market, and in other large urban centres, may be increasing, particularly in the luxury segment. However, little is known about foreign investment in housing, and this is an area for further research.

<sup>21</sup> Nominal rental prices per square foot rose by between 3.5 and almost 7 per cent year over year during the 2011–13 period, but have dropped to about 1 per cent since the start of 2014, which implies that they are now falling on a real (inflation-adjusted) basis.

Box 3

## Heightened Valuations in Commercial Real Estate

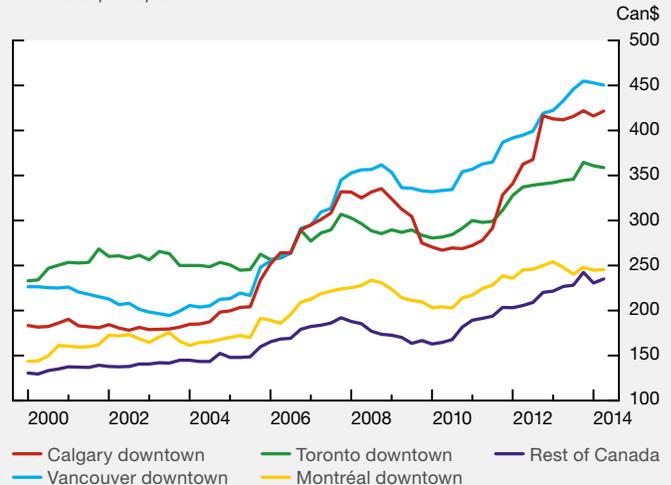
In Canada, as well as internationally, commercial real estate (CRE) prices and investment activity tend to be highly cyclical in nature.<sup>1</sup> CRE financing could employ significant leverage.<sup>2</sup> This leverage, in conjunction with the long lead times required for construction and development, can contribute to severe supply-demand imbalances and price movements in the event that economic growth is well above or below expectations.

Following a slowdown in 2008–09, Canadian CRE investment activity and prices have experienced a rebound in the post-crisis period. Although investment has levelled off since the high point in 2012, CRE investment volumes in 2014 are projected to almost double the approximately \$13 billion observed in 2009.<sup>3</sup>

With the recovery in investment activity to pre-crisis levels, the average real value per square foot has increased by 39 per cent since 2009. The downtown markets of several urban centres have seen especially large increases, led by a rise of about 50 per cent in downtown Calgary (Chart 3-A). Capitalization rates (or “cap rates”)<sup>4</sup> are an important measure of valuation for CRE investors. Since rising property values have continued to outpace growth in rental incomes, cap rates have fallen steadily in the post-crisis period. In the current low interest rate environment, strong investor demand has contributed to rising valuations for CRE. Real estate investment trusts (REITs), pension funds and private equity, in particular, have significantly increased their

**Chart 3-A: Commercial real estate values have been rising**

Real value per square foot



Note: Real values are calculated using provincial CPI for downtown markets and national CPI for the rest of Canada.

Source: MSCI Real Estate- IPD

Last observation: 2014Q2

investment activity in recent years.<sup>5</sup> Moreover, while cap rates have continued to decline, they nonetheless remain very attractive for investors. According to CBRE, the average cap rate spread relative to 10-year Government of Canada bond yields was 396 basis points in the third quarter of 2014.<sup>6</sup>

Given the cyclical nature of CRE markets, particularly the potential sensitivity of CRE to a rise in interest rates, the relatively high valuations and rapid increases in CRE prices observed since 2009 represent a vulnerability. A sharp correction in CRE markets could affect a wide range of financial sector entities, including banks, credit unions, and life insurance companies.

1 For example, Canadian CRE indexes experienced significant declines in the early 1980s the early 1990s, and in 2008–09.  
2 Many Canadian REITs have total debt-to-capital ratios of between 45 per cent and 55 per cent (DBRS, Industry Study, “Canadian Real Estate, Q3 2014,” December 2014).  
3 “Canada Investment - MarketView: Q2 2014,” CBRE Global Research and Consulting.  
4 Cap rates are typically calculated as the ratio of the net operating income produced by a property to either its historical cost or its current market value.

5 Although there is a lack of hard evidence regarding foreign investment in Canadian CRE, market commentary suggests that post-crisis demand has been amplified further by foreign investors attracted to Canada’s “safe-haven” status.  
6 “Investment Insights: Q3 2014,” CBRE Capital Markets.

## Vulnerability 3: Investor Risk Taking and Illiquidity in Financial Markets

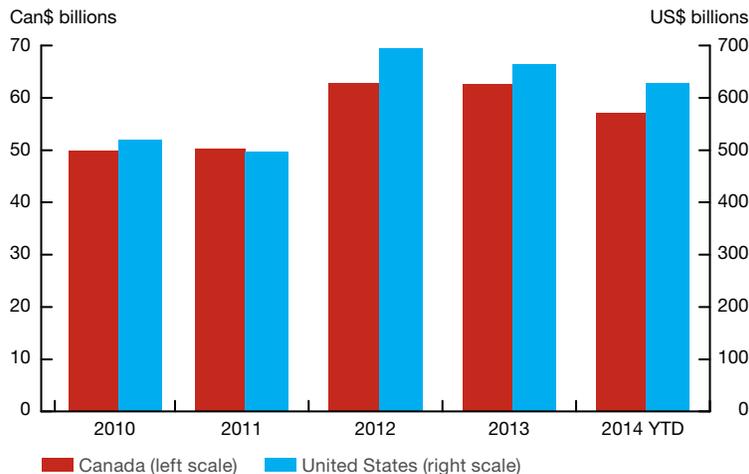
Despite widely held expectations of an eventual tightening in monetary policy, current monetary conditions continue to create incentives for increased risk taking in financial markets, both globally and in Canada. Anecdotal evidence suggests that highly leveraged positions remain limited in domestic markets. Nevertheless, increased risk taking related to credit, markets and liquidity could increase volatility in times of market stress.

**Investors continue to search for higher returns in Canadian markets**

Demand for riskier assets in Canada has been robust over recent years, leading to a significant increase in the size of some asset markets. For example, from 2006 to 2013, the value of Canadian non-financial corporate bonds outstanding rose by 70 per cent from Can\$118 billion to Can\$203 billion. Throughout 2014, issuance of corporate bonds has remained strong (Chart 12), both domestically and in the United States, and spreads have been below long-term averages. Spreads are higher, however, than those observed in the period leading up to the financial crisis and have widened in recent months (Chart 13).

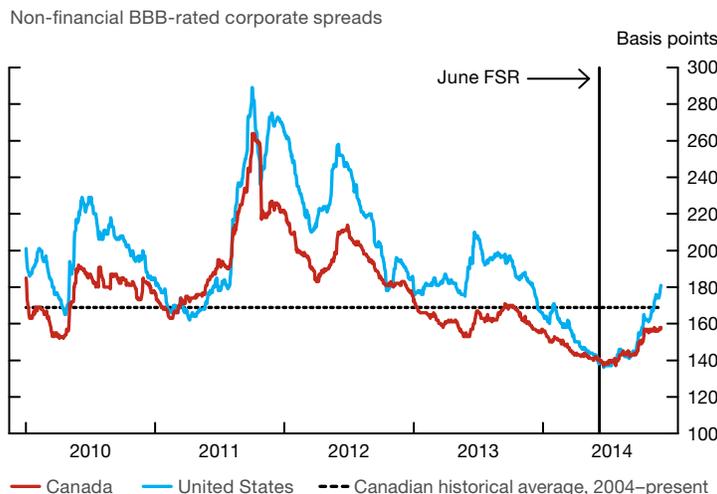
Similarly, during 2014, Canadian equity prices have generally remained fairly close to record nominal levels. The demand for Canadian corporate bonds and equities has been supported, in part, by foreign investors. Over the past two years, foreign investment flows into Canada have shifted away from government bonds toward corporate bonds and equities (Chart 14).

**Chart 12: Issuance of non-financial corporate bonds has remained strong**



Note: Issuance includes all investment and non-investment-grade corporate bonds.  
 Source: Dealogic Last observation: 3 December 2014

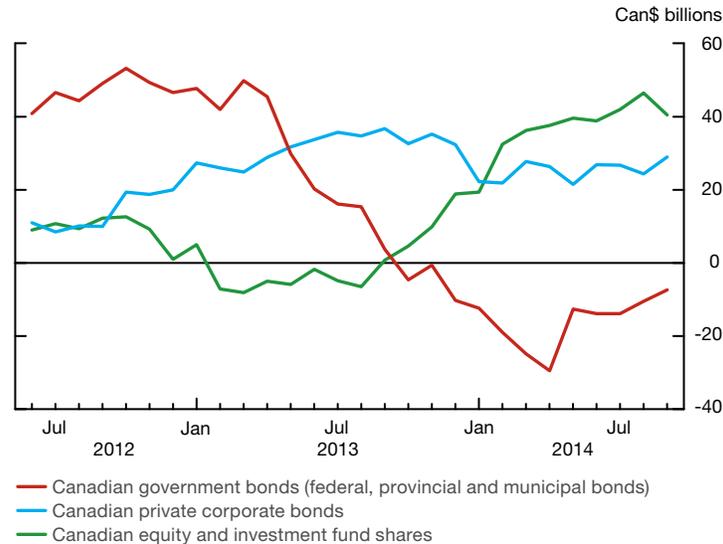
**Chart 13: Corporate bond spreads have widened recently**



Source: Bank of America Merrill Lynch Last observation: 3 December 2014

**Chart 14: Foreign investors have shifted into Canadian equities and corporate bonds**

12-month foreign flows into Canadian securities



Source: Statistics Canada

Last observation: September 2014

In addition to improving fundamentals, recent trends in asset prices could reflect investors' search for higher returns, possibly indicating that some investors have not fully taken into account potential credit downgrades, interest rate increases or possible difficulties unwinding their positions if future market conditions deteriorate. Market intelligence suggests that, in order to achieve higher returns, global investors, including those in Canada, are purchasing riskier assets rather than taking on more leverage. In the short term, continued low volatility in Canadian and other developed markets might create further incentives for risk taking. Therefore, a sudden revaluation of risk or a rise in volatility could amplify periods of market stress and lead to sizable losses for some investors.

***A potential deterioration of liquidity in Canadian corporate bond markets may not be fully priced in***

As in other financial markets, liquidity in Canadian corporate bond markets could deteriorate quickly and significantly during episodes of future financial distress. Market trends suggest that more sizable price swings might be observed in the future than previously, should investors seek to simultaneously unwind large positions. This impact might be exacerbated should these price fluctuations induce further portfolio reallocations.

Two market trends in particular should be highlighted.

First, the composition of corporate bondholders is changing. One aspect of this is that the share of outstanding corporate bonds held by mutual funds and exchange-traded funds (ETFs) has been rising.<sup>22</sup> These funds must rebalance frequently to track an index or match a benchmark. Mutual funds and ETFs are likely to contribute positively to the liquidity of the Canadian corporate bond market in normal times, but could contribute to price dislocations if there are a large number of redemptions or investor

<sup>22</sup> In the United States, the share of outstanding non-financial corporate bonds held by mutual funds, ETFs and closed-end funds increased from 8 per cent in 2006 to 23 per cent in 2013.

runs (see the report on page 37).<sup>23</sup> One mitigating factor, however, is that Canadian mutual funds holding relatively more leveraged or illiquid assets also tend to hold comparatively larger cash balances. This should help them to meet higher redemptions and reduce the risk of large forced sales.

Similarly, foreign investors are also holding a growing share of Canadian corporate bonds outstanding, thereby contributing to liquidity in normal times. However, while increasing the diversity of market participants is a stabilizing factor, foreign investors with significant holdings of Canadian assets could expose domestic markets to external shocks that might trigger or intensify sell-offs in periods of financial stress.

Second, many market participants believe that dealers in Canada and elsewhere are reducing their market-making activities, partly reflecting the impact of regulatory changes. This in turn is thought to have made it more difficult and more costly to unwind large corporate bond positions. A recent report by the Committee on the Global Financial System (CGFS) points to a range of evolving market factors, such as the adoption of stronger risk-management frameworks, reduced risk appetite and less proprietary trading, as potential determinants for reduced market-making activities.<sup>24</sup>

## Key Risks

This section discusses the risks that the Governing Council judges to be the most important for assessing the stability of the Canadian financial system. The triggers for these key risks are broadly the same as those noted in the June FSR and emanate mainly from the external environment.<sup>25</sup> The discussion includes an overall risk rating that is based on judgment regarding the probability of the risk materializing and the expected severity of the impact on the Canadian financial system if it does materialize.

### Risk 1: Household Financial Stress and a Sharp Correction in House Prices

The most important domestic financial system risk is the inability of highly indebted households to service their debt in the face of a sharp decline in their incomes, leading to a large and widespread correction in house prices. This risk continues to be rated as “elevated.” The probability of this risk materializing is low, but if it were to materialize, the effect on the economy and financial system could be severe.<sup>26</sup>

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<sup>23</sup> Note, however, that the U.S. Securities and Exchange Commission has adopted amendments to rule 2a-7 that authorize new tools for money market mutual funds to use in times of stress to stem heavy redemptions and avoid contagion. These include the ability to impose a liquidity fee and to suspend redemptions temporarily (i.e., to “gate” funds), if a fund’s weekly liquid assets (i.e., cash, government securities, short-dated securities, etc.) fall below 30 per cent of its total assets.

<sup>24</sup> The CGFS report, “Market-Making and Proprietary Trading: industry Trends, Drivers and Policy Implications” (November 2014), notes that it is difficult to provide a definitive assessment of the impact of regulations on market-making activity, since changes are being driven by both conjunctural and structural factors. Regulations are intended to facilitate the adjustment of liquidity premiums to be more consistent with actual market-making capacity and costs, given that liquidity risks were broadly underpriced in the run-up to the financial crisis.

<sup>25</sup> The discussion of the key risks updates the analysis provided in the June 2014 FSR.

<sup>26</sup> Any parallels to the U.S. housing crash and its impact on the financial system are, however, limited. First, unlike in the United States, nearly all mortgages in Canada are full-recourse loans. Second, there is no evidence that the poor underwriting standards that supported the explosion of subprime mortgages in the United States prior to the crisis are present in Canada. Third, much of the Canadian housing finance system is backstopped by CMHC-guaranteed mortgages and, ultimately, by a fiscally sound federal government. See “The Residential Mortgage Market in Canada: A Primer” by Allan Crawford, Cesaire Meh and Jie Zhou, December 2013 FSR, pages 53–56.

The most likely trigger for this risk is a negative foreign demand shock, or a combination of shocks, that leads to a severe recession in Canada and a sharp rise in the unemployment rate. While the recent fall in commodity prices has had a negative effect on the Canadian economy, it is likely that a larger shock would be needed to trigger this risk. Alternatively, the risk could be triggered by a rise in unemployment that is caused by a surge in global long-term interest rates, as discussed in **Risk 2**.

### *The risk continues to be rated as elevated*

The Bank continues to expect a constructive evolution of imbalances in the household and housing sectors as the economy improves.<sup>27</sup> However, vulnerabilities associated with Canadian household indebtedness and housing markets are edging higher, partly owing to low interest rates. As a result, the impact of this risk, should it materialize, has increased somewhat. The probability of a large negative foreign demand shock, however, has gone down. The strengthening U.S. economy makes it more likely that we will see the long-hoped-for rotation in Canadian demand away from household spending and toward exports and investment, together with a gradual increase in long-term interest rates. As a result, the risk continues to be rated as elevated.

### *A decline in incomes exposes high household indebtedness and spills over to housing markets*

The impact of sharply lower incomes, magnified by the high level of household indebtedness, would be quite challenging for the Canadian economy. Younger homeowners would likely be affected most severely. Servicing debt would become particularly difficult for highly leveraged households that have been affected by job losses, leaving less income for consumption spending. Many households would be forced to sell their homes, triggering a drop in house prices.

A sharp tip in the balance toward more sellers than buyers could lead to a large price correction, especially if house price valuations are significantly overstretched. Lower house prices would lead to a reduction in housing activity, but also, perhaps more importantly for the macroeconomy, to a reduction in consumption spending via a negative wealth shock. All of this would, in turn, adversely affect the Canadian financial system, causing negative feedback effects on the real economy.<sup>28</sup>

In such circumstances, financial sector entities could experience a sharp decline in revenues and an increase in loan losses. Consumer and business loans, particularly those linked to construction and real estate financing, would generate sizable losses. Mortgage insurers would also be heavily exposed. Financial institutions, typically those smaller lenders that are more highly exposed to uninsured mortgages of lower credit quality, could see a substantial rise in loan defaults and losses. In this event, a group of smaller lenders could fail.

Financial institutions could also experience considerable funding challenges. Funding through additional NHA MBS could be cut off or become more expensive, owing to higher mortgage delinquency rates.<sup>29</sup> Wholesale

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<sup>27</sup> A constructive evolution is characterized by the stabilization and gradual decline in the household-debt-to-income ratio, housing activity in line with demographic requirements, and house price increases in line with or below income growth.

<sup>28</sup> For example, non-price credit conditions could tighten significantly, and the cost of borrowing could rise sharply.

<sup>29</sup> If the rate surpassed the 1 per cent threshold set by CMHC, issuers would lose additional NHA MBS funding. See footnote 24 in the June FSR for a full explanation.

market funding could also be curtailed, and any funding pressures on larger banks could be passed on to smaller entities—for instance, if larger banks were to pull back their brokered deposits.

Significant effects could also be felt in Canada’s financial markets through sharp declines in the prices of equities and corporate debt. The construction, real estate and financial sectors could be particularly hard hit.<sup>30</sup>

### Risk 2: A Sharp Increase in Long-Term Interest Rates

The second key financial system risk is sharply higher long-term interest rates, both globally and in Canada, caused by a substantial increase in long-term interest rates in the United States that could be triggered, for example, by a market reassessment of the future path of U.S. monetary policy. This risk continues to be rated as “moderate.” Its probability is low, but there would be a moderately severe effect on the Canadian financial system if the risk were to materialize.

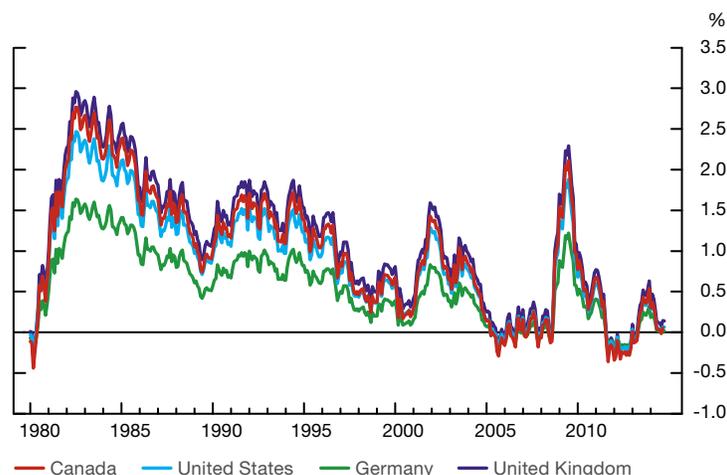
In the wake of a sudden shift in market expectations about the evolution of U.S. monetary policy, global term premiums and long-term interest rates could spike higher (Chart 15). This could then lead to higher risk premiums and decreases in asset prices that could be exacerbated by liquidity constraints. The effects of these international developments would be rapidly transmitted to Canada through its strong links to global financial markets, as well as through trade and confidence channels.

#### *Despite market uncertainty, the probability of a sharp increase in long-term rates continues to be low*

Market participants continue to express uncertainty related to both the timing and pace of future increases in the U.S. policy rate.<sup>31</sup> It is also unclear how a shift in the expectations for U.S. policy rates might affect term premiums and, in turn, long-term rates and asset prices, especially as crowded positions unwind in illiquid markets.

**Chart 15: Global term premiums remain low**

Yields on 10-year zero-coupon government bonds: estimated term-premium component



Sources: Bloomberg, International Monetary Fund, Bank of England, Deutsche Bundesbank, U.S. Federal Reserve and Bank of Canada (including calculations)

Last observation: October 2014

<sup>30</sup> Stock prices for the largest Canadian banks fell by 20 per cent during the 1990s housing correction.

<sup>31</sup> See J. H. E. Christensen and S. Kwan, “Assessing Expectations of Monetary Policy,” Federal Reserve Bank of San Francisco *Economic Letter*, 8 September 2014.

Historical experience suggests that interest rates adjust rapidly once a tightening cycle is imminent, which could lead to increases in long-term rates and a sudden revaluation of asset prices.<sup>32</sup> However, the relatively mild market reaction to the end of the Federal Reserve's program of asset purchases suggests that U.S. monetary policy adjustments in the near term may not have outsized outcomes. Furthermore, the U.S. Federal Reserve is well aware of the challenges to policy normalization and has taken a number of measures to facilitate a smooth exit from its accommodative monetary stimulus, including clear communications about its intentions.<sup>33</sup>

### *The potential impact of this risk remains moderately severe*

Strong financial market integration would transmit changes in U.S. long-term rates to other jurisdictions, including Canada. The global risk-premium component in long-term yields could rise sharply, leading to increases in Canadian yields and market volatility.<sup>34</sup> More generally, higher term premiums would put downward pressure on global and domestic asset prices, potentially leading to losses that could motivate investors to unwind their positions in risky assets. As a result, longer-term borrowing rates in Canada, such as 5-year mortgage rates and long-term rates on corporate and government bonds, would rise abruptly.

Also, as noted in the June FSR, higher long-term rates would increase debt-service costs for highly indebted Canadian households, which could lead to a rise in loan defaults and downward pressure on housing prices. Higher long-term rates could also increase funding costs for financial and non-financial corporations, which would lead to a reduction in business investment. Weaker demand for Canadian exports, lower commodity prices and reduced confidence would also weigh on the Canadian economy.

If the rise in long-term rates occurred in the context of weak employment in Canada, it could trigger the scenario described in **Risk 1**. Similarly, higher long-term rates globally would also increase debt-service costs for euro-area banks and sovereigns, potentially setting off financial stress in the euro area, as outlined in **Risk 3**.

## **Risk 3: Financial Stress from the Euro Area**

A significant euro-area stress event is a key risk for Canada's financial system. Offsetting positive and negative developments since the June FSR have kept the risk rating unchanged at "elevated": the probability that this risk would materialize is medium, and the impact on Canada is unchanged at moderately severe.

A sharp slowdown in euro-area economic growth, particularly when combined with deflation, could threaten fragile sovereign balance sheets and aggravate lingering vulnerabilities in the banking sector, triggering significant, widespread stress in the euro-area financial system that feeds back

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<sup>32</sup> For example, in mid-March 2004, before the tightening cycle that subsequently started in June of that year, the December 2004 eurodollar contract traded at around 1.5 per cent. In early May, just prior to the first rate hike, this rate was over 2.50 per cent. Similarly, in January 1994, before the tightening cycle that began in February 1994, the December 1994 eurodollar contract traded at around 4.30 per cent. By early March, this rate was 5.25 per cent. See Ted Wieseman (Morgan Stanley), *Treasury Market Commentary*, 17 September 2014.

<sup>33</sup> These measures include the introduction of an Overnight Reverse Repurchase Agreement facility and a Term Deposit facility. Both of these facilities are still in development, but when operational, they will complement the set of tools available to the Federal Reserve for implementing monetary policy.

<sup>34</sup> The IMF estimates that a 100-basis-point rise in the U.S. term premium would result in an increase of 50 to 70 basis points in the Canadian term premium. For a more complete discussion on the potential impacts of U.S. monetary policy normalization on other major economies and their sovereign bond markets, see the International Monetary Fund, *Global Financial Stability Report: Moving from Liquidity to Growth-Driven Markets*, April 2014, Chapter 1.

to the real economy. An external economic event, such as that described in **Risk 2** or **Risk 4**, or a severe stress in the Russian economy and financial system, could also lead to significant economic and financial difficulties in the region.

### *The probability of significant financial system stress in the euro area remains medium*

In October, the results of the ECB's comprehensive assessment of European banks were released, and concerns about a potential negative market reaction proved unwarranted.<sup>35</sup> Indeed, the market response has been relatively muted. The exercise has improved transparency and comparability across banks, for example through a harmonized definition of non-performing assets, and there is increased market confidence about the health of most major European banks. Although a small subset of banks was identified as needing more capital, many banks had taken necessary actions in advance of the release to strengthen their balance sheets. In addition, the stress-test scenario was viewed by commentators as sufficiently rigorous, although it has been noted that the exercise did not capture the possibilities of a sovereign default or widespread deflation.

Despite positive outcomes from the banking sector review and recent monetary policy actions by the ECB, a resurgence in bank lending will still be constrained by the lack of private sector demand: the euro-area recovery has stalled, and persistently low inflation in the region has reduced inflation expectations to their lowest levels since the crisis (**Chart 16**). A further slowdown in nominal GDP growth and the threat of widespread deflation raise the spectre of an even more difficult deleveraging process going forward, especially in the peripheral countries.

Market concerns regarding some peripheral sovereign debt have resurfaced along with the deteriorating economic outlook. For example, 10-year sovereign spreads to German bunds have widened in Greece and Portugal, and the share prices of banks in these countries, which have strong links to their governments, have fallen.<sup>36</sup>

In addition to domestic constraints on growth, the euro area is vulnerable to a worsening of geopolitical tensions, as well as a deterioration in economic and financial conditions in Russia.<sup>37</sup> Sanctions imposed by Western countries and the considerable fall in oil prices have contributed to financial market turmoil in Russia. The ruble has depreciated by around 30 per cent versus the U.S. dollar since 1 September, and capital has flowed out of Russia in recent months. The decline in oil prices has also put a significant strain on Russia's fiscal situation, given that oil accounts for about 45 per cent of government revenues. With Russian external debt of about \$US700 billion, recent events have led to heightened concerns by investors about their exposures.

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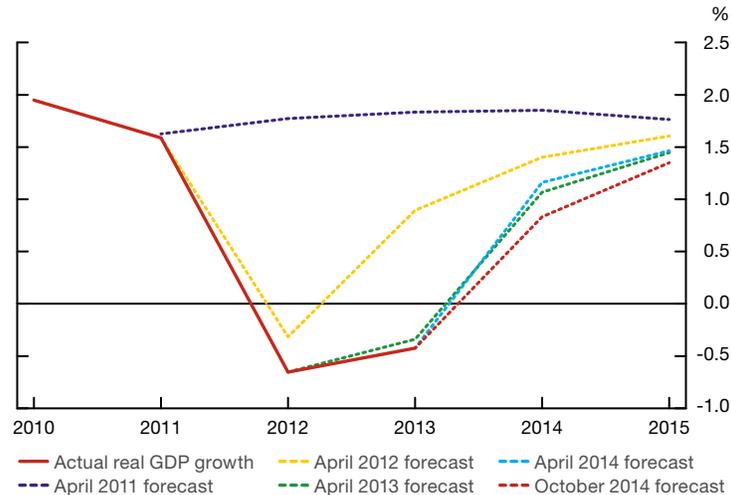
<sup>35</sup> On 26 October 2014, the ECB released the results of its year-long review of the balance sheets of European banks and accompanying stress tests conducted by the European Banking Authority.

<sup>36</sup> As of the second quarter of 2014, the ratio of government debt to GDP in Greece and Portugal was 180 per cent and 130 per cent, respectively.

<sup>37</sup> Banks from Austria, France, Italy and the Netherlands have the highest exposures to Russia and to the Russian non-bank private sector. In terms of capital, Austrian banks are the most exposed to Russia at 39 per cent of CET1 capital, while exposures of the Netherlands, France and Italy are 24 per cent, 20 per cent and 20 per cent, respectively.

**Chart 16: Serial disappointment is evident in IMF forecasts of euro-area GDP**

Annual percentage change in real GDP



Sources: International Monetary Fund (IMF), *World Economic Outlook*, April 2011, April 2012, April 2013, April 2014 and October 2014

Last data point plotted: 2015

On balance, offsetting developments since the June FSR have kept the probability of significant stress in the euro area at a medium level. However, the expected slow recovery has become even more fragile, with greater risk of a more severe decline, which could interfere with the completion of necessary reforms and further weigh on the economic and financial outlook for the area.

*The overall impact of a euro-area stress event would have a moderate level of severity for Canada*

As described in the June 2014 FSR, financial linkages would be the main transmission channel of a euro-area crisis to Canada, with a global flight to safety, a widespread retrenchment from risk and a broad repricing of assets. Canadian banks could see higher wholesale funding costs, as well as losses related to their exposures to U.K. and U.S. banks that have important euro-area exposures.<sup>38</sup> In addition, Canadian economic growth would be reduced through tighter credit conditions for Canadian households and businesses; a deterioration in overall confidence; a reduction in exports, due in part to third-country effects such as weaker U.S. demand; and lower commodity prices.

**Risk 4: Stress Emanating from China**

The fourth key financial system risk is a serious financial disruption in China that leads to a significant slowdown in Chinese and global economic growth. This risk continues to be rated as “elevated”: the probability of this risk materializing is still medium, and the impact on Canada from this risk scenario would be moderately severe.

Existing strains in China’s financial system could worsen, triggering a series of defaults in the shadow banking sector that could then spread quickly across the financial system, leading to a credit squeeze and a severe decline

<sup>38</sup> During the period of euro-area stress in 2011–12, Canadian banks fared better than their global peers, given their relatively strong capital positions and limited direct exposures to euro-area assets. These factors could again help to mitigate the impact of a deterioration in overall global funding conditions.

in economic growth. This would reduce global economic growth and lead to a reduction in global commodity prices, trade and confidence that would feed back to Canada.

*The probability of financial disruption in China is unchanged from the June FSR, although some vulnerabilities are intensifying*

On the positive front, Chinese authorities have continued to take measures to better control credit growth and address risks in the supply chain of credit intermediation. These actions have led to slower growth in non-bank lending overall, particularly direct lending by trust companies.<sup>39</sup> However, this may also be encouraging credit generation to move to other areas in the shadow banking system.<sup>40</sup>

Official measures have also recently been put in place to help address vulnerabilities related to property markets.<sup>41</sup> Property valuations have deteriorated sharply, and there is the possibility of an even-deeper-than-expected correction in China's housing market. Property developers are struggling with high inventories, thin profit margins and high debt levels, and non-bank lenders have significant exposures to these developers.

At the same time, the value of non-performing loans at Chinese banks is growing in aggregate (Chart 17), and an increasing reliance on short-term, interbank borrowing by small and medium-sized banks suggests some funding and liquidity challenges.<sup>42</sup> In addition, local government debt obligations have grown to represent almost 35 per cent of China's GDP, and this remains a key financial system vulnerability.

While there is continued belief that the Chinese authorities have the ability to raise financial resources to backstop the financial system, if required, the complexity of the system and the speed with which incidents could proliferate could make it challenging for authorities to prevent a hard landing.

*The effects of a hard landing in China would be felt globally, with a moderate severity in Canada*

As described in the June 2014 FSR, a hard landing in China would have global ramifications through trade, financial and confidence effects. The effects could be amplified if this occurred in the context of higher U.S. long-term interest rates, as outlined in Risk 2, or if such an event reignited a euro-area financial crisis (Risk 3).

<sup>39</sup> In the first three quarters of 2014, total social financing (TSF), a broad credit measure, was down by RMB 1.1 trillion from a year earlier, in part owing to the tightening regulation over shadow banking activity. However, on 21 November, the People's Bank of China (PBoC) cut its benchmark one-year lending rate by 40 basis points—the first cut in more than two years—as a means to stimulate the economy.

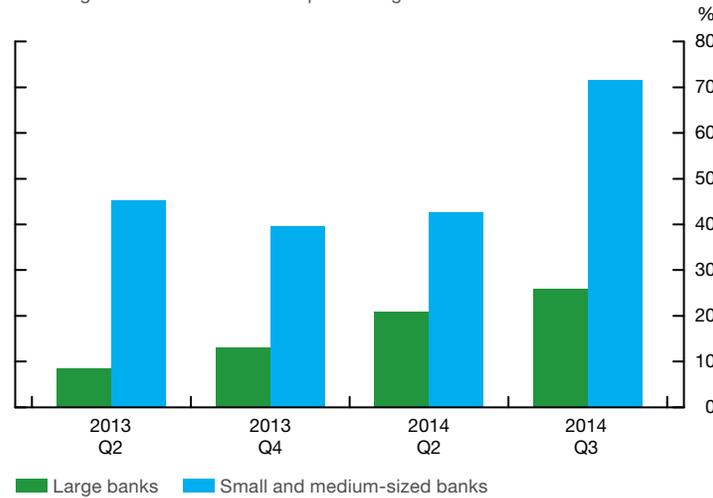
<sup>40</sup> For example, it is estimated that entrusted loans—corporate-to-corporate lending that typically involves on-lending of bank credit to riskier borrowers—are the fastest-growing component of the shadow banking sector. These loans are more difficult to monitor and control.

<sup>41</sup> In September, the PBoC announced a number of measures to support property markets, most significantly a reduction in the down payment requirements on mortgages for second homes for those homeowners who have paid off the mortgage on their first home. The PBoC also encouraged banks to issue mortgage-backed securities and other long-term obligations to support mortgage loans, as well as to meet the reasonable financing needs of real estate developers. In addition, most local governments have also relaxed ownership restrictions on investment properties.

<sup>42</sup> On 30 November, the State Council of China released a draft plan to establish a deposit insurance program covering almost all depositors in Chinese commercial banks, although wealth-management products and other off-balance-sheet activities would not be included. The program, which is considered by market analysts to be a necessary step for the liberalization of deposit rates, would likely lead to additional funding challenges and increase the potential for failures for small and medium-sized banks.

**Chart 17: Non-performing loans at Chinese banks are on the rise**

Annual growth in the value of non-performing loans



Sources: Bloomberg and company reports

Last observation: 2014Q3

The resulting decline in global commodity demand and prices would be the key transmission channel back to Canada. The impact would be particularly acute given the large declines in prices already experienced in some commodities such as oil. Lower commodity prices lead to a decline in Canada’s terms of trade and cause Canadian income, wealth and GDP to fall. Parts of Western Canada, in particular, would be severely affected, including housing markets. Lower commodity prices would also induce commercial loan losses at Canadian banks and other financial sector entities, especially certain regional lenders. In addition to the direct impact of lower commodity prices, there would also be important trade effects and a potential spillover of lower confidence to Canada.

## Potential Emerging Vulnerabilities and Risks in the Canadian Financial System

The identification of key vulnerabilities and risks in the financial system is a dynamic process. Therefore, the list presented in this document is not intended to be exhaustive. There are other potential emerging vulnerabilities and risks that are being monitored. In this section, we highlight some of these concerns, including the threat from cyber attacks, which is discussed in **Box 4**.

**Weaker commodity prices:** The prices of oil and other commodities have fallen significantly in recent months, leading to concerns that commodity-producing economies and their financial systems could become stressed. In particular, if low commodity prices persist or decline further, fiscal conditions in Russia and some Latin American countries could continue to deteriorate, leading to additional capital outflows, currency depreciations and a market reassessment of their sovereign and corporate debt, particularly if issued in U.S. dollars.

Global financial markets could also be affected if commodity prices continue their downward trend. Price fluctuations in credit and commodity derivatives could lead to higher market volatility and induce investor losses.

## Box 4

## Cyber Risk in the Canadian Financial System

A cyber attack that affects the core systems of financial market infrastructures (FMIs) or multiple financial institutions could cause a prolonged disruption to the provision of financial services in Canada. A disruption at one financial institution could affect others because of the high degree of interconnectedness between financial institutions and the FMIs that facilitate transactions between them. A prolonged interruption could in turn have serious systemic impacts on financial markets, owing to the inability of financial institutions to exchange transactions.

An event of this magnitude has a very low probability of occurring. Recent high-profile attacks on financial institutions have been limited to the theft of proprietary data<sup>1</sup> and the disruption of web-based services.<sup>2</sup> However, the increasing

capabilities of a broader range of cyber actors require that cyber defences keep pace in order to guard against a potential shift toward disrupting core operations.

A cyber attack that leads to a prolonged operational disruption would have a profound impact on the Canadian financial system. The inability to conduct financial transactions, such as making payments or settling securities purchases, could have knock-on effects through impacts on financial markets.

Overall, the financial sector is judged to have advanced cyber defences, but there are areas for improvement. For example, intelligence exchange and safeguards for preventing data loss are less mature than other aspects of cyber resilience, such as threat detection. The establishment of strong individual cyber-security defences is not sufficient to mitigate the potential risks in an interconnected financial system. Therefore, there is a need for continued collaboration among financial institutions, FMIs and the federal government to achieve collective operational resilience.

1 N. Perloth, "JPMorgan and Other Banks Struck by Hackers," *The New York Times*, 27 August 2014.

2 P. Crosman, "DDoS Attacks Are Still Happening — and Getting Bigger," *American Banker*, 28 July 2014.

In addition, in an effort to mitigate the impact on their fiscal balances, commodity-producing countries might liquidate some of their foreign reserves, creating instability in fixed-income markets.

In the United States and Canada, persistent low oil prices could reduce revenues below break-even points for some producers and restrict access to funding for smaller companies in the oil sector. In the long run, this could increase unemployment in certain regions and accrue financial losses for regional banks with high exposures to the energy sector. Larger banks, however, tend to be well diversified and are less likely to be as affected by regional or sectoral fluctuations.

**Growth in market-based financing (shadow banking):** Owing in part to more stringent banking sector regulations, market-based financing in Canada and other advanced economies has grown over the past several years and will likely continue to grow as regulatory reforms are fully implemented. While a dynamic financial sector is a necessary condition for real economic growth, activity outside of the regulatory perimeter could allow vulnerabilities to build, with the potential for negative spillover effects to other sectors of the financial system. In particular, the lack of transparency could hide excessive leverage, maturity mismatches and, more generally, inadequate risk-management practices.

Canada is participating in international monitoring exercises and is also conducting its own monitoring in order to determine developing trends and potential risks. Canada is also contributing to ongoing international efforts to strengthen the regulation of market-based financing.

**Growing use of e-money:** E-money, or monetary value stored electronically and not linked to a bank account, is rapidly creating new efficiencies as well as new risks. Among the different types of e-money, cryptocurrencies are riskier, because users could be exposed to theft, fraud and loss. This type of e-money could also be used for money laundering, terrorist financing and

other criminal activities that would have broader ramifications. From a financial system perspective, a crash or failure of one issuer of e-money could potentially cause not only a loss of wealth among users, but also a loss of confidence in other issuers and in the payment system more generally. In addition, if the use of cryptocurrencies became widespread and significant, frictions could develop in the transmission of monetary policy.

Although the use of e-money and the related payments technology is not substantial enough to pose a material risk to financial stability at this time, the Bank and other authorities are watching developments closely to ensure that the degree of regulation of payment methods and systems is appropriate.<sup>43</sup>

## Safeguarding Financial Stability

Six years after the commitment by G-20 Leaders to fundamentally reform the global financial system and build safer, more resilient sources of finance that better serve the needs of the real economy, the Financial Stability Board (FSB) declared in November that the job of agreeing to the measures is substantially complete.<sup>44</sup> Clear progress has been made to strengthen the sectors that were directly linked to the cause of the recent financial crisis—banks, shadow banking and derivatives markets—and to prevent systemic risk from building in other areas of the financial system. In addition, measures to deal with the failure of global systemically important banks, without the need for taxpayer support and without disruption of the financial system or the real economy, are being implemented.

Parallel to the ongoing achievements over this longer time frame, there have been further positive developments since the June FSR, both globally and in Canada, in each of the FSB's four priority areas of reform:

### 1. Building the resilience of financial institutions

The Basel Committee on Banking Supervision (BCBS) has substantially completed the Basel III framework by finalizing, in October 2014, a standard for the Net Stable Funding Ratio that will become a minimum requirement by 1 January 2018. In November, the BCBS also set out its plan to address excessive variability in the risk models used by banks to determine their capital needs. In Canada, OSFI finalized its Leverage Requirements Guideline in October, in line with the Basel III requirements. Public disclosure of leverage ratios will come into effect for Canadian D-SIBs in the first quarter of 2015 and at end of 2015 for all other federally supervised banks.

### 2. Ending the problem of “too big to fail”

In November 2014, the G-20 Leaders endorsed two important proposals related to the resolution of global systemically important banks (G-SIBs). The first was for a common international standard on the total loss-absorbing capacity of G-SIBs that will ensure that shareholders and creditors will also absorb losses when these banks fail. Public consultation on this proposal has begun, and a quantitative impact study will also

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<sup>43</sup> See “Money in A Digital World,” speech by Bank of Canada Senior Deputy Governor Carolyn Wilkins, Wilfrid Laurier University, 13 November 2014 (<http://www.bankofcanada.ca/2014/11/money-digital-world/>).

<sup>44</sup> For a full account of policy developments and progress on reform implementation since the St. Petersburg Summit in September 2013, see “Overview of Progress in the Implementation of the G20 Recommendations for Strengthening Financial Stability,” Report of the Financial Stability Board to G20 Leaders, 14 November 2014.

be completed before the standard is finalized in 2015. The second was related to removing impediments to cross-border resolution. The Leaders endorsed an industry protocol that prevents cross-border derivatives contracts from being terminated in the event that a G-SIB enters resolution.<sup>45</sup>

A number of other initiatives have been advanced over the past several months to reduce the probability and impact of systemically important financial institutions (SIFIs) failing. The FSB's SIFI framework includes assessment and designation of SIFIs, additional loss absorbency, supervisory intensity, effective resolution, addressing data gaps and strengthening core infrastructure. In September, the FSB also issued a consultative document on policy measures and guidance for statutory regimes for cross-border recognition of resolution actions. The FSB reports that national implementation of the SIFI framework is still at a relatively early stage.

### 3. Transforming the shadow banking sector

Progress has continued on policy measures to strengthen oversight and regulation of the shadow banking sector, although work is ongoing in several areas. Of note, in October, the FSB published a regulatory framework for haircuts on non-centrally cleared securities financing transactions between banks and non-banks and issued a consultative proposal on the application of numerical haircut floors to transactions between non-bank entities. The framework is expected to be implemented by the end of 2017.

### 4. Ensuring that OTC derivatives markets are continuously open

Implementation of over-the-counter (OTC) derivatives reforms remains uneven and overdue across FSB jurisdictions, despite some measurable progress. Since a majority of countries have implemented trade-reporting obligations, resolving issues related to accessibility and usability is a priority.<sup>46</sup>

Other recent milestones aimed at supporting market integrity include initiatives aimed at reforming the setting of financial benchmarks. In July, the FSB published a proposal, plans and timelines for the reform and strengthening of existing major interest rate benchmarks and for additional work on the development and introduction of alternative benchmarks. In September, a report on foreign exchange rate benchmarks included a number of recommendations for reform of these benchmarks and related market practices.

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<sup>45</sup> The protocol, which prevents counterparties from taking their money before others when a bank needs to be resolved, was developed by the International Swaps and Derivatives Association in consultation with regulators and the FSB and was announced in October. FSB members have agreed to promote broad adoption of the protocol, and an initial set of 18 of the largest dealer banks, representing 90 per cent of global derivatives activity, have already adhered to it. For more information, see [http://www.financialstabilityboard.org/wp-content/uploads/pr\\_141011.pdf](http://www.financialstabilityboard.org/wp-content/uploads/pr_141011.pdf).

<sup>46</sup> While a majority of FSB member jurisdictions have introduced trade-reporting requirements, the usefulness of these data in supporting monitoring of financial stability risks is limited by data quality issues. In addition, authorities continue to face challenges regarding the accessibility and usability of data held by trade repositories. In September, the FSB published a feasibility study of various options for a mechanism to produce and share globally aggregated trade repository data. As a next step, international institutions will be working to develop common identifiers and guidance on harmonizing data elements, and to eliminate legal barriers to allow authorities to access needed data.

### *Canada has made good progress on the implementation of some reforms in priority areas*

The FSB also recently provided a progress report on implementation in key areas, by individual member jurisdictions. Canada's scorecard indicates high marks for the implementation of Basel III capital requirements, standards for compensation practices by banks, and the implementation of recovery and resolution plans for D-SIBs. As noted in the IMF's Financial Sector Assessment Program for Canada earlier this year, Canada had established recovery and resolution planning for D-SIBs as early as 2010, well before the formal regime was announced. In the area of trade reporting for OTC derivatives, requirements came into effect on 31 October 2014 in some provinces.<sup>47</sup> In addition, OSFI has clarified its expectations with respect to the derivatives activities of federally regulated financial institutions, including the reporting of derivatives data to a trade repository, as well as central clearing of standardized OTC derivatives, under draft Guideline B-7, which was released on 1 October 2014.<sup>48</sup>

The FSB scorecard highlights that for many countries, including Canada, more effort is needed on other elements of OTC derivatives reforms and on resolution powers related to banks. On the second point, the federal government launched a consultation in August on a bail-in regime for banks, as part of its comprehensive risk-management framework for Canada's D-SIBs.<sup>49</sup>

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<sup>47</sup> Securities regulators in Manitoba, Ontario and Quebec require that OTC derivatives transactions involving dealers or other clearing agencies in the province must be reported to a designated trade repository as of 31 October 2014, while other counterparties have until 30 June 2015 to comply.

<sup>48</sup> Although currently in draft form, the guideline applies as of 1 November 2014. The full draft can be found at <http://www.osfi-bsif.gc.ca/Eng/fi-if/rg-ro/gdn-ort/gl-ld/Pages/b7.aspx>.

<sup>49</sup> See "Taxpayer Protection and Bank Recapitalization Regime: Consultation Paper" at <http://www.fin.gc.ca/activity/consult/tpbrr-rpcrb-eng.asp>.

# Reports

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Reports examine selected issues of relevance to the Canadian and global financial systems.

## Introduction

This section of the *Financial System Review* features two reports on important developments in the financial system: rapid growth and innovation in the market for exchange-traded funds, and the increasing significance of cyber attacks to the operational resilience of financial institutions and financial market infrastructures.

**In Exchange-Traded Funds: Evolution of Benefits, Vulnerabilities and Risks**, Ian Foucher and Kyle Gray explain the different types of exchange-traded funds (ETFs), which present both benefits and risks for investors. They discuss ways in which the risk characteristics of certain ETF products could have broader implications for the financial system, and describe the evolution of ETF market structure and regulation in different jurisdictions as authorities try to mitigate risks related to ETFs.

**Cyber Security: Protecting the Resilience of Canada's Financial System**, by Harold Gallagher, Wade McMahon and Ron Morrow, examines the various sources of cyber attacks and their potential for systemic risk. Against this background, the report highlights efforts being made to protect against cyber-security threats, including individual and collective actions by financial institutions and financial market infrastructures, as well as initiatives by international organizations, regulatory authorities and governments. The authors then describe the coordination, under the Joint Operational Resilience Management program, of private and public sector actions in Canada for managing and testing capabilities during severe operational events such as cyber attacks.

# Exchange-Traded Funds: Evolution of Benefits, Vulnerabilities and Risks

Ian Foucher and Kyle Gray

- The global market for exchange-traded funds (ETFs) has exhibited strong growth in recent years, reaching US\$2.3 trillion by the end of 2013. ETFs have clear advantages for investors, such as low-cost portfolio diversification and the liquidity of an exchange-traded product. However, recent disruptions in certain ETF products have highlighted the need to better understand the vulnerabilities and risks associated with this market.
- ETFs are generally perceived by investors as having equity-like liquidity, but in times of stress, this liquidity may prove illusory for some funds. Synthetic ETFs also carry additional counterparty and collateral risk. If any of these risks materialized, it could trigger an investor run, which could negatively impact the underlying market as well as other similar funds.
- The synthetic ETF market in Canada has a high concentration of counterparty risk compared with other jurisdictions. However, given the small size of this market segment, it does not represent a significant vulnerability for the Canadian financial system. Nonetheless, rapid changes in the ETF market imply that authorities need to monitor developments closely.

## Introduction

While insulin, poutine and ice hockey have come to exemplify Canadian innovation, perhaps less well known is Canada's pioneering work in the creation of exchange-traded funds (ETFs) in the early 1990s.<sup>1</sup> With

close to US\$2.3 trillion in assets globally, ETFs have become the fastest-growing investment product worldwide (Deutsche Bank 2014).

An ETF is an investment fund that is traded on a stock exchange. Its popularity is largely attributable to the benefits it provides to investors: the liquidity, ease of trade, and lower cost associated with an exchange-traded product, but with the diversification of a mutual fund. The structure of ETFs also shares certain characteristics with mutual funds; for example, the returns of both these investments are based on the performance of an underlying basket of securities, less a management fee.

However, the rapid growth and innovation in the ETF market may be heightening risks to investors, such as liquidity, counterparty and collateral risk, as well as introducing risks to the financial system. For example, ETFs are generally perceived as having equity-like liquidity; however, in times of stress, this liquidity may prove illusory for some funds.<sup>2</sup> As well, synthetic ETFs, which use derivatives to achieve their intended exposure, offer investors lower management fees but at the cost of additional counterparty and collateral risk. These investor risks may have negative implications for the financial system: if a run on an ETF is triggered, it could amplify selling pressure in the underlying asset market and on other similar funds.<sup>3</sup> The potential for investor runs is heightened for synthetic ETFs and ETFs that provide exposure to less-liquid assets. These risks and the rapid growth of the ETF market have attracted the attention of regulatory authorities globally.<sup>4</sup> In conjunction with these efforts, this report aims to contribute to the ongoing monitoring and analysis of the ETF market.

<sup>1</sup> Canada is often recognized as having created the first modern-day exchange-traded fund (ETF). Launched on the Toronto Stock Exchange (TSX) in March 1990, an evolved version of this ETF still trades on the TSX under the symbol XIU. However, in May 1989, the American Stock Exchange and the Philadelphia Stock Exchange offered "shares" that allowed investors to buy or sell an interest in an equity market without having to purchase the individual stocks. Owing to lawsuits by U.S. regulators, the federal court ruled that the shares were actually a futures contract (i.e., a derivative) and therefore could not trade on a stock exchange. While Canada is credited with the creation of the first modern-day ETF, it was in fact the U.S. market that popularized the financial product we see today with the launch of a Canadian-style ETF—the SPDR S&P 500 or "Spider"—in January 1993.

<sup>2</sup> Equities themselves, like any other asset class, can also experience market volatility and decreases in liquidity if shocks occur.

<sup>3</sup> An investor run on an ETF occurs when a large number of investors try to sell their shares simultaneously because they believe the share price will decrease for reasons other than normal market behaviour.

<sup>4</sup> Since 2011, organizations such as the International Monetary Fund (IMF), the International Organization of Securities Commissions (IOSCO), the Financial Stability Board (FSB) and the Bank for International Settlements (BIS) have intensified their scrutiny of the risks associated with ETFs.

The report begins by providing an overview of the ETF market and goes on to describe the trade-offs between investor benefits and risks, as well as the potential implications for the financial system. It concludes with a discussion on how regulations have influenced the evolution of these risks in various jurisdictions, including Canada.

## Overview of the Market for Exchange-Traded Funds

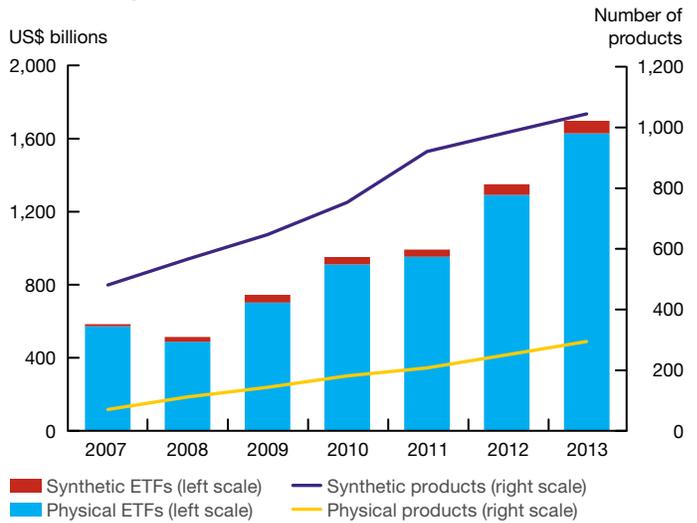
### ETF products and global trends

ETFs can be classified into two broad categories: physical and synthetic. Physical ETFs hold individual securities or physical assets (such as commodities); synthetic ETFs use derivatives to replicate the exposure of physical ETFs. For example, a physical ETF that tracks the performance of the S&P 500 would hold individual stocks in proportion to the index. The synthetic version of that same ETF might use a total return swap (TRS) to provide exposure to the S&P 500. With a TRS, the ETF provider would rely on a swap counterparty, typically a financial institution, to replicate the total returns of the S&P 500 (the structure of swap-based synthetic ETFs is described in more detail on page 40).<sup>5</sup>

The United States and Europe represent the two largest ETF markets in the world, with assets estimated at US\$1.7 trillion and €288 billion (or US\$395 billion), respectively. Synthetic ETFs account for an estimated 33 per cent of the European ETF market but only 4 per cent of the U.S. ETF market (Chart 1 and Chart 2).

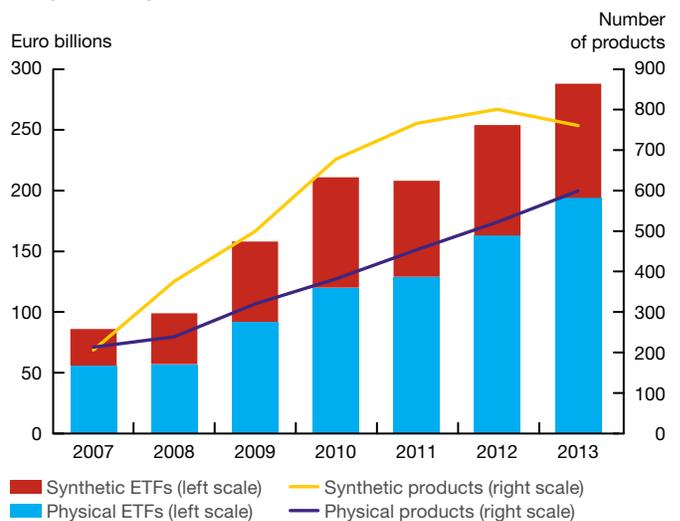
In line with global trends, the Canadian ETF market has exhibited strong growth in recent years, reaching Can\$72 billion in assets in July 2014 (Chart 3). In relative terms, the Canadian ETF market is about one-tenth the size of the mutual fund market—this is comparable with the relative size of the ETF market in the United States (IFIC 2014; ICI 2014). Canadian investors also increased their holdings of U.S.-listed ETFs to approximately Can\$16 billion as of June 2014 (Chart 4).<sup>6</sup> While physical ETFs are the dominant product in the Canadian marketplace, synthetic ETFs are estimated at Can\$3.2 billion in assets; Canadian investors also hold U.S.-listed synthetic ETFs estimated at Can\$500 million.

**Chart 1: Physical ETFs dominate the U.S. ETF market**



Sources: Morningstar and Bloomberg, based on Bank of Canada calculations Last observation: December 2013

**Chart 2: A large share of the European ETF market consists of synthetic products**

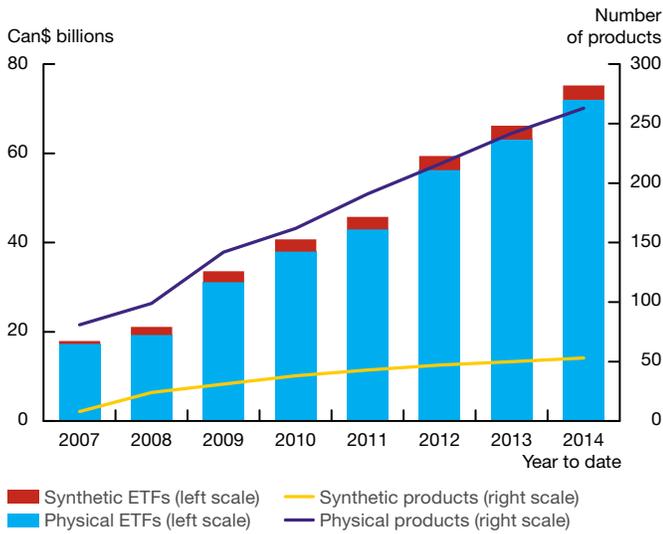


Sources: Deutsche Bank and Bloomberg, based on Bank of Canada calculations Last observation: December 2013

<sup>5</sup> The term “synthetic ETF” describes any ETF that uses derivatives such as total return swaps, forwards and equity options to achieve its investment strategy. For the purpose of this report, we focus primarily on swap-based ETFs. Leveraged ETFs, which seek to double or triple the daily returns of their benchmark index, use an economically equivalent “swap” arrangement through the use of forwards. This type of ETF structure has risk characteristics similar to those of a total return swap in Canada.

<sup>6</sup> Canadian investors may purchase U.S.-listed ETFs for various reasons. For retail investors, the U.S. ETF market offers a wider variety of products at a potentially lower cost. For institutional investors, it may be easier to trade in ETFs with more volume.

**Chart 3: Physical ETFs dominate the Canadian ETF market**



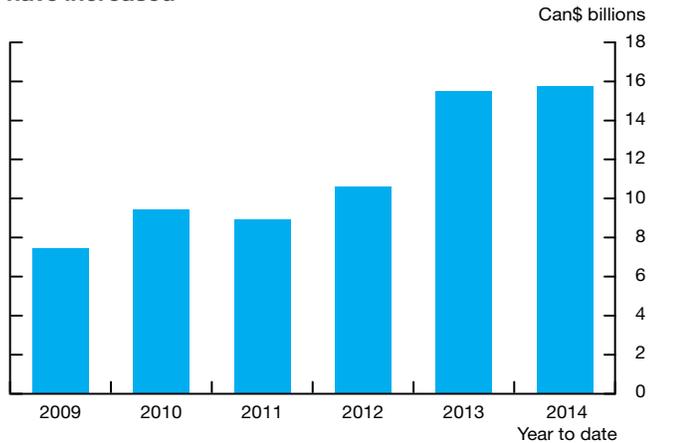
Sources: Morningstar and Bloomberg, based on Bank of Canada calculations  
 Last observation: July 2014

**Chart 5: Passive physical ETFs closely track the return on underlying assets**



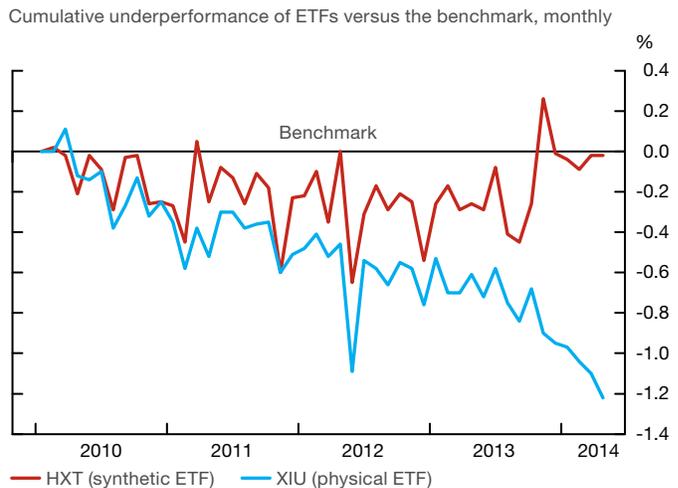
Source: Bloomberg, based on Bank of Canada calculations  
 Last observation: August 2014

**Chart 4: U.S.-listed ETFs held by Canadian investors have increased**



Source: Investor Economics  
 Last observation: June 2014

**Chart 6: Synthetic ETFs track returns more closely than physical ETFs**



Source: Bloomberg, based on Bank of Canada calculations  
 Last observation: August 2014

## Benefits of exchange-traded funds

Given that the ETF market has more than tripled in size over the past five years, it is evident that investors value the benefits of these products, including low management-expense ratios and the liquidity of an exchange-traded product.<sup>7</sup> Most ETFs have a “passive” investment strategy in that they try to replicate their benchmark. A passive investment strategy follows its benchmark’s returns very closely, minus its tracking error.<sup>8</sup> In contrast, leveraged or actively managed ETFs are designed to outperform their stated benchmark.

<sup>7</sup> The average ETF expense ratio is 0.6 per cent, compared with 1.3 per cent for mutual funds (Morningstar 2014).

<sup>8</sup> Tracking error is a measurement of how much the return on an ETF deviates from the return on its benchmark index. Trading and management costs represent one of the largest sources of tracking error.

For example, an investor who compared the returns of the iShares S&P/TSX 60 Index (XIU) physical ETF—one of the most popular ETFs in Canada—with the returns of the S&P/TSX 60 Index itself would find that the iShares ETF has deviated from its benchmark by only 1.2 per cent on a cumulative basis over a four-year period (Chart 5). Synthetic ETFs, such as Horizon’s S&P/TSX 60 Index (HXT), are even more efficient at tracking their benchmark, with a deviation of only 0.02 per cent (Chart 6).

An ETF is able to closely track its benchmark through its unique share-creation/redemption process, which allows the number of outstanding ETF shares to fluctuate on a daily basis to reflect investor demand. This ensures that the ETF share price more accurately reflects the value of the underlying assets. The motivation to create or redeem shares stems from whether the ETF is trading at a premium or a discount to the net asset value (NAV) of the underlying assets. ETFs typically have multiple authorized participants (APs)—usually financial institutions—that are responsible for creating and redeeming

shares with the ETF provider.<sup>9</sup> As a result, an ETF’s liquidity depends not only on the supply and demand for ETF shares on the exchange, but also on an orderly share-creation/redemption process. (For more information on the role of an AP and its process for creating and redeeming shares, see **Box 1**.)

<sup>9</sup> For example, if the share price of an ETF trades higher than its net asset value (i.e., at a “premium”), the AP may have an incentive to create shares by buying the underlying assets, exchanging them for ETF shares, and selling those ETF shares in the market, which would drive the ETF share price down, closer to its NAV. Conversely, when an ETF’s share price is trading lower than its NAV (i.e., at a “discount”), the AP may purchase the ETF shares in the market and redeem them with the ETF provider in exchange for the underlying assets. This would raise the ETF share price closer to its NAV.

Box 1

### The Mechanics of the Share-Creation/Redemption Process for Physical and Swap-Based Synthetic Exchange-Traded Funds

The share-creation/redemption process for exchange-traded funds (ETFs) is what makes this investment product unique among pooled investment funds.

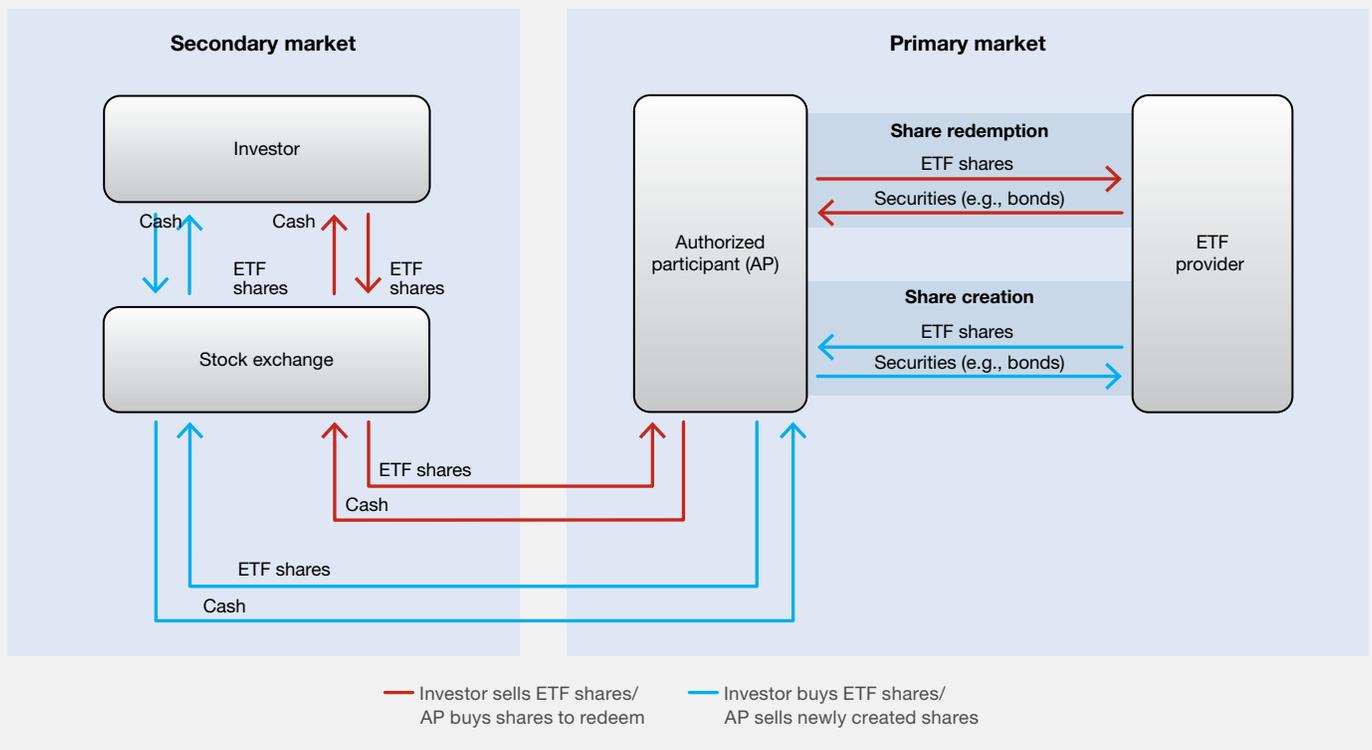
#### Physical ETFs

Before an investor can purchase a share in an ETF, shares must be created and delivered to an exchange by an authorized participant (AP) (Figure 1-A). To create an ETF share, the AP deposits a basket of securities with the ETF provider, which then issues a specific number of ETF shares to the AP

(the primary market). The AP can then either keep the shares or sell some of them on an exchange, making them available to investors (the secondary market). This process can also work in reverse as APs can redeem their shares with the ETF provider in return for securities. APs provide a central market-making function that allows ETFs to derive some of the benefits that distinguish them from traditional mutual funds (e.g., greater liquidity and a share price that is closer to the value of the underlying assets).

(continued...)

**Figure 1-A: Physical ETFs—Simplified Process for Creating and Redeeming Shares**



Box 1 (continued)

**Swap-based synthetic ETFs**

Unlike a physical ETF, a swap-based ETF provider does not hold the basket of underlying securities. Instead, the ETF provider enters into a derivatives contract, known as a total return swap (TRS), with a counterparty (Figure 1-B).<sup>1</sup> The swap counterparty delivers the total returns (including dividends) on the ETF's stated investment strategy (e.g., replicating the S&P 500 index) to the ETF provider in exchange for an agreed funding rate, typically based on a reference rate (e.g., LIBOR) plus a spread. The ETF provider issues newly created shares to an AP in exchange for cash. With the cash, the ETF provider invests in collateral; the interest earned on the collateral typically covers the cost of the swap.

To meet share redemptions, the ETF provider sells the collateral in return for the ETF shares. The swap counterparty plays no role in the share-creation/redemption process. The only obligation of the swap counterparty is to pay the return

on the index or underlying basket of assets it is contracted to replicate for the investors.

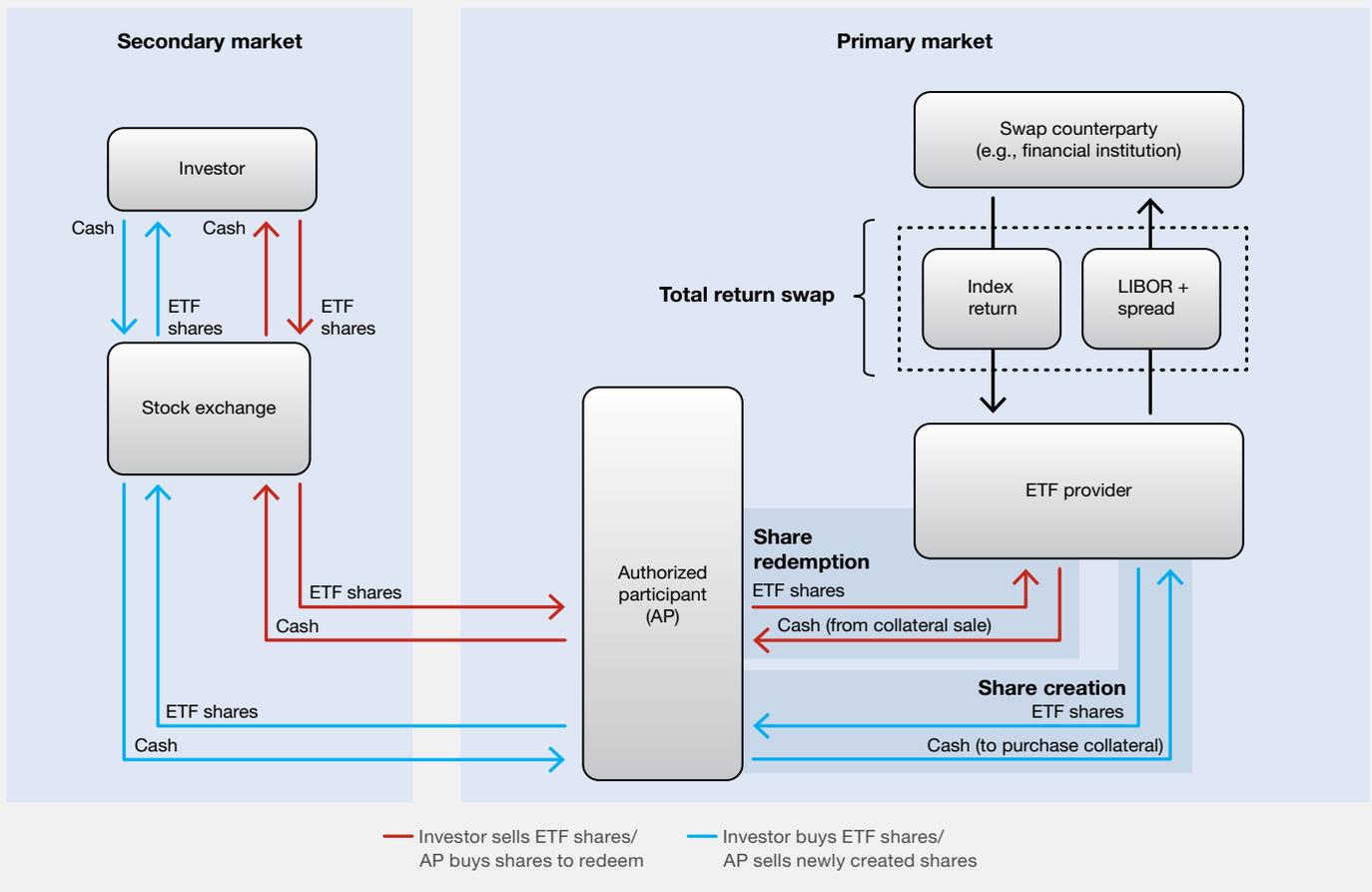
At any time, the value of the ETF consists of the combined value of the collateral and the marked-to-market value of the swap. For the ETF's swap counterparty, the motivation for entering into a TRS arises from the synergies with its normal banking activities (for example, to hedge exposures to existing trading-book positions), low-risk fee generation and economies of scope (e.g., tax and regulatory benefits).

Based on standard market practices for interest rate swaps, if a swap counterparty terminates a TRS contract early, it must cover any decline in the value of the index it tracks from the last date when an exchange of payment occurred (i.e., the reset date), and usually pays an early exit fee (or replacement cost for a new swap).<sup>2</sup>

1 Based on typical market practice, a swap counterparty buys a fresh portfolio of assets for every new total return swap it enters, in order to tailor the basket to the specific risk profile sought by the ETF provider. In some cases, banks may opt to borrow rather than purchase the assets outright. Banks sell this basket of assets upon the termination or expiration of the TRS contract.

2 Determining the value of early termination payments is difficult and is largely dependent on the terms of the swap contract, the performance of the underlying asset at the time of termination (including its liquidity) and the nature of the negotiations between the counterparties.

**Figure 1-B: Swap-Based Synthetic ETFs—Simplified Process for Creating and Redeeming Shares**



Another major benefit of ETFs is that they facilitate the diversification of investor portfolios. Through ETFs, investors can now gain low-cost exposure to asset classes such as corporate bonds and commodities that previously were only accessible to institutional or high net worth investors. More importantly, retail investors can now use ETFs to broaden their diversification to markets, such as emerging-market assets and real estate.

## Risks to Investors and the Financial System

Investors have realized tangible benefits from the introduction of ETFs. Yet, despite these benefits, ETFs also carry risks for the investor. While all ETFs exhibit price fluctuations and liquidity risk, certain ETFs also pose counterparty and collateral risk to investors. If any of these risks materialized, an investor run could be triggered, which could have a negative effect on the financial system. While liquidity risk is common across all types of ETFs, additional counterparty risk and collateral risk can be found in synthetic ETFs.<sup>10</sup>

### Liquidity risk

Authorized participants (APs) provide an essential market function that allows ETFs to derive some of their advantages over traditional mutual funds (e.g., greater liquidity and a share price that is closer to the value of the underlying assets). However, APs can also transmit liquidity shocks from the ETF to the underlying assets (and vice versa). As ETFs and the underlying market become more interconnected, a small liquidity shock originating in either the ETF or the underlying securities could be amplified through a feedback loop (via APs). This could result in a large liquidity shock and a reduction in price informativeness for both the ETF and the underlying market (Cespa and Foucault 2014).

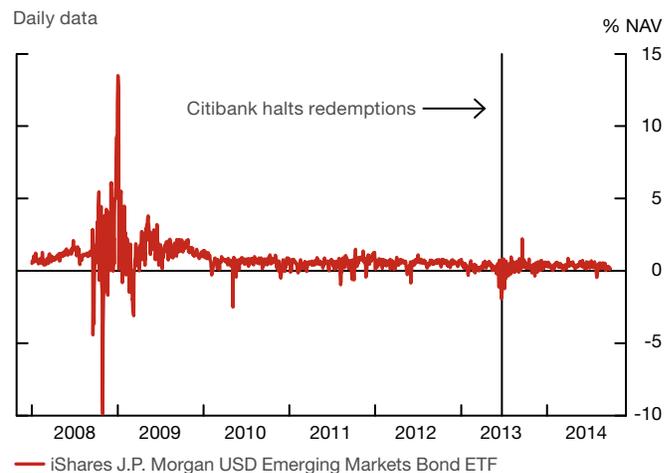
While ETFs are typically priced based on their underlying securities, the underlying securities of ETFs that track less-liquid securities, such as high-yield bonds, may also be priced off the ETF, since it trades more frequently (Tucker and Laipply 2012, 2013). Given that the price of the underlying securities is a source of information for the price of an ETF, a shock to the underlying securities (e.g., an increased fear of corporate defaults) raises uncertainty for the APs, which could lead them to halt redemptions for prolonged periods of time. Should this price-discovery mechanism between the ETF and the underlying market break down, this shock to the ETF (via the halt in redemptions) can then feed back to the underlying market. The effect on the underlying market is then amplified, since investors in this market have lost a key source of information to price their securities.

A liquidity shock to an ETF can also occur if multiple APs halt redemptions for reasons other than a shock to the underlying securities. For example, if the APs are balance-sheet constrained owing to their other banking activities (e.g., regulatory constraints on capital, equity or leverage), they may have to halt redemptions.

In both scenarios, whether a shock originates in the underlying securities or from the AP itself, an ETF may trade at a discount to its NAV. While short periods of discounts to the NAV are not a major concern (since they may be a result of the price-discovery process), there is a potential risk for large discounts to the NAV to persist and to worsen over time. If investors believe that a prolonged halt in redemptions might occur, an investor run could be triggered as it could create a perceived first-mover advantage. This selling pressure would further aggravate the discount to the NAV, increasing the probability of contagion to the underlying market and to other similar ETFs. As more investors herd into ETFs based on less-liquid assets in their search for yield, it is more likely that a run event may be amplified (U.S. FSOC 2013).

A breakdown in the redemption process by an AP is not a hypothetical event (Massoudi, Braithwaite and Foley 2013). One of the most recent redemption failures took place during a period of market volatility in June 2013, when Citibank (an AP) refused to redeem shares to avoid exceeding its balance-sheet-risk limits. In this case, Citibank's refusal to provide redemptions did not create a large discount to the NAV for its ETFs, since other APs were able to step in and redeem shares (Chart 7).<sup>11</sup> However, in times of market stress, such as the 2008

**Chart 7: Less-liquid ETFs price at larger discounts to their NAV in times of stress**



Source: Bloomberg, based on Bank of Canada calculations

Last observation: 23 September 2014

<sup>10</sup> Some physical ETFs may be exposed to counterparty and collateral risk if they engage in securities lending.

<sup>11</sup> Citibank was identified as an authorized participant for the iShares J.P. Morgan USD Emerging Markets Bond ETF as of April 2013 (Blackrock 2013).

financial crisis, certain ETFs temporarily had large discounts to their NAV, which could have been exacerbated in a scenario where APs halted redemptions.

## Counterparty risk

Synthetic ETFs predominantly rely on swap counterparties to provide their underlying asset exposure (e.g., via a TRS). While the main benefit of synthetic ETFs is that they offer a lower tracking error than physical ETFs, the trade-off is that investors are exposed to collateral and counterparty risk.

Swap transactions are typically terminated automatically if a counterparty defaults or its credit rating falls below a pre-specified level. Should the swap counterparty default, the ETF provider may be able to replace the swap with a new counterparty. However, if a replacement swap is not secured, the ETF provider would have to liquidate its collateral in an attempt to either (i) physically purchase the underlying securities that it is trying to replicate in its investment strategy or (ii) close the fund. Both of these options may expose investors to potential losses through the forced liquidation of collateral. This risk to investors is heightened if there is a concentration of counterparty risk (i.e., a single swap counterparty). In addition, risks to the financial system could be higher if multiple ETFs rely on the same counterparty.

A deterioration in a counterparty's creditworthiness has the potential to create an investor run if some investors try to pre-empt the possibility that a swap cannot be replaced.<sup>12</sup> Even in a scenario where there are multiple swap counterparties to the ETF, if one of those counterparties defaults, the possibility of an investor run may still be present. As noted by the Bank for International Settlements, synthetic ETFs have yet to be tested by large investor redemptions and do not have liquidity risk-management tools to restrict investor withdrawals (e.g., "gating" techniques such as those used by hedge funds in times of market stress) (Ramaswamy 2011).

## Collateral risk

At any time, the value of a synthetic ETF consists of the combined value of the collateral and the marked-to-market value of the swap. Because the counterparties in a swap transaction do not exchange notional values of the underlying basket of securities, most of the value for investors resides in the assets held in the collateral account of the ETF. An investor in a synthetic ETF is exposed to the market value of the collateral used to secure the TRS in two ways. First, given that the interest received from the collateral is used to cover the funding

rate (i.e., the cost) of the swap, the investor is exposed to interest rate risk if the funding cost for the swap exceeds the interest generated by the collateral. Second, if the value of the collateral falls, it could decrease the price of the ETF; liquidation of collateral could also put downward pressure on prices in the underlying asset market. This effect will be more pronounced with less-liquid collateral.

## Potential system-wide risks

In principle, if any of the above risks were to materialize, they could amplify or transmit shocks through the financial system. If a physical ETF is based on less-liquid securities (e.g., corporate bonds), a liquidity shock in the underlying asset market could transmit to the ETF. Alternatively, a liquidity shock can originate in the ETF itself; as APs provide their services to multiple ETFs, a redemption halt could affect a number of funds simultaneously. In a worst-case scenario, this could trigger investor runs on the ETFs and similar funds (e.g., mutual funds). These events could then feed back to the underlying asset markets, amplifying the initial shock and propagating beyond the ETF market.

For synthetic ETFs, counterparty and collateral risk are a greater concern to the financial system—especially where there exists a concentration of counterparty risk. If investors believe that a significant swap counterparty may have its swaps terminated, it could trigger investor runs on multiple ETFs, potentially spilling over to other related ETFs. In a default scenario of a swap counterparty, ETFs may be forced to liquidate their collateral; if the ETFs are large enough, the immediate sale of their collateral could affect the asset market of the collateral. Alternatively, if synthetic ETFs are holding less-liquid or low-quality collateral, a shock to the collateral's asset market could trigger investor runs on those ETFs as investors try to sell their shares before the decline in the value of the collateral decreases the share price. This would create redemption pressure, leading to an amplification of the initial shock to the asset market of the collateral.

Regardless of the ETF product involved, an investor run would have a negative impact on overall investor confidence in the market. A loss of this confidence would further exacerbate market volatility and amplify selling pressure on ETFs and their underlying assets.

## Regulatory Developments and Implications for the Financial System

The market structure and regulatory framework governing ETFs have had a significant impact on how risks have evolved in various jurisdictions.

<sup>12</sup> According to Baba, McCauley and Ramaswamy (2009), institutional investors would likely be the first to run when markets question the solvency of a fund provider, which could trigger a broader run on other similar funds.

## United States and Europe

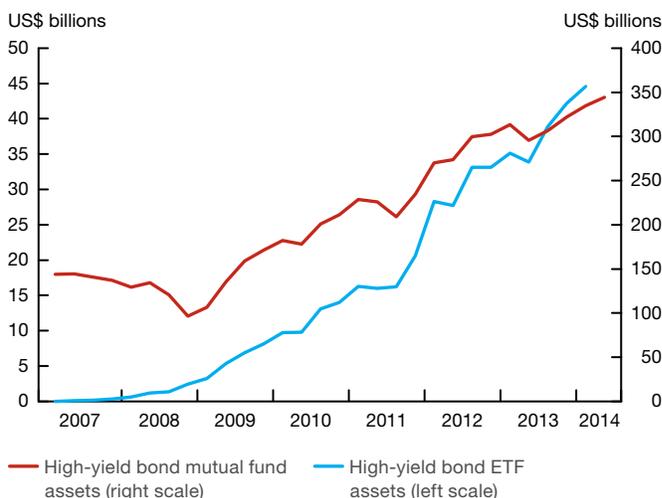
In the United States, which has the largest and most-liquid ETF market in the world, regulators have closely monitored the rapid innovation in the sector and have modernized the rules governing ETFs, especially with regard to counterparty and collateral risk. For example, the limited growth of synthetic ETFs in the United States is due in part to regulatory standards that limit the use of derivatives to replicate underlying indexes and promote the adoption of sound market practices, such as the use of multiple counterparties in swap agreements.<sup>13</sup> Additionally, in March 2010, the Securities and Exchange Commission imposed a moratorium on new synthetic ETFs that use swaps.<sup>14</sup>

While European synthetic ETFs grew in popularity between 2006 and 2010, a gradual shift toward physical ETFs took place between 2011 and 2013, driven in part by new guidelines on ETFs issued by the European Securities and Markets Authority.<sup>15</sup> Despite the size of synthetic ETFs in Europe, regulators limit counterparty risk to 10 per cent of the ETF's NAV, suggesting that investors would have a cap on their initial losses if a swap counterparty defaulted.<sup>16</sup> In addition, and similar to swap arrangements in the United States, most synthetic ETFs have multiple counterparties for a single swap. Despite these regulatory controls, the synthetic ETF market in Europe continues to represent a source of risk to investors and the financial system and, as such, is monitored closely by local regulators.

In the United States, the growth of ETFs based on less-liquid assets such as high-yield bonds represents a greater risk. U.S. high-yield bond ETFs now account for approximately 3 per cent of the outstanding U.S. high-yield bond market. While the market share held by ETFs is not large, there is a risk that a sell-off could spill over to the underlying bond market, triggering a sell-off in the much larger high-yield bond mutual fund market (Chart 8). According to J.P. Morgan, during sell-off periods, outflows from high-yield bond funds are generally led by the ETF sector, partly owing to the larger

**Chart 8: U.S. high-yield bond fund assets have increased rapidly in recent years**

Quarterly



Sources: Thomson Reuters LPC and Morningstar, based on Bank of Canada calculations

Last observation: 2014Q2

presence of hedge funds (or “fast money”).<sup>17</sup> Therefore, sophisticated institutional investors likely monitor high-yield ETFs closely in times of stress. Should ETFs face a sudden sell-off and APs halt redemptions, ETF outflows could quickly transmit to the underlying market, which could also trigger or aggravate outflows from bond mutual funds and amplify the impact on the financial system.

## Canada

In Canada, provincial securities commissions regulate the ETF market. Canadian ETFs are classified as “exchange-traded mutual funds in continuous distribution” and, as such, are subject to the same regulations as mutual funds, including rules governing the use of derivatives.<sup>18</sup> Much like the United States, Canada has not experienced notable growth in synthetic ETFs. While there is no regulation specifying the collateral composition of synthetic ETFs, strong collateral-management market practices prevail in Canada.<sup>19</sup> However, certain

<sup>13</sup> Under the U.S. Investment Company Act of 1940, an investment fund can invest no more than 25 per cent of its total assets with a single issuer for 50 per cent of the fund's assets. With respect to the remaining 50 per cent of the fund's assets, no more than 5 per cent may be invested in a single issuer. Although the application of this framework is somewhat unclear with respect to swaps, as a matter of practice, funds typically consider the counterparty to be an issuer for purposes of compliance with these regulations. As a result, funds that rely heavily on swaps typically use multiple counterparties (ICI 2011).

<sup>14</sup> In December 2012, the Securities and Exchange Commission announced that it would lift part of its moratorium on applications for new, actively managed ETFs that use swaps.

<sup>15</sup> According to Morningstar (2012), European regulation prior to 2011 allowed banks sufficient flexibility to post lower-quality and less-liquid collateral when they serve as swap counterparties.

<sup>16</sup> This is based on the European Union UCITS III directive (2009/65/EC).

<sup>17</sup> Based on 13F regulatory filings, it is estimated that hedge funds make up close to 31.5 per cent of the investor base in high-yield ETFs, the largest share among all asset classes. In comparison, the ownership rate of hedge funds for the top five investment-grade bond ETFs is approximately 17 per cent (J.P. Morgan 2014).

<sup>18</sup> This classification of ETFs is established under National Instrument (NI) 81-102 provided by the Canadian Securities Administrators. ETFs that employ leveraged strategies or are backed by commodity pools can be exempt from 81-102 and are subject to NI 81-104. For fund disclosure requirements, ETFs must also be compliant with NI 81-106.

<sup>19</sup> For swap-based synthetic ETFs in Canada, ETF providers typically hold high-quality short-term money market instruments as collateral (Pallaris 2011).

existing synthetic ETFs are currently backed by less-liquid collateral or collateral unrelated to the investment strategy of the ETF.

A greater concern in the Canadian synthetic ETF market relates to the concentration of counterparty risk. As in Europe, Canadian regulations specify that an investor’s exposure to a counterparty default cannot exceed 10 per cent of its NAV. However, a majority of synthetic swap-based ETFs in Canada use a single counterparty to provide their synthetic exposures, concentrating all counterparty risk with one entity. Given the concentration of counterparty credit risk in Canada, a default by a swap counterparty would lead to the simultaneous termination of swap contracts backing multiple synthetic ETFs.<sup>20</sup> Currently, Canadian synthetic ETFs using swaps have an estimated Can\$2 billion in assets (Chart 9).<sup>21</sup> An affected ETF would have three options: (i) find a replacement swap; (ii) liquidate the collateral and use the remaining funds to physically purchase the underlying index; or (iii) liquidate the collateral and return the remaining funds to investors (i.e.,

close the ETF). This concentrated counterparty risk could be mitigated with multiple swap counterparties or backup swap agreements.

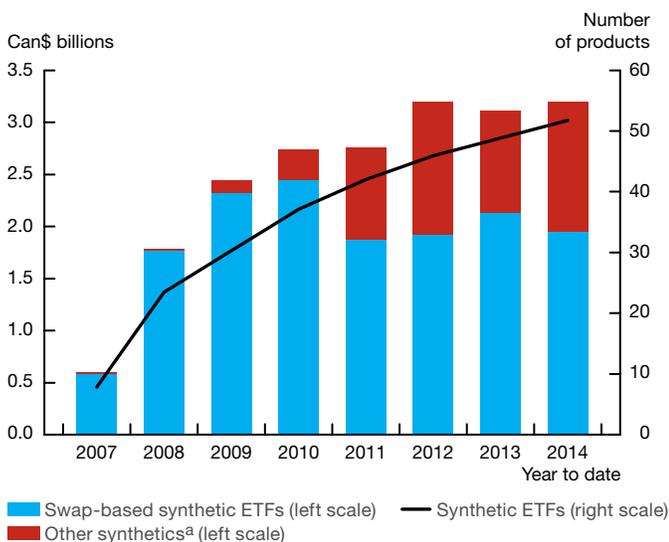
In terms of liquidity risk, less-liquid ETFs such as high-yield bond funds represent a small segment of the ETF market in Canada (estimated at Can\$3.9 billion). More importantly, many of the underlying high-yield bonds in Canadian ETFs are U.S. assets, suggesting that any sell-off of these Canadian ETFs would have limited implications for the Canadian bond market. However, Canadian ETFs that hold U.S. bonds could transmit a liquidity shock originating from the U.S. bond market to the Canadian ETF.

## Conclusion

Exchange-traded funds (ETFs) generate significant benefits for investors, such as low-cost portfolio diversification and the liquidity of being traded on an exchange. However, they also introduce a number of new risks that may have implications for the financial system. While ETFs are generally perceived by investors as having equity-like liquidity, their structure is heavily reliant on authorized participants for this liquidity. The underlying asset market against which ETF shares derive their value may also be less liquid. Synthetic ETFs also carry additional counterparty and collateral risk. While ETFs have so far proved resilient in times of market stress (including the 2008 financial crisis), if any of these investor risks materialized, it could trigger an investor run, which could amplify shocks and negatively impact the underlying asset market and other similar ETFs.

The regulatory framework in major ETF markets has evolved alongside the growth and innovation of ETFs. However, different jurisdictions continue to face challenges unique to their markets. Given the past growth of synthetic ETFs in Europe, counterparty and collateral risk are being monitored, especially in light of the experience of European banks during the sovereign debt crisis. In the United States, the growing share of less-liquid ETFs suggests that riskier segments of the credit market, such as high-yield bonds, may be vulnerable to liquidity shocks. Owing to the high level of integration between the Canadian and U.S. financial markets, Canadian bond and equity markets would likely not be immune to liquidity shocks occurring in the United States. In addition, the synthetic ETF market in Canada has a concentration of counterparty risk, which could have implications for the financial system in the event of counterparty credit concerns. However, given the small size of this market segment in Canada, this is not a significant vulnerability for the Canadian financial system. Nevertheless, with the rapid changes in the ETF market, authorities need to monitor developments closely.

**Chart 9: Canadian synthetic ETF assets remain a small market**



a. “Other synthetics” use futures, currency forwards or equity options as part of the ETF’s investment strategy, and usually complement a portfolio of securities. This is in contrast to swap-based ETFs that use a single derivatives instrument (i.e., a total return swap) to provide the desired exposure.

Sources: Morningstar and Bloomberg, based on Bank of Canada calculations Last observation: July 2014

<sup>20</sup> Securities law in Canada requires that counterparties providing a forward structure or swap agreement maintain a designated rating by a designated rating organization (e.g., single “A” by DBRS). For example, if a swap counterparty is downgraded below the designated rating, it could be considered a “technical default,” which would automatically terminate all of that counterparty’s swap contracts.

<sup>21</sup> In Canada, 38 of 42 swap-based ETFs employ forward agreement “swaps” as a replication method, whereas the remaining four funds use total return swaps. The prevalence of forward agreement “swaps” is largely owing to their favourable tax treatment.

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# Cyber Security: Protecting the Resilience of Canada's Financial System

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- Cyber attacks have the potential to pose systemic risk by disrupting the business operations of key participants in Canada's financial system.
- The operational resilience of these participants—large financial institutions and the financial market infrastructures (FMIs) they participate in—is central to the overall resilience of the financial system.
- The attackers targeting elements of Canada's financial system are a diverse group, with varying levels of sophistication and capabilities.
- Canadian financial institutions and FMIs have been proactive in building up their defences against cyber attacks, and actively collaborate with one another and with the federal government.

## Introduction

The financial system depends on the collective operational resilience of financial institutions and the payment clearing and settlement systems that facilitate financial transactions. These entities, collectively referred to as financial market infrastructures (FMIs), act as a hub for financial transactions, connecting financial institutions like the spokes of a wheel. Resilient connections between financial institutions and FMIs are integral to the safety and efficiency of the financial system, but these connections also potentially serve as a means to propagate shocks. A long and impressive history of operational resilience is no reason for complacency. An operational event such as a cyber attack that causes a significant interruption to financial services and transactions could have a disruptive effect across the financial system.

To address these vulnerabilities, Canadian financial institutions and FMIs invest considerable effort and resources to ensure the resilience of their operations to a wide variety of disruptions (e.g., natural disasters, power outages

and terrorist attacks). However, the rising threat of cyber attacks presents a fresh set of challenges to operational resilience. A cyber attack is the malicious attempt by a group or an individual to compromise or gain unauthorized access to an institution's systems and technology. Globally, the average number of cyber attacks on financial institutions grew by 169 per cent between 2012 and 2013 (PWC 2013). Cyber attacks on FMIs are not as frequent, but FMIs' heavy reliance on technology puts them at risk of a disruptive attack.

This report explores the increasing significance of cyber attacks as a potential source of systemic risk, as well as the types of actors responsible for them and the methods they use. Following a discussion of the risks posed by cyber attacks, the report describes some of the measures being taken by international organizations, financial institutions, FMIs and the federal government to enhance cyber security.

## Critical Financial Market Infrastructures

FMIs facilitate the safe and efficient exchange of funds, securities and other financial products between financial institutions such as banks and investment dealers, which rely on FMIs to facilitate the transactions necessary for their operations. In Canada, FMIs have the capacity to process daily cash payments of \$150 billion and more than \$450 billion in trades of stocks and bonds.

Operational failures at FMIs can sometimes have implications for systemic risk. More specifically, the inability of one financial institution to meet its payment or settlement obligations to the FMI can cause other participants to be unable to meet their obligations, precipitating a cascading failure that spreads throughout the financial system. Given their potential to pose systemic risk, FMIs are overseen by the Bank of Canada to ensure the smooth functioning of the Canadian financial system (**Box 1**).

Box 1

## Bank of Canada Oversight of Designated FMIs

A financial market infrastructure (FMI) is a system that facilitates the clearing, settling or recording of payments, securities, derivatives or other financial transactions among participating entities. FMIs allow consumers and firms to safely and efficiently purchase goods and services, make financial investments, and transfer funds.

Some FMIs are designated as “systemically important” because they have the potential to pose systemic risk, in that the inability of one participant to make a payment or deliver a security to the FMI could cause other participants to be unable to meet their obligations, propagating risk throughout

the financial system. It is therefore essential that these FMIs incorporate appropriate risk-control mechanisms so that systemic risk is adequately controlled. The Governor of the Bank of Canada has designated several FMIs as systemically important to the Canadian financial system and subject to Bank oversight (Table 1-A).<sup>1</sup> The Bank’s objectives for its oversight are (i) to ensure that the FMIs operate in such a manner that risk is properly controlled; and (ii) to promote efficiency and stability in the Canadian financial system.

<sup>1</sup> For more details on the Bank of Canada’s oversight role, see the Bank’s website at [www.bankofcanada.ca/core-functions/financial-system/oversight-designated-clearing-settlement-systems/](http://www.bankofcanada.ca/core-functions/financial-system/oversight-designated-clearing-settlement-systems/).

**Table 1-A: Activities of Designated FMIs in 2013**

|  | Volume    | Value (Can\$ billions) |
|--|-----------|------------------------|
| <b>Large Value Transfer System</b> <ul style="list-style-type: none"> <li>Processes large-value time-critical payments</li> <li>Operated by the Canadian Payments Association</li> <li>Daily average of Canadian-dollar transactions settled:</li> </ul>   | 30,000    | 150                    |
| <b>CDSX</b> <ul style="list-style-type: none"> <li>Settles equities and fixed-income securities</li> <li>Operated by the Canadian Depository for Securities Limited</li> <li>Daily average of Canadian-dollar transactions settled:</li> </ul>   | 1,372,000 | 452                    |
| <b>Canadian Derivatives Clearing Service</b> <ul style="list-style-type: none"> <li>Clears repos and derivatives</li> <li>Operated by the Canadian Derivatives Clearing Corporation</li> <li>Daily average value cleared, cash and repurchase agreements:</li> <li>Daily average value cleared (notional), exchange-traded derivatives:</li> </ul> | --<br>--  | 20<br>101              |
| <b>Continuous Linked Settlement Bank</b> <ul style="list-style-type: none"> <li>Settles foreign exchange payments</li> <li>Operated by CLS Bank</li> <li>Daily average of Canadian-dollar transactions settled:</li> </ul>   | 27,000    | 126                    |
| <b>SwapClear</b> <ul style="list-style-type: none"> <li>Clears over-the-counter interest rate swaps</li> <li>Operated by LCH.Clearnet Limited</li> <li>Daily average value of Canadian-dollar swaps cleared:</li> </ul>  | --        | 30                     |

Source: Bank of Canada (2014)

## Sources of Cyber Attacks

Cyber attacks on Canadian financial institutions and FMIs are a growing concern for both government and industry. While Canadians are most familiar with the web-based services offered by financial institutions, these services make up a small portion of the technology employed by large and complex financial institutions. Consequently, significant effort goes into blocking intruders from using web-based services as an access point to the internal networks, systems and data that support firm operations. In the case of FMIs, internal systems are typically segregated from web-based applications, and thus present a more difficult target for potential intruders. Nevertheless, mitigation efforts must keep pace with the increasingly sophisticated and changing tactics employed by cyber actors.

Cyber actors are a diverse group who represent different threat levels, depending on their motivation and capabilities (Table 1). The impact of cyber attacks can vary considerably, but the greatest potential to cause systemic risk comes from cyber actors seeking to disrupt the business operations of financial institutions or to impair FMI critical functions (Table 2).

Adversaries are well-organized and well-funded groups of hackers with the most advanced attack capabilities and are motivated by more than just the potential for financial gain. For example, the NASDAQ stock exchange was reportedly infiltrated by adversaries who were able to gain access to confidential information for what might have been years without detection. Once the breach was discovered, investigators suggested that the infiltrators’ capabilities extended beyond espionage

and provided the means to sabotage the operations of infected targets (Riley 2014). The impact of the cyber attack was purportedly limited to the theft of proprietary information, but had the group exploited the full extent of its capabilities, the resulting operational disruption could have had implications for systemic risk.

The attack on the NASDAQ revealed that the attackers exploited defects in the architecture of NASDAQ's information technology to allow them access to internal systems. The Heartbleed and Shellshock flaws are examples of this kind of defect, since attackers could exploit defects in commonly used software to access sensitive data, alter website content or compromise visitors' computers (Symantec 2014). Another commonly used technique to gain access to internal systems is known as "spear phishing," which involves sending

personalized emails to employees. Once opened, the email installs malware that provides intruders with access to internal systems.

The business operations of financial institutions and FMIs may also be subject to more frequent low-level attacks from groups with less-advanced capabilities. These attacks are often perpetrated by "hacktivists," cyber actors who focus on disrupting operations rather than seeking financial gain. Distributed denial of service (DDoS) attacks are one example of a hacktivist activity, in which high volumes of Internet traffic are manipulated or redirected by hackers to overwhelm company networks. Such attacks are often a daily occurrence for financial institutions and, in some cases, have successfully crashed websites and interrupted the online services of large international banks (Nguyen 2013; Crosman 2014). While these attacks, if successful, are a

**Table 1: Cyber Actors—Categories and Attack Capabilities**

| Cyber actors               | Definition   |
|----------------------------|--|
| Organized crime            | Groups of hackers primarily motivated by profit who seek to attack underdefended targets with techniques previously employed by cyber actors with more advanced capabilities |
| Hacktivism                 | Hackers with similar capabilities to those of organized crime but motivated by ideological beliefs rather than financial gain  |
| Adversaries                | Groups of hackers with the financial resources and technical expertise to carry out prolonged attacks with motivations that span economic, financial and political factors   |
| Insiders                   | Disgruntled employees who violate the trust placed in them by using their access to internal systems to launch cyber attacks   |
| Third parties              | Competitors or third-party vendors seeking access to proprietary information or to sell information on a system's vulnerabilities to other cyber actors on the black market  |
| Skilled individual hackers | Individuals seeking to exploit target vulnerabilities to achieve notoriety or receive compensation   |

**Table 2: Risk Map—Rating Cyber Actors by Their Potential Impact**

| Cyber actors               | Impacts               |   |                     |  |                     |                        |            |
|----------------------------|-----------------------|---|---------------------|--|---------------------|------------------------|------------|
|                            | Financial theft/fraud | Theft of intellectual property on strategic plans | Business disruption | Destruction of critical infrastructure | Reputational damage | Threats to life/safety | Regulatory |
| Organized crime            | Very High             | Moderate  | Low                 | Low                                    | Very High           | Low                    | Very High  |
| Hacktivism                 | High                  | High  | Very High           | High                                   | Very High           | Low                    | High       |
| Adversaries                | High                  | High  | Very High           | High                                   | Very High           | Low                    | Very High  |
| Insiders                   | Very High             | High  | High                | High                                   | High                | Moderate               | High       |
| Third parties              | High                  | Moderate  | Moderate            | Moderate                               | Very High           | Low                    | Very High  |
| Skilled individual hackers | Very High             | High  | High                | High                                   | High                | Low                    | High       |

Very High High Moderate Low

Note: The ratings are adapted from a Deloitte assessment of risks to financial institutions.

Source: Deloitte Center for Financial Services (2014)

source of reputational risk because of short-term outages to web-based services, they do not compromise internal systems.

Many cyber attacks are also motivated by the potential for financial gain. In particular, the theft of proprietary data and financial information (i.e., cyber espionage) can be attempted by a wide variety of cyber actors, including competitors, third parties and insiders (i.e., an institution's own employees). The threat from insiders can be especially difficult to protect against because of pre-existing access to internal systems. Cyber espionage is not exclusive to financial institutions or FMIs but can also include attacks on government entities (Perloth 2014; Weston 2011). While these types of attacks may not directly affect the functioning of operations, the inability of financial institutions or FMIs to protect the confidentiality of their financial transactions could lead to reduced confidence in the financial system.

Cyber attacks aimed more directly at achieving financial gain by means of theft or fraud could also affect confidence in the financial system. Organized crime groups have recently progressed to more diverse tools and techniques that were previously employed by only the most sophisticated cyber actors. Publicized attacks on financial institutions include the theft in 2013 of US\$45 million in cash from ATMs in over two dozen countries, which was coordinated by hackers who manipulated withdrawal limits on compromised credit cards (Santora 2013).

The importance of financial institutions to the economy and the potential for financial gain will continue to provide motivation for cyber attacks from a broad range of actors. Not surprisingly, industry sources cite the financial sector as the target of 15 per cent of all cyber attacks globally, the highest percentage for any industry (Mandiant 2014). FMIs are subject to fewer cyber attacks than are financial institutions; nonetheless, they should remain vigilant and take appropriate precautions to defend against attacks.

## Potential Risks

An important part of assessing the potential for systemic risk from a cyber attack is understanding the channels that could propagate the effects of an attack across the financial system.

The potential seriousness of such attacks depends on the degree to which an entity's business operations are impaired. A cyber attack that results in the theft of financial or proprietary data does not affect the core functions of the financial institution or FMI. However, the reputational damage from a data breach can have a negative impact on investors' perceptions of a firm's future profitability (Sharf 2014). It is possible that a loss

of confidence in the ability of a financial institution or an FMI to function could have broader implications for systemic risk, since financial system participants could cease to enter financial transactions and withdraw funds in response to a security breach. However, past experience shows that reputational effects may only be transitory and depend on a number of factors, including the type of security breach that occurs and the size of the entity affected (Acquisti, Friedman and Telang 2006).

A cyber attack that disrupts business operations has the potential to directly create systemic risk, depending on the services affected and the duration of the outage. For example, an operational outage that disrupts the core functions of financial institutions or FMIs likely outweighs the impact of DDoS attacks experienced by Canadian financial institutions where only online services are affected.

The impact of a business disruption could also become more severe if core data and systems are corrupted. When the integrity of information and systems can no longer be relied on, services may be interrupted for an extended period as attempts are made to restore the system. The potential for systemic risk could also be amplified if financial market participants lose trust in the accuracy of their financial transactions and positions (CPMI 2014). Financial institutions and FMIs recognize the potential risk of cyber attacks that penetrate internal systems and have taken individual and collective actions to address these risks.

## Responses to Cyber Threats

Given the risks, firms around the world are making significant investments to help protect their operations from threats to cyber security. This is particularly true for global operators of critical infrastructure in various sectors, which planned to spend up to US\$46 billion on cyber security in 2013 (Rubinfeld 2013). As targets of cyber attacks, financial institutions and FMIs have strengthened cyber security through investments that cover a wide range of initiatives. The first line of defence is the protection of internal systems. The strategies, tools and technologies deployed to prevent a cyber breach include network-penetration testing, strict controls governing access to internal systems, vulnerability-scanning tools, data encryption and timely security updates (OSFI 2013). However, the goal of implementing impermeable perimeter defences to keep attackers out is no longer considered realistic or sufficient to effectively manage cyber-security risks (Kochan 2014). A proactive approach to cyber security involves monitoring the external environment for cyber threats and adopting tools such as network monitoring to detect system breaches when they happen. Financial institutions and

FMI must also develop appropriate processes and procedures to respond to and recover from a cyber attack once a breach has occurred (NIST 2014).

In addition to the actions being taken by financial institutions and FMIs, authorities need to update supervisory frameworks to reflect cyber-security threats (Bin Ibrahim 2014). In Canada, this process is under way as authorities work to ensure that cyber-security practices incorporate the necessary properties and characteristics to protect against elevated threat levels. The Office of the Superintendent of Financial Institutions has published guidance on cyber security to assist federally regulated financial institutions in assessing the adequacy of their cyber-security practices and help determine the changes required to meet industry best practices (OSFI 2013). Similarly, the Bank of Canada has required systemically important domestic FMIs to complete a self-assessment of their cyber-security practices against standards that promote a risk-based approach to managing cyber-security risk.

Current efforts in Canada mirror actions taken in other jurisdictions since cyber security has been identified as a global public policy issue. In the United States, the Department of Homeland Security issued an Executive Order in early 2013 on “Improving Critical Infrastructure Cybersecurity.” Similarly, in 2014, the European Commission published a cyber-security strategy for the European Union. A key point of the strategy is the assessment of security practices for critical infrastructure. These broad initiatives cover essential infrastructure in every industry and form the basis for regulation in the financial sector within those jurisdictions.

International organizations are also seeking to update their policy frameworks to reflect the evolving risk from cyber threats. The Committee on Payments and Market Infrastructures recently published a report on the current cyber-security practices of FMIs (CPMI 2014). The Bank of Canada has adopted the general risk-management guidance issued by this committee as the standard for designated FMIs, and fully expects to incorporate any subsequent guidance related to cyber security (CPSS-IOSCO 2012).

## Co-operation on Cyber-Security Initiatives

The establishment of strong cyber-security defences at financial institutions and FMIs is not enough to mitigate the potential for risks to propagate in an interconnected financial system. Because a severe cyber attack could have spillover effects, effective collaboration among FMIs, financial institutions and the federal government is necessary. Engagement with other key sectors (e.g., telecommunications and energy) is also important for ensuring collective operational resilience.

Public Safety Canada is responsible for implementing Canada's cyber-security strategy, which seeks to secure government systems, work with others to secure systems outside of government and help Canadians to be safer online.<sup>1</sup> This approach employs a broad tool kit and focuses on an active, rather than reactive, approach to mitigating cyber-security threats. A key component of the strategy is to strengthen partnerships across sectors and between government and industry. Co-operative initiatives that facilitate information sharing enhance cyber security by creating a forum to exchange best practices, share threat-intelligence information and establish communities of trust between sectors. These initiatives represent a transition from strategies that rely solely on an entity's internal resources to one that leverages the expertise of partners to reduce the likelihood of cyber attacks occurring and to facilitate more effective mitigation strategies.

Initiatives such as Public Safety Canada's Canadian Cyber Incident Response Centre (CCIRC), in which Canadian financial institutions and FMIs actively participate, exemplify the benefits of information-sharing efforts. CCIRC is an intelligence exchange that combines key data on cyber attacks reported by participants across industries and government with input from law-enforcement agencies to produce relevant threat information for participating institutions. The receipt of timely threat information can lead to proactive solutions that could prevent a cyber attack from materializing. Furthermore, CCIRC continues to work together with Canadian financial institutions to search for better and more efficient ways to share intelligence information.

FMIs and financial institutions are also involved in co-operative initiatives that focus on exchanging best practices and developing long-term mitigation strategies. Such initiatives provide an effective means to share lessons learned and to develop strategies that address shared vulnerabilities to cyber attacks. While these programs continue to produce important benefits for participating entities, there is a need to expand the existing communities to include other strategic partners. Current efforts by the federal government, financial institutions and operators of FMIs continue to seek ways to establish formal information exchanges with each other and with other key sectors.

Information-sharing initiatives break down barriers to co-operation between entities to produce cyber-security strategies that are superior to any developed in isolation. Achieving meaningful progress on sector-wide operational resilience requires building a consensus among institutions that bring their own priorities and approaches to resolving an issue.

<sup>1</sup> For more information, see the Public Safety Canada website at [www.publicsafety.gc.ca/cnt/ntnl-scr/cbr-scr/index-eng.aspx](http://www.publicsafety.gc.ca/cnt/ntnl-scr/cbr-scr/index-eng.aspx).

## Testing Cyber Security

Despite individual and collective actions to mitigate cyber threats, a large-scale cyber attack remains a possibility. The Canadian Bankers Association has a coordinated framework for managing a severe operational event that affects more than one financial institution, including a cyber-incident committee consisting of information technology experts. Canadian FMIs also have their own procedures and contingencies for managing a severe operational disruption. However, the scope of these separate frameworks is too limited for a truly sector-wide operational event. To coordinate actions in a severe disruption, the Joint Operational Resilience Management (JORM) program links members of major Canadian banks, FMIs and the federal government.

To this end, participants in the JORM program have conducted a series of “tabletop” exercises that use fictional scenarios to test the capabilities of both the private and public sectors in some form of crisis situation. These exercises can help to assess key risks, determine how to escalate incidents to decision-makers and coordinate mitigation strategies.

The recently completed 2014 exercise explored a scenario that included a targeted cyber attack on an FMI, resulting in delays and disruptions to the back-office operations of financial institutions. The objective of the exercise was to help clarify roles and responsibilities during a sector-wide operational event. The development of an escalation framework was a key component of the test, and helped to formalize how participants would share information during a crisis event and coordinate actions to respond to such an event. The observations and lessons learned from this exercise will help to further refine industry crisis-response procedures.

The scale of the exercises conducted, in terms of their complexity and the number of stakeholders involved, will continue to expand to a full-scale, sector-wide exercise planned for 2016. This exercise will require a level of planning and coordination comparable with similar

exercises conducted by the Bank of England<sup>2</sup> and the Securities Industry and Financial Markets Association (SIFMA) in the United States.<sup>3</sup>

Continued collaboration on testing cyber-security vulnerabilities and capabilities will help to advance the complexity of these tests. In the realm of industry testing, many different dimensions could be expanded. For example, the U.K. financial authorities have focused on developing a framework for conducting tests based on specific cyber-threat intelligence to ensure that the tests replicate as closely as possible the evolving threat landscape.<sup>4</sup>

## Conclusion

In addition to traditional threats to operational resilience, financial institutions and financial market infrastructures are facing growing challenges in the form of cyber-security threats. The extensive reliance on technology by financial institutions and financial market infrastructures, coupled with the high degree of interconnectedness between them, increases the sector's vulnerability to a cyber attack. Hence, both private and public sector stakeholders have recognized the need to work together to address these potential vulnerabilities.

Public-private partnerships such as the Canadian Cyber Incident Response Centre and the Joint Operational Resilience Management program have made progress in improving the resilience of financial institutions and FMIs to emerging cyber-security threats. However, to further advance cyber-security initiatives, Canadian financial institutions and FMIs, and their government partners, must continue to leverage established co-operative initiatives.

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- 2 On 12 November 2013, the Bank of England held its second exercise (Waking Shark II) designed to rehearse the collective response of the wholesale banking sector, including investment banks and key FMIs, to understand and minimize the impact of a cyber attack on the sector.
  - 3 On 18 July 2013, SIFMA held its second exercise (Quantum Dawn 2) that simulated a systemic cyber attack on the U.S. financial system and provided the industry with an opportunity to test its response procedures.
  - 4 See “An introduction to CBEST,” available on the Bank of England's website at [www.bankofengland.co.uk/financialstability/fsc/Documents/anintroductiontocbest.pdf](http://www.bankofengland.co.uk/financialstability/fsc/Documents/anintroductiontocbest.pdf).

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