



BANK OF CANADA
BANQUE DU CANADA

FINANCIAL SYSTEM REVIEW

June 2014

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June 2014

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This report includes data received up to 5 June 2014.

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Preface

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.

Enhanced Risk-Assessment Framework

Since the financial crisis, efforts in Canada and internationally have been focused on making financial systems safer through regulatory reform and improving the identification and assessment of risks that could threaten financial stability. In this context, the Bank of Canada is introducing an enhanced framework for assessing risks to the Canadian financial system.¹ Key to this framework is the explicit identification of vulnerabilities to inform and direct the risk-assessment process. A “vulnerability” is a pre-existing condition that could amplify and propagate shocks throughout the financial system. In contrast, “risks” are events or outcomes that could threaten the ability of the financial system to perform its core functions. Risks materialize when trigger events—either domestic or foreign—interact with vulnerabilities to cause stress in the domestic financial system.

Risks and vulnerabilities are closely related. A particular risk may involve more than one vulnerability; conversely, a given vulnerability may be involved in more than one risk. The interaction of multiple vulnerabilities is illustrated by the experience of the global financial crisis of 2007–09: while that crisis originated with housing market vulnerabilities in the United States and some European countries, it was further amplified and transmitted through a number of other vulnerabilities, including opaque and fragile securitization structures, inadequate capital and liquidity buffers in many financial institutions, skewed risk-taking incentives by “too-big-to-fail” institutions whose interconnectedness made them major channels for financial stress, and the susceptibility of some core funding markets to liquidity freezes.

Focusing explicitly on vulnerabilities in the Canadian financial system has several advantages. It highlights where the major fragilities lie and how they are evolving. It also puts greater emphasis on those characteristics of the Canadian financial system that can be addressed by the actions of individuals, institutions and policy-makers, and less emphasis on the hard-to-predict trigger events that may ignite financial system vulnerabilities.

To identify vulnerabilities in the Canadian financial system, we examine several sectors:

- financial sector institutions, including both domestic systemically important banks (D-SIBs); life insurance companies and pension funds; and smaller financial entities, such as small banks, credit unions and trust companies;

¹ The framework draws from work undertaken by T. Adrian, D. Covitz and N. Liang, “Financial Stability Monitoring,” Federal Reserve Board Finance and Economics Discussion Paper No. 2013-21, 2013, as well as the Office of Financial Research, *2013 Annual Report*, U.S. Department of the Treasury, 2013.

- asset markets, including financial markets and shadow banking activities, as well as property markets;
- the non-financial sector, households, governments and non financial corporations—the end-users of financial system services; and
- financial market infrastructures (FMIs), the systems that facilitate the clearing, settlement and recording of payments, securities and derivatives or other financial transactions among participating entities.

Vulnerabilities in these different sectors can be measured along various dimensions, such as the degree of leverage, complexity, and liquidity and maturity transformation, and the behaviour of asset prices. While these elements are part of the normal functioning of the financial system, they may make the system vulnerable if they become excessive. In addition, a vulnerability assessment should review the extent and type of external exposures and the degree of interconnectedness across the Canadian financial system. These are fundamental characteristics of the financial system that provide important economic benefits, but they can also potentially serve as a means of propagating shocks. For example, the interbank market provides an important funding mechanism for financial sector entities, but could also rapidly transmit funding problems across the system in the event of a financial shock.

The size and number of vulnerabilities, and the interactions among them, determine the size of the trigger required to cause a material impact on the functioning of the financial system.

Given the set of vulnerabilities and potential triggers, the main financial stability risks can be assessed in terms of the loss that they could impose on the financial system. This expected loss depends on the probability that the risk will materialize and the expected impact on the system in the event that it does (**Figure 1**). Both quantitative and qualitative factors are considered in determining whether the probability and impact of a particular risk are lower or higher. The risks being considered are in many cases rare events. The rating of risks is relative and is meant to summarize our views on the relative importance of the key risks to the Canadian financial system.

Figure 1: Mapping probability and impact to FSR risk ratings

		Impact				
		Less severe → More severe				
Probability	Higher					
	Lower					
		Low	Moderate	Elevated	High	Very high

Overview

The *Financial System Review* (FSR) summarizes the judgment of the Bank of Canada's Governing Council on the key vulnerabilities—pre-existing conditions that could amplify and propagate shocks—and risks to the stability of the Canadian financial system. The discussion starts with overall macro-financial conditions to provide context for the identification of domestic vulnerabilities and the assessment of the financial system risks for Canada.

The global economy, led by the United States, continues to strengthen and is expected to underpin sustainable economic growth and financial stability in Canada. Tensions in the euro area continue to recede, owing to the support of the European Central Bank (ECB), progress in banking system repair and fiscal consolidation in the peripheral countries. As well, a number of emerging-market economies (EMEs) have taken steps to improve their fundamentals and increase the resilience of their financial systems.

Nevertheless, significant economic uncertainties remain. The combination of low inflation and lacklustre growth remains a concern in many advanced economies. In the euro area, these issues are compounded by still-unresolved structural problems, as well as geopolitical risks from the Ukraine-Russia situation. In China, the unsustainable composition of growth and the corresponding buildup of financial exposures in shadow banking suggest the possibility of a sharp slowdown. Other emerging markets are subject to risks associated with the normalization of monetary policies in the advanced economies. In Canada, the anticipated rebalancing of economic growth toward exports and investment remains elusive, and, while housing market developments are consistent with the Bank's view that conditions are evolving in a constructive manner, a disorderly unwinding of household sector imbalances remains a significant risk to the economic outlook.

Despite the still-elevated degree of macroeconomic uncertainty, financial conditions remain buoyant in advanced economies, with financial market volatility and credit-risk premiums at historically low levels. These developments may largely reflect the effects of central bank operations and communications in increasing valuations of riskier assets and limiting their variability. The yields on long-term bonds have also decreased during 2014, partly reflecting these same effects, together with growing market anticipation that interest rates will remain low over the long term.

The Canadian financial system remains robust. Canadian banks are well capitalized, financial markets are functioning well and financial market infrastructures are supporting core financial market activities. The non-financial sector continues to benefit from the low interest rate environment. Nevertheless, three key vulnerabilities deserve emphasis:

1. Imbalances in the Canadian housing market

- Despite some signs of a soft landing, valuations are stretched and there are signs of overbuilding in certain segments of the housing market.

2. Elevated level of Canadian household indebtedness

- Canadian households are highly leveraged. Household debt-to-income ratios remain at historically high levels despite a recent moderation in the growth of mortgage credit and continued low interest payments on mortgage debt.

3. Significant exposures to potential external shocks

- Canada is exposed to sizable external vulnerabilities and risks through economic and financial links. Current examples include the effects on the Canadian financial market of higher investor risk taking, consistent with a global search for yield; strong correlations between U.S. and Canadian long-term interest rates; and the significance of world commodity prices to the Canadian economy and financial system.

Vulnerabilities in the Canadian financial system could be exposed by a domestic or foreign trigger, which could then cause a risk to materialize. Overall, the nature of the risks to the Canadian financial system is broadly the same as that discussed in the December FSR. In defining these individual risks, the descriptions have been modified from the December FSR to reflect the scenarios that pose important and plausible risks to the Canadian financial system. 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. In addition, some of these risks could cause other risks to materialize, thereby amplifying the impact.

The four key risks to the Canadian financial system are:

- 1. A sharp correction in house prices**, resulting from a large, macro-economic shock that leads to higher unemployment and a reduced ability of Canadian households to service their debts.
 - In view of the expected strengthening of the global and Canadian economies, the probability of this risk materializing is low. If such a risk were to materialize, the impact could be severe.
 - The current rating for this risk is “elevated,” unchanged from the December 2013 FSR.
- 2. A sharp increase in long-term interest rates** globally, including in Canada, likely resulting from an overshoot in U.S. long-term interest rates.
 - Market reaction to U.S. monetary policy adjustments has thus far been benign, suggesting a low probability that future adjustments will have outsized outcomes. However, the global search for yield has created financial conditions that could unwind abruptly, precipitating a sharp, widespread increase in long-term rates. If this occurred, there could be a moderately severe economic and financial impact on Canada.
 - The current rating for this risk is “moderate,” unchanged from the December 2013 FSR.

3. **Stress emanating from China and other EMEs**, triggered by a severe financial disruption in China associated with a significant slowdown in Chinese economic growth. There would be widespread repercussions on global economic and financial systems that would feed back to Canada.
 - In China, accumulating fragilities in the banking and shadow banking sectors, in local government finances, and in property markets indicate a greater probability of a financial stress event that sharply tightens financial conditions and, in turn, reduces China's growth. This could result in a steep drop in global commodity demand and prices that could have a moderately severe impact on the Canadian economy and financial system.
 - The current rating for this risk is "elevated" and has increased since the December 2013 FSR.
4. **Serious financial stress from the euro area** with global consequences, possibly caused by market concern about the adequacy of bank balance-sheet repair or a sudden economic shock related to heightened geopolitical stress in Ukraine and Russia.
 - Many positive developments in the euro area have reduced the likelihood of a euro-area crisis to a relatively more moderate level, but significant vulnerabilities remain in the financial system and economy. If this risk did materialize, financial links and economic spillovers could lead to a moderately severe impact on Canada.
 - The current rating for this risk is "elevated" and has decreased since the December 2013 FSR.

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

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

Risk 1: A sharp correction in house prices				
Risk 2: A sharp increase in long-term interest rates				
Risk 3: Stress emanating from China and other EMEs				
Risk 4: Financial stress from the euro area				

Probability	Higher ↑ Lower	Impact		
		Less severe → More severe		
			Risk 3, Risk 4	
			Risk 2	Risk 1
Low		Moderate	Elevated	High
				Very high

Assessment of Vulnerabilities and Risks

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 survey 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 the impact if they do occur.

Macrofinancial Conditions

Global economic growth is expected to strengthen over the next three years as factors that have slowed the expansion in advanced economies diminish, including fiscal consolidation and private sector deleveraging. Uncertainty about future demand is receding, and monetary policy continues to be highly accommodative. This is creating favourable financial conditions for a more entrenched, albeit gradual, recovery in business spending. While risks to global economic growth are, on balance, roughly similar to those in December, there is increased concern about financial fragility and unbalanced growth in China, persistent low inflation in advanced economies and heightened geopolitical tensions.

Although economic growth in China remains solid, there are challenges related to achieving a rotation in domestic demand toward greater household consumption while restraining the rapid growth of credit. In other EMEs, economic growth is expected to strengthen in the second half of 2014 as demand from advanced economies picks up and further progress is made on economic reforms.

In the euro area, market concerns about the risk of deflation have arisen in the context of prolonged low inflation and the fragile economic recovery. The situation in Ukraine and Russia could exert further drag on the euro-area recovery. However, the European Central Bank's recent actions represent important steps to support growth and address low inflation.

In Canada, the anticipated improvement in global economic growth, particularly in U.S. business and residential investment, is expected to boost exports. Strong prices for non-energy commodities and oil are expected to support Canadian investment. An increase in exports and investment will lead to a more broadly based and more sustainable economic recovery in Canada, which will promote domestic financial stability.

Financial market conditions in advanced economies remain buoyant...

Major equity indexes have continued to increase since the December FSR, and some are at all-time highs (Chart 1).

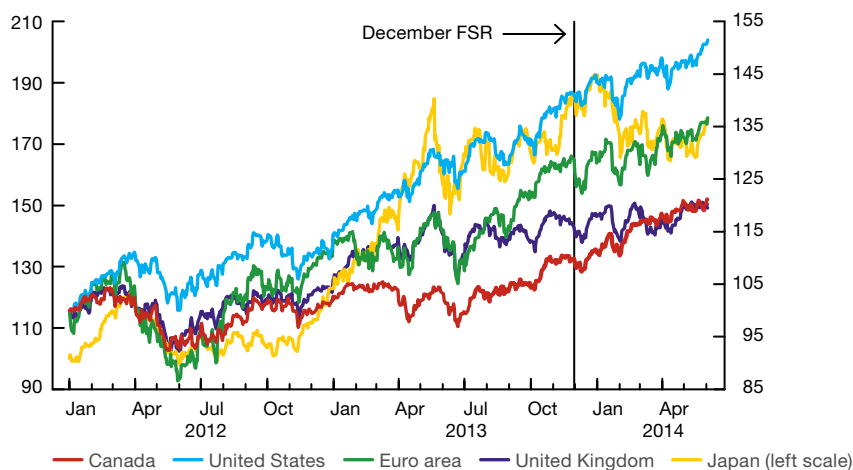
Canadian equity indexes have also increased, although they have not reached record-high levels. At the same time, yields on long-term government bonds in Canada and other advanced economies have declined since the December FSR and remain low by historical standards (Chart 2).

Realized market volatility has remained below historical averages, and implied volatility, derived from options prices, has declined across several asset classes (Chart 3).²

This combination of higher equity prices, lower bond yields and lower volatility may reflect, in part, growing market expectations of a post-crisis steady state that is characterized by reduced global potential growth and lower long-term equilibrium interest rates. It may also partly reflect lower risk premiums, driven by prolonged, exceptional monetary policy stimulus in these economies. The relative impacts of these different factors will have implications for the eventual normalization of monetary policy.

Chart 1: Equity indexes in several advanced economies are at all-time highs

Equity indexes (3 January 2012 = 100)



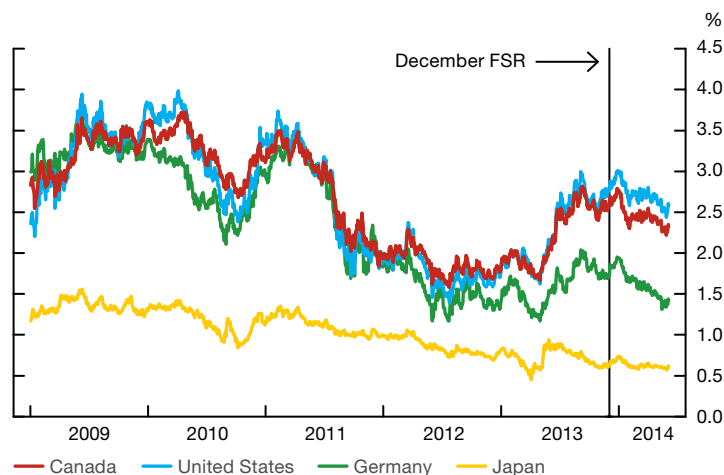
Source: Bloomberg

Last observation: 5 June 2014

² “Realized” or “historical” volatility is the average price deviation from its mean over a specific period. “Implied” volatility is an indicator of future volatility. Measures of implied volatility are derived from the pricing of options purchased by investors, either to protect against or speculate on the price movements of an underlying asset (i.e., a bond or a stock).

Chart 2: Yields on long-term government bonds have declined

Yields to maturity on 10-year sovereign bonds

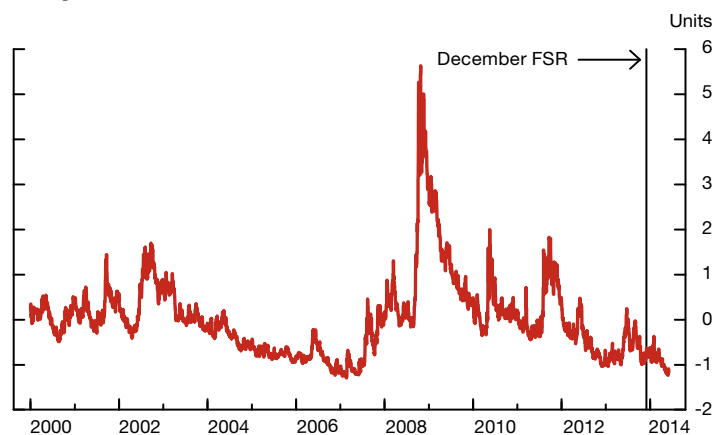


Source: Reuters

Last observation: 5 June 2014

Chart 3: Implied volatility has declined across a range of asset classes

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



Note: Implied volatility measures include 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

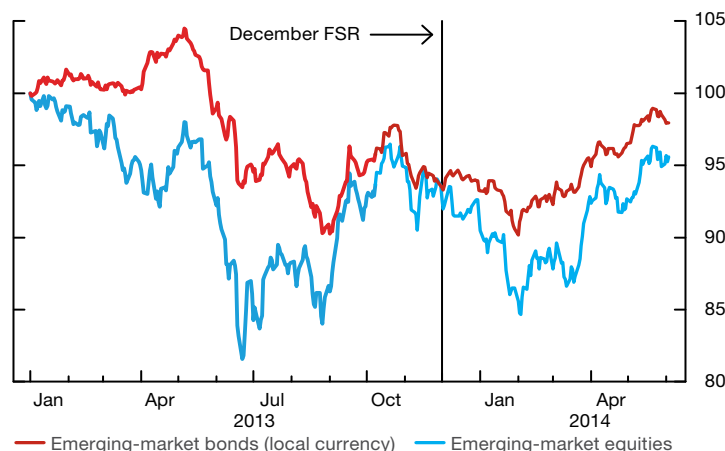
Last observation: 5 June 2014

...while financial conditions in some emerging-market economies are improving

Financial conditions in EMEs are more favourable than at the time of the December FSR. EME equity and local-currency bond indexes have risen over the past six months, supported by lower market volatility and a modest increase in retail portfolio flows (Chart 4). However, performance at the country level varies widely as investors discriminate across EMEs based on economic fundamentals. This is most notable in equity markets, where the rolling 30-day correlation of equity returns across EMEs has remained well below the levels seen last summer and significantly below the levels observed during the global financial crisis.

Chart 4: Emerging-market bond and equity indexes have risen since December

Emerging-market indexes (3 January 2013 = 100)



Note: The MSCI Emerging Markets Index is used to track emerging-market equities and the Markit iBoxx GEMX Local Currency Bond Index tracks bonds.

Source: Bloomberg

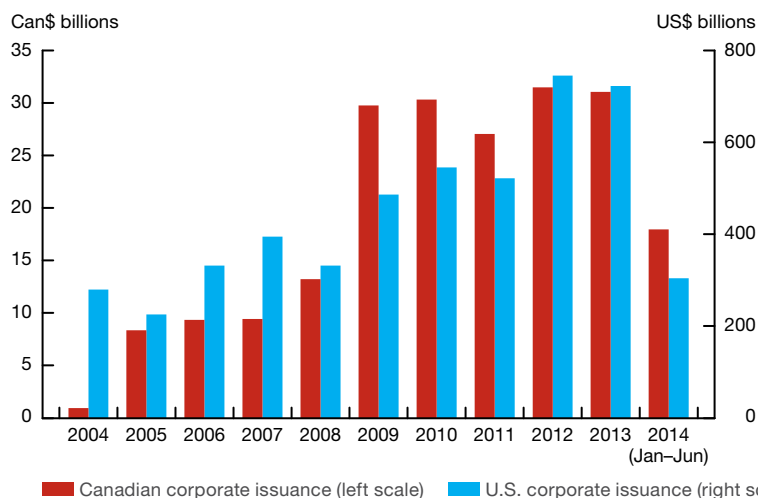
Last observation: 5 June 2014

The North American corporate sector continues to benefit from the low interest rate environment

Low interest rates, combined with low market volatility, have continued to support the demand for corporate debt. Accordingly, primary corporate issuance in Canada and the United States has been robust so far this year (Chart 5). While corporate credit spreads in the investment-grade and high-yield sectors have continued to narrow, they are still above the lows reached before the financial crisis.

Business-lending conditions in Canada are supportive

Business-lending conditions have eased slightly further since the last FSR. Responses to the Bank of Canada's 2014Q1 *Senior Loan Officer Survey* continue to point to some easing in both the price and non-price aspects of business lending for all categories of borrowers. The Bank's spring 2014 *Business Outlook Survey* also suggests an easing in credit conditions in recent months.

Chart 5: Non-financial corporate bonds are on track for another solid year of issuance


Source: Dealogic

Last observation: 5 June 2014

Canadian banks have sound capital and liquidity positions

The second-quarter 2014 results for the Big Six Canadian banks indicate that earnings remain solid and provisions for credit losses remain low. In addition, all six domestic systemically important banks (D-SIBs) have continued to build up their capital bases, and their common equity Tier 1 (CET1) capital ratios remain above the 8 per cent all-in target required by the Office of the Superintendent of Financial Institutions (OSFI) by 2016. In addition, all six are in line to comply with new liquidity requirements that will take effect in 2015.³

Key Vulnerabilities in the Canadian Financial System

This section identifies the Canadian financial system vulnerabilities that the Governing Council judges to be the most important to monitor and assess at this time. The discussion is not exhaustive: it is intended to examine the conditions that could materialize into serious risks.

The Canadian financial system remains robust: Canadian banks are well capitalized; financial markets continue to function well; and financial market infrastructures are supporting core activities, in line with international standards. The strength and resilience of the Canadian financial system were affirmed by the International Monetary Fund (IMF) in its most recent Financial Sector Assessment Program (FSAP).⁴ Nonetheless, there are three key vulnerabilities in the Canadian financial system that could serve to amplify and propagate shocks. In addition, the interconnectedness across Canadian financial institutions, via their financial exposures and their participation in financial markets, creates various channels through which shocks could be transmitted through the system.

Vulnerability 1: Imbalances in the Canadian Housing Market

Imbalances in the housing sector continue to be demonstrated by elevated house prices, together with a buildup of supply in some segments of the housing market. While the Governing Council continues to see a constructive evolution in these imbalances—as the pace of house price increases has moderated and housing sector activity has remained broadly in line with fundamentals—this vulnerability remains important.

Residential property valuations continue to be stretched

House prices have continued to rise since the December FSR. Although the more moderate pace of price increases suggests a soft landing, they are still growing faster than disposable income (Chart 6).

On an aggregate basis, the growth of house prices in Canada has decelerated over the past few years. In certain cities, particularly Toronto, Québec, Winnipeg and Hamilton, house prices have risen more than in other areas, which may reflect differences in regional demand that are driven by underlying economic fundamentals (Chart 7).⁵ Nevertheless, stretched valuations appear to be more widespread geographically than in past housing booms, although the average degree of overvaluation, relative to trend, is still lower than in those previous episodes.

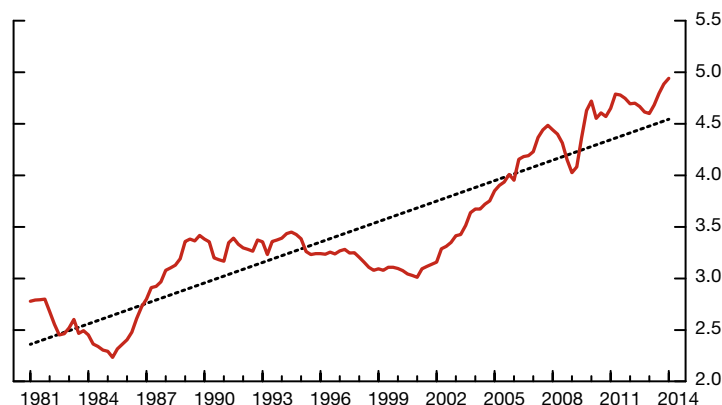
³ The final Canadian guidelines on liquidity adequacy requirements were issued by OSFI at the end of May 2014. See www.osfi-bsif.gc.ca/Eng/wn-qn/Pages/LAR.aspx.

⁴ For a summary of the FSAP results, see Box 3 in the Safeguarding Financial Stability section of this issue.

⁵ Strong price growth has been observed in Calgary and Vancouver so far this year.

Chart 6: House prices in Canada are still high relative to disposable income

House-price-to-income ratio and linear trend

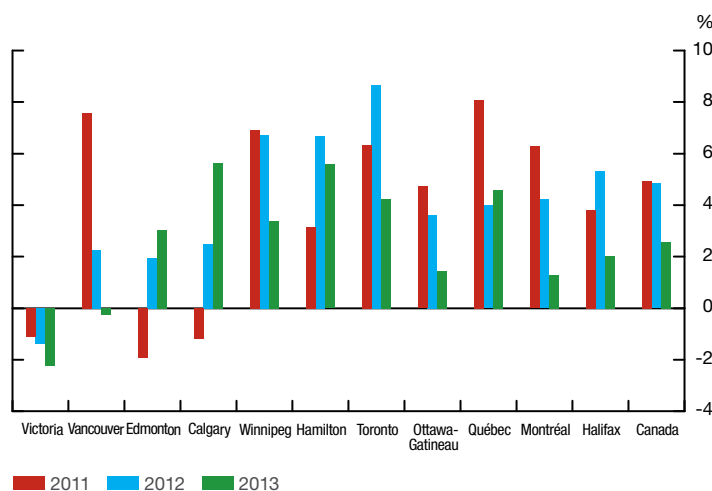


Sources: Statistics Canada, Canadian Real Estate Association and Bank of Canada calculations

Last observation: 2014Q1

Chart 7: House prices have shown strong growth in certain cities

Average year-over-year growth rate over the period



Source: Teranet-National Bank

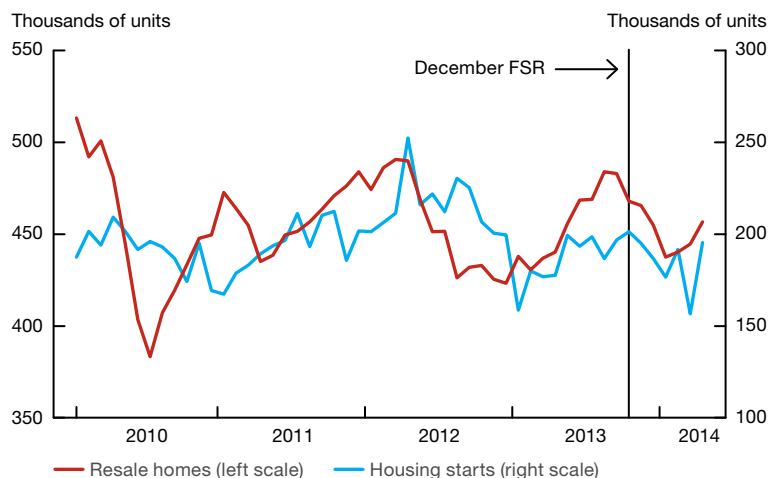
Last observation: December 2013

Housing market activity remains broadly in line with fundamentals

Housing market activity is broadly in line with demographic fundamentals, despite recent signs of a resurgence from the weather-related slowdown in late 2013 and early 2014. Sales of existing homes and housing starts have picked up over the past few months (Chart 8).

The concentration of housing starts in multiple-unit dwellings, however, has been a focus of attention, with a level of construction that, relative to population, is significantly above its historical average (Chart 9). While some of this increase can be explained by demographics, shifting preferences toward living in the city core, and rising commuting costs,⁶ the substantial increase in construction over the past 15 years has raised questions about its sustainability.

⁶ The relevant demographic factors include an aging population, immigration and demand by non-residents. In addition, preferences toward living in the city core may have risen along with increased costs for single, detached houses and for transportation.

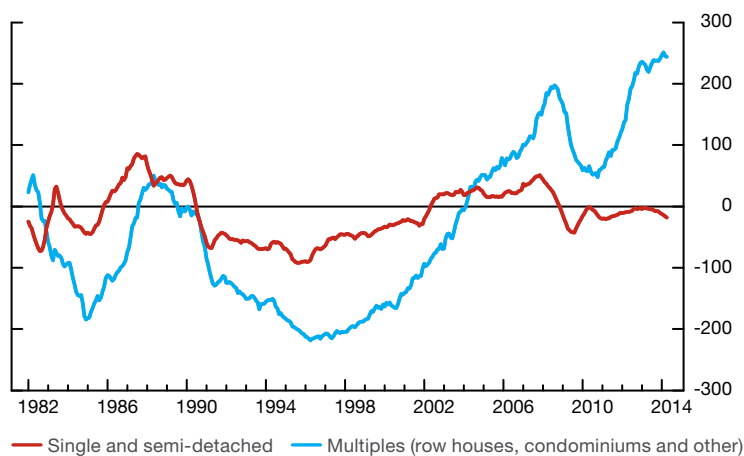
Chart 8: Housing activity has picked up recently following weakness due to unusual weather conditions

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

Last observation: April 2014

Chart 9: The supply of multiple-unit dwellings under construction continues to increase

Deviation from historical average, per 100,000 people (aged 25+ years),
major metropolitan areas



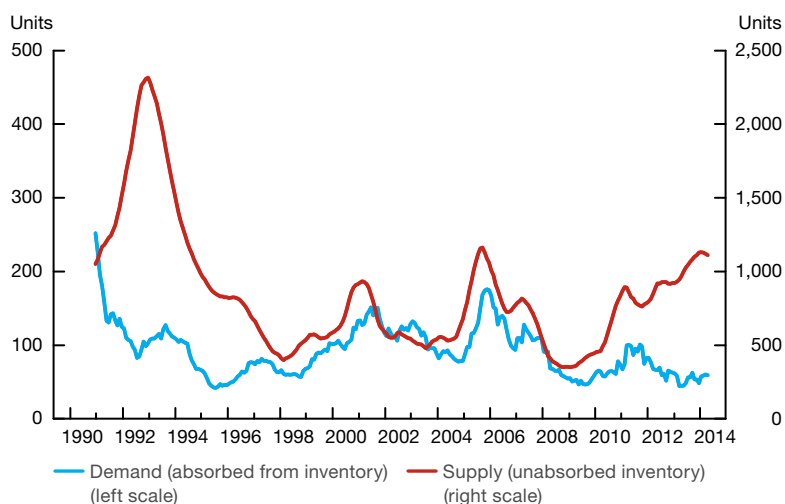
Sources: Canada Mortgage and Housing Corporation,
Statistics Canada and Bank of Canada calculations

Last observation: April 2014

The Toronto condominium market remains a pocket of vulnerability

Of particular concern is the high level of construction activity in the Toronto condominium market. While the inventories of newly completed but unoccupied units have been increasing since the crisis, the absorption from unoccupied inventory has been lagging the buildup in supply over the past several years (Chart 10). A correction in this important market could spill over into other parts of the housing market through various channels, including buyers' price expectations.

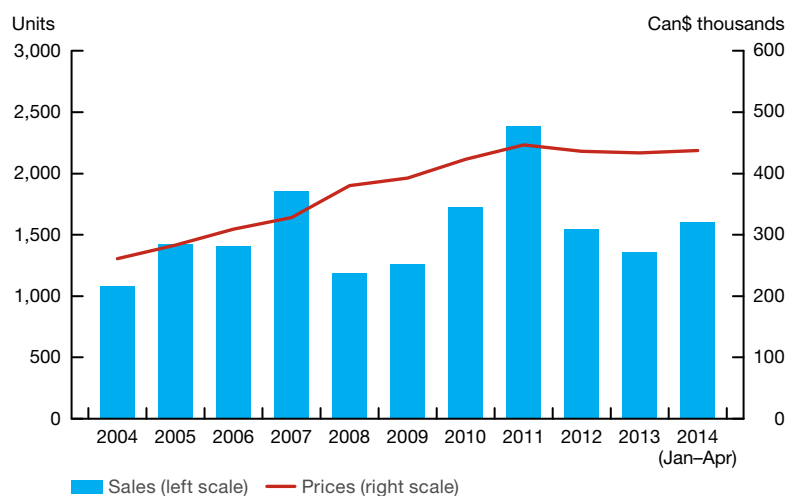
Chart 10: The stock of newly completed but unoccupied condominiums in Toronto has been growing
12-month moving average



Source: Canada Mortgage and Housing Corporation

Last observation: April 2014

Chart 11: Although sales have picked up in 2014, prices for new Toronto high-rise units have been flat
Home sales and prices (monthly average)



Source: RealNet Canada Inc.

Last observation: April 2014

The number of unsold condominium units in the pre-construction stage also remains high. Price discounting, which often occurs before construction begins in order to accumulate a sufficient level of advance sales to secure financing, can have a broader impact on pricing in the condominium market.⁷ Indeed, the prices for new high-rise units, at all stages of construction, have remained flat despite stronger sales so far in 2014 (Chart 11).

⁷ Supply under construction could also affect price expectations and current prices. In addition to price discounting, non-price incentives also occur at different stages of construction.

Vulnerability 2: Elevated Level of Canadian Household Indebtedness

High household leverage, demonstrated by elevated debt-to-income ratios, leaves Canadians vulnerable to an unexpected decline in employment earnings or an increase in debt-servicing payments. While this ratio has been stabilizing as household credit growth slows, the level remains high. An unemployment or interest rate shock could have significant and widespread effects on households that would be felt across the financial system and the economy.

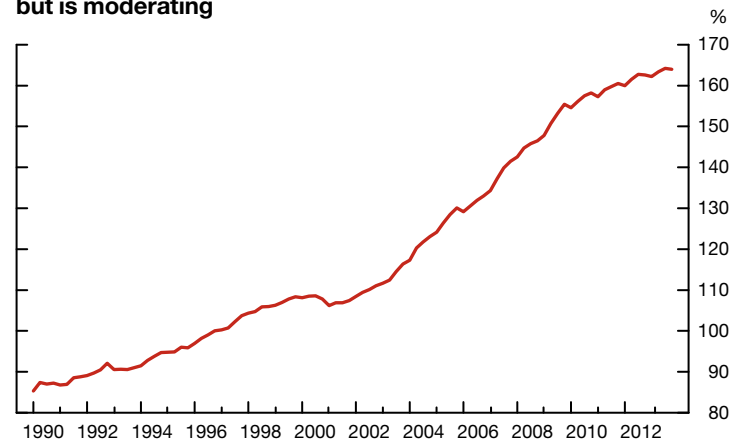
Household debt remains at historically high levels

The ratio of aggregate household debt to disposable income in Canada remains at a historically high level, although it edged down at the end of 2013 (Chart 12).

The growth of household credit continues to be relatively stable, at around 4 per cent (Chart 13), although the growth in consumer credit has been higher since the last FSR, owing to a strong increase in personal loans for automobile purchases.

Despite high debt levels, the exceptionally low interest rate environment has restrained the rise in household debt-service burdens. For example, over the past several years, Canadian homeowners have been able to reduce their payments when renewing their fixed-rate mortgages.⁸ The debt-service ratio, measured by aggregate interest rate payments on mortgage debt, has steadily declined. However, when estimates of the required repayment of the mortgage principal are included, the share of household disposable income currently devoted to servicing mortgage debt has not fallen with lower interest rates (Chart 14). If payments on consumer debt were included, total debt-service costs would be even higher.

Chart 12: The ratio of household debt to disposable income is high but is moderating



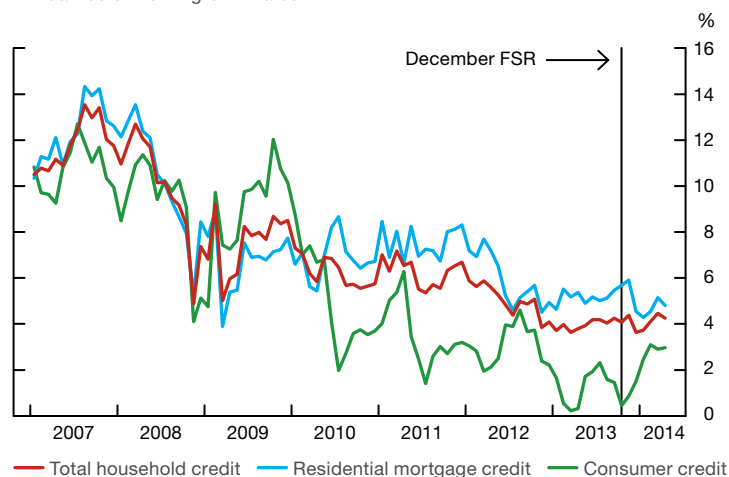
Source: Statistics Canada

Last observation: 2013Q4

⁸ Over the past three years, borrowers with existing fixed-rate term mortgages have benefited from renewing their loans at lower interest rates. Reduced rates on longer-term (3- to 5-year) fixed-rate mortgages have also made it more attractive to lock into longer terms. Over this period, homeowners renewing their mortgages have experienced an interest rate decrease of between 1.3 and 2.4 percentage points per year, which translates into substantial savings in annual interest payments.

Chart 13: The growth of household credit has been relatively stable

Annualized 3-month growth rates

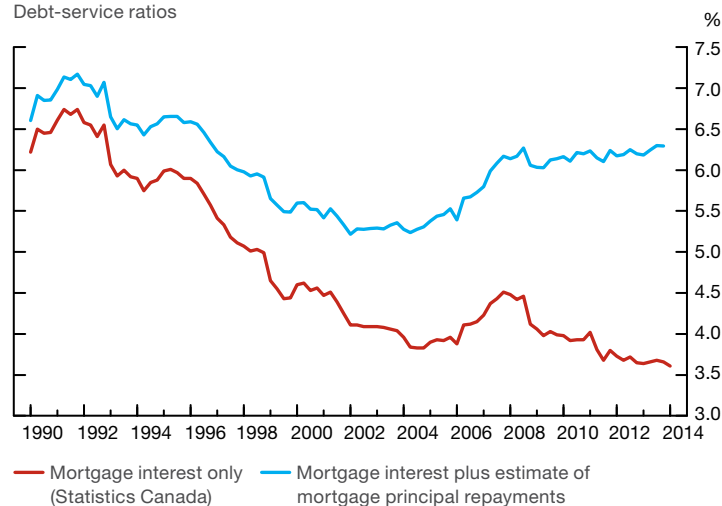


Source: Bank of Canada

Last observation: April 2014

Chart 14: Mortgage debt service, including principal repayment, has not fallen with lower interest rates

Debt-service ratios



Sources: Statistics Canada and Bank of Canada calculations

Last observations: Mortgage interest only, 2014Q1; mortgage interest plus estimate of mortgage principal repayments, 2013Q4

Canadian households are exposed to interest rate and income shocks

To some degree, low mortgage interest rates have offset the high valuations in the housing market, so that affordability has remained relatively stable (Box 1). However, housing would become less affordable for some households if interest rates moved higher (Chart 15).

Existing Canadian homeowners are exposed to the risk of a change in long-term interest rates, either at the reset date for variable-rate mortgages or when refinancing a fixed-rate mortgage (when the term is shorter than the amortization period). With a 5-year fixed-rate maturity being the most popular term chosen by Canadian homeowners, on average, 20 per cent of the outstanding stock of fixed-rate mortgages would be up for renewal

Box 1

Measuring the Affordability of Housing

The housing affordability index used by the Bank of Canada has been updated. The revised measure provides an estimate of the share of disposable income that a representative household, rather than a first-time homebuyer, would put toward housing-related expenses. Beyond this change in definition, the measure has been improved to consider utility fees, borrowing costs that are a better reflection of market conditions and household disposable income rather than personal disposable income. The latter change better reflects the income that is available to service housing-related obligations. The updated measure also incorporates changing demographic trends. Since the revised measure focuses on current affordability, all variables are expressed in nominal terms rather than real terms, which had been used in the past.

The housing affordability index is calculated as a ratio, where the numerator, housing-related costs, is the sum of the average quarterly mortgage payment plus utility fees, and the denominator is the average household disposable income. The higher the level of the index, the more difficult it is to afford a house. Costs depend on the effective mortgage rate, the total value of the mortgage, the amortization period and utility fees.¹

¹ The effective mortgage rate is a weighted average of discounted 1-, 3- and 5-year fixed-rate mortgages and the discounted variable-rate mortgage. Weighted posted rates, which are higher, had been used in the previous index. The amortization period is assumed to be 25 years.

The total value of the mortgage depends on the price of the home and the size of the down payment, which we assume to be 5 per cent.² These assumptions reflect one of the least costly options to purchase a home that is available to the representative household, although we recognize that the majority of households pay down their mortgages faster or may have a larger down payment than these terms imply. House prices in this affordability measure strictly reflect existing homes and would include all types of housing sold in Canada.³

The current level of the affordability index is slightly higher than past variants, largely because it uses nominal, rather than real, measures of income, interest rates and house prices. This effect is further amplified by the addition of utility fees. Partly offsetting these upward effects is the focus on household disposable income, rather than personal disposable income, and the use of discounted mortgage rates, which are below the posted rates that were previously used.

² The Bank of Canada's measure of housing affordability does not include mortgage insurance premiums.

³ For more details on the methodology used to calculate the affordability index, consult the Bank of Canada's website at <http://credit.bankofcanada.ca/financialconditions/hai>.

within the next year and exposed to changes in mortgage rates.⁹ Since mid-2013, the share of new originations with variable-rate terms has been about 30 per cent (Chart 16).¹⁰

Canadian households with very high debt-to-income ratios, who tend to be younger with lower incomes, are even more vulnerable to shocks related to interest rates and income.¹¹ High household debt-to-asset ratios and debt-service ratios would increase the likelihood of bankruptcy if their debt burdens become unsustainable following an increase in interest rates or if their homeowner equity was eliminated by a decline in house prices.¹²

⁹ Although this is only a partial picture of the outstanding stock of fixed-rate residential mortgages, almost 20 per cent of these mortgages that are originated by federally regulated financial institutions have terms remaining that range from one month to one year, and about 45 per cent have remaining terms of up to three years.

¹⁰ In addition, approximately one-third of all outstanding mortgages have variable-rate terms.

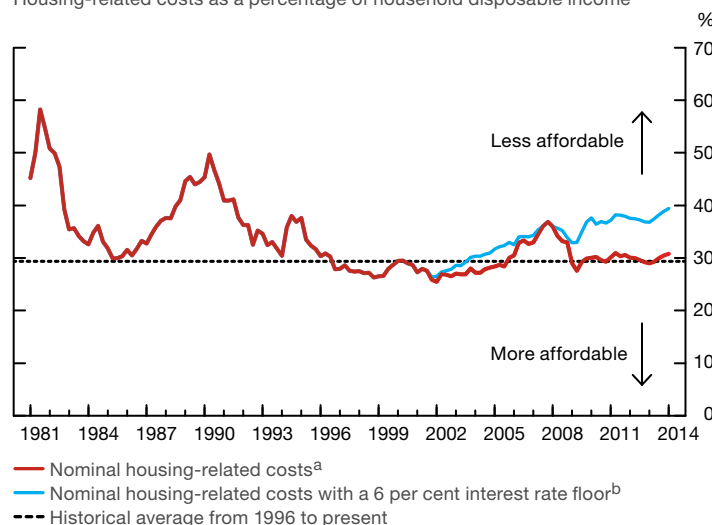
¹¹ U.S. households with debt-to-income ratios of at least 450 per cent are considered to have higher incentives to default on their mortgages in the face of shocks, owing to greater borrowing constraints. See J. Y. Campbell and J. F. Cocco, "A Model of Mortgage Default," National Bureau of Economic Research Working Paper No. 17516, 2011. The percentage of Canadian households in this category is close to 3 per cent, and this proportion has been stable over the past two years.

¹² When house prices fall, the equity built up through home ownership declines. Therefore, in the event of an unexpected expense or a temporary loss of income, these homeowners would be unable to use this equity to borrow against their homes through a home equity line of credit (HELOC), which could lead them to default on their debt obligations.

Smaller financial entities in Canada are increasing their lending to these higher-risk households, as well as to other risky sectors. However, as a group, smaller entities still issue a relatively small share of loans in comparison with the major Canadian banks. **Box 2** discusses some potential vulnerabilities in Canada's financial system stemming from the activities of these smaller entities.

Chart 15: Housing affordability would decrease if interest rates moved higher

Housing-related costs as a percentage of household disposable income



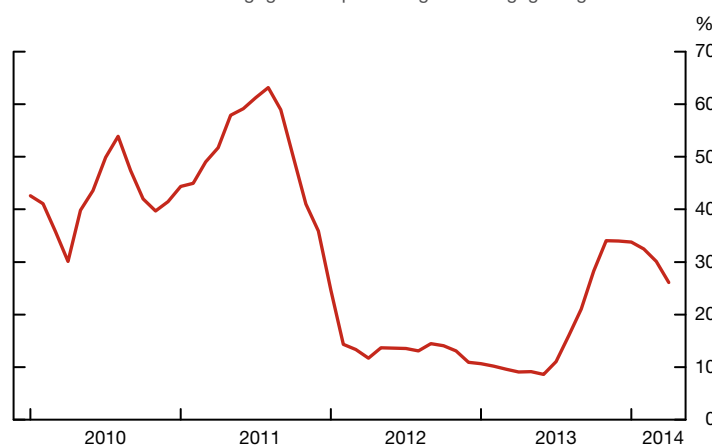
- This measure estimates the size of mortgage and utility payments for a representative household, given prevailing interest rates and house prices, and then scales this value by personal disposable income per household in order to measure affordability.
- To illustrate affordability if interest rates were higher, the average nominal mortgage rate from 1996 (6 per cent) is used to set a floor for the nominal interest rate; if the observed value is below 6 per cent in a period, the floor is used in the calculation.

Sources: Statistics Canada, Canadian Real Estate Association and Bank of Canada calculations

Last observation: 2014Q1

Chart 16: Variable-rate mortgages are still relatively popular

Share of variable-rate mortgages as a percentage of mortgage originations



Note: Variable-rate mortgages (VRMs) include hybrid mortgages, capped VRMs, VRMs of all terms and open VRMs.

Source: Regulatory filings of Canadian banks

Last observation: April 2014

Box 2

Smaller Financial Entities and Their Links to Canadian Property Markets

Smaller financial entities such as small banks, small credit unions, trust companies and small investment funds have important implications for the stability of the Canadian financial system, because of potential common exposures to particular shocks, in terms of both lending and funding. Although, as a group, smaller financial entities account for only a small share of overall lending in Canada, a disproportionate share of their business is oriented toward riskier areas.¹ The failure of one or more of these entities could have adverse financial and economic spillover effects. The vulnerability of smaller, federally regulated institutions to shocks is mitigated by higher capital positions and tighter supervision, but requirements vary for entities that are not federally regulated.²

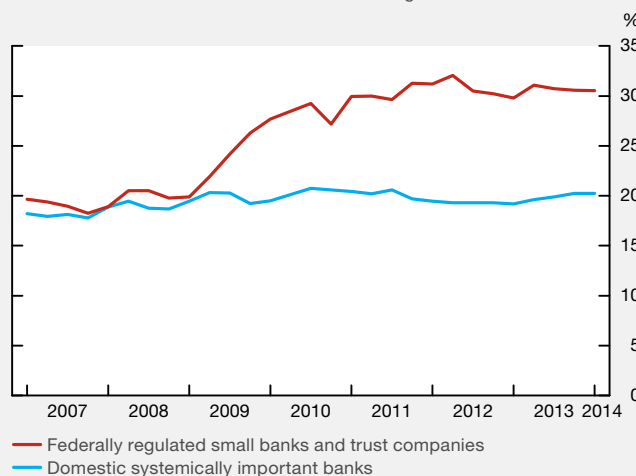
Many of these smaller entities are active in lending to riskier segments of the Canadian residential and commercial property markets, and these activities have been trending upward over the past decade. In addition to the potentially lower credit quality of their loan portfolios, some smaller financial entities have business models that are less diversified from either a sectoral or a geographical perspective. Some of these entities are dependent on less-stable funding sources; for example, brokered deposits (which represent a greater source of rollover risk and interest rate risk), bulk mortgage sales and private-label securitization.³ A negative, regional shock to property markets could have significant effects on one or several of these entities.

Two particularly risky business areas are: (i) non-prime mortgage lending⁴ and (ii) construction and real estate financing.

- Many smaller entities, including some mortgage investment corporations (MICs)⁵ and smaller credit unions, cater specifically to borrowers who do not qualify for insured mortgages. These may include low-income individuals, recent immigrants, rural residents whose income tends to be more volatile or borrowers lacking income documentation.⁶ The credit quality of these borrowers could deteriorate sharply during economic downturns.

Chart 2-A: Construction loans and non-residential mortgages have been growing at smaller financial institutions

As a share of total commercial loans outstanding at these institutions



Source: Regulatory filings of Canadian banks

Last observation: 2014Q1

- Non-residential mortgages and construction loans are also riskier, owing to their more cyclical nature. Smaller banks and trust companies have become more active in this market segment over the past several years (Chart 2-A).⁷

NHA MBS link the housing sector to various financial entities, as well as to the federal government

Funding by smaller or “less-regulated” lenders⁸ through residential mortgage securitization has been growing, and some of these entities may be using National Housing Act Mortgage-Backed Securities (NHA MBS) as a means to insure and then sell off mortgages, as opposed to holding them to maturity.⁹ Larger banks are an important outlet for the sale of issued mortgages. However, because regulation and supervision do not sit with one authority, the business relationships between large financial institutions, smaller monoline lenders and non-prudentially regulated entities are not well measured. As such, it is difficult to fully evaluate the extent of any potential vulnerability posed by these relationships. NHA MBS carry a guarantee by the federal government, which mitigates the risks to the financial system, although at the same time this also increases the federal government’s exposures to the financial and housing sectors.

1 It is estimated that smaller entities account for, at most, 20 per cent of outstanding intermediated credit (household and business, excluding bonds, debentures, equities, warrants and trust units) as of the first quarter of 2014.

2 In addition, federally regulated mortgage lenders are subject to OSFI’s B-20 mortgage underwriting guidelines.

3 Brokered deposits are acquired through wealth managers and broker-dealers who represent clients seeking a higher return on their deposits. These arrangements are largely made through the major Canadian banks and, to a lesser extent, with independent dealers. Since retail deposits are given preferential treatment under regulatory liquidity rules, major banks could curtail access to these deposits if they need liquidity themselves. This exposes these smaller entities to funding risks.

4 Non-prime borrowers are generally characterized as having weaker documentation of income, less capacity to make debt payments and an imperfect credit history. See “The Residential Mortgage Market in Canada: A Primer,” in the December 2013 FSR.

5 MICs are typically regulated as non-redeemable investment funds under applicable provincial legislation. MICs specialize in relatively high-interest, non-insured mortgages to segments of the market that may traditionally be underserved: for example, bridge loans to real estate developers, second mortgages and high loan-to-value mortgages. MICs have grown dramatically since 2009, although they remain small in absolute terms.

6 See Credit Union Central of Canada, “System Brief: Implications of Recent Federal Policy Changes for Canada’s Credit Unions,” 2012.

7 At the end of 2013, non-residential mortgage loans outstanding at Canadian chartered banks amounted to 2 per cent of nominal GDP, compared with approximately 3.5 per cent for all other financial institutions.

8 Less-regulated entities are not subject to prudential regulation at the federal level, under OSFI, or at the provincial level. However, some do fall under the jurisdiction of provincial securities regulators.

9 The practice of lenders making loans with the intention of selling them to other institutions or investors proliferated in the United States in the lead-up to the global financial crisis, and was an important vulnerability associated with the collapse of the U.S. subprime mortgage market.

Canadian authorities have taken additional measures to reduce vulnerabilities related to household mortgage debt

In addition to the cumulative measures already taken since the financial crisis to improve the soundness of the Canadian mortgage market,¹³ changes related to mortgage insurance have occurred since the last FSR. In April, OSFI proposed new (B-21) guidelines for residential mortgage insurance underwriting that are an extension of its B-20 residential mortgage underwriting principles for banks.¹⁴ Under the draft guidelines, mortgage insurers must undertake due diligence regarding the overall prudence and rigour employed by a mortgage lender in the loan process. At the end of May 2014, the Canada Mortgage and Housing Corporation (CMHC) eliminated the availability of mortgage insurance for second homes and for self-employed borrowers without third-party income verification. More recently, CMHC announced that it would discontinue mortgage insurance for financing multi-unit condominium construction and imposed new limits on house prices, amortization periods and debt-servicing ratios for low-ratio mortgage insurance.

Vulnerability 3: Significant Exposures to Potential External Shocks

Canada is an open economy, which means that its markets for goods, services and finance are globally integrated. While access to global markets provides important benefits to Canadian households, businesses and governments, cross-border linkages can also transmit external vulnerabilities and shocks to Canada. For example, Canadian financial markets reflect the global search for yield, and Canadian long-term interest rates are heavily influenced by movements in global rates, owing to financial market integration. Similarly, because Canada is an important producer of commodities, world commodity prices can transmit shocks in the global economy back to Canada.

The global search for higher returns by investors is increasing

Canadian equity and corporate bond markets, like those in other advanced economies, are suggesting that there may be increased risk taking as investors try to achieve higher returns. This leaves investors vulnerable should a sudden stress event occur. For example, the TSX index has tracked upward alongside equity markets in the United States and in other advanced countries.

Corporate spreads have also narrowed (**Chart 17**), because Canadian investors are taking on greater credit and liquidity risks to achieve higher returns on their fixed-income investments. For example, since the financial crisis, the average Canadian fixed-income mutual fund has increased its exposure to default risk by more than that of the common benchmark, the DEX Universe Bond Index, while its exposure to interest rate risk has remained below that of the DEX.¹⁵ Investors in corporate bond markets also do not appear to be pricing in liquidity risks, commensurate with the widespread market perception that dealers will be less able to act as liquidity

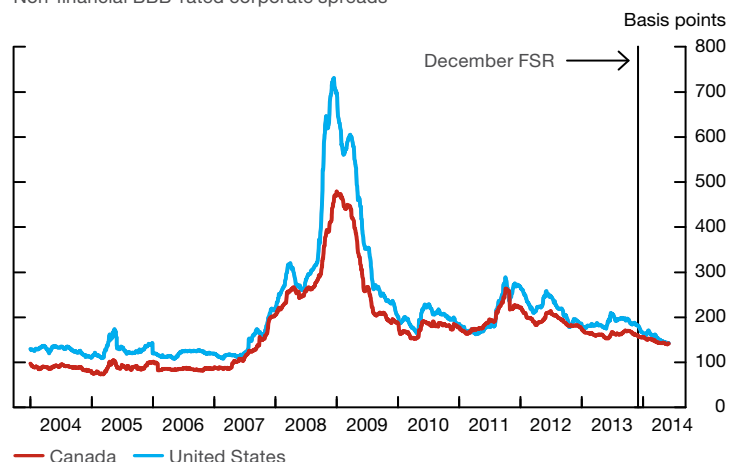
¹³ These changes have been discussed in various FSRs, including in Box 2 in the December 2012 FSR, and in the June and December 2013 FSRs.

¹⁴ Available at www.osfi-bsif.gc.ca/Eng/fi-if/rg-ro/gdn-ort/gi-ld/Pages/b21.aspx.

¹⁵ The DEX Universe Bond Index is a broad measure of the Canadian investment-grade fixed-income market, comprising 1,322 securities with a total market value of approximately Can\$1.302 trillion as of 5 June 2014. For more information on tracking bond fund risk exposures, see S. Gungor and J. Sierra, "Search-for-Yield in Canadian Fixed-Income Mutual Funds and Monetary Policy," Bank of Canada Working Paper No. 2014-3, 2014.

Chart 17: U.S. and Canadian corporate spreads have continued to narrow

Non-financial BBB-rated corporate spreads

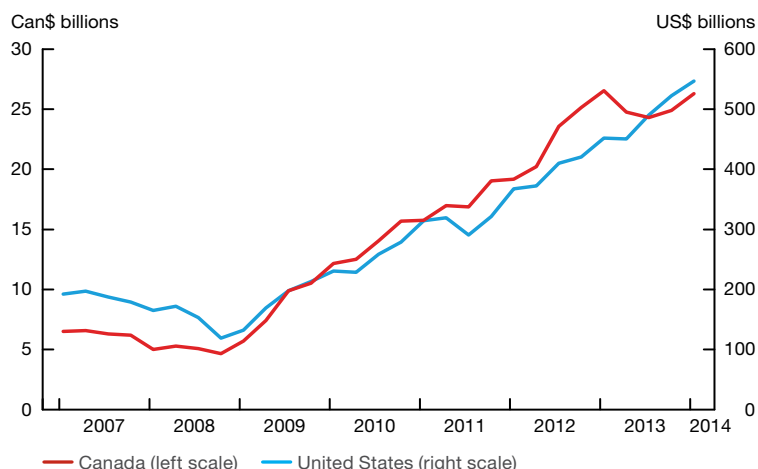


Source: Bank of America Merrill Lynch

Last observation: 5 June 2014

Chart 18: U.S. and Canadian high-yield mutual funds and exchange-traded funds have experienced rapid growth in recent years

Assets under management



Note: High-yield mutual funds and exchange-traded funds in the above chart include bonds and loans.

Sources: Morningstar and Thomson Reuters LPC

Last observation: 2014Q1

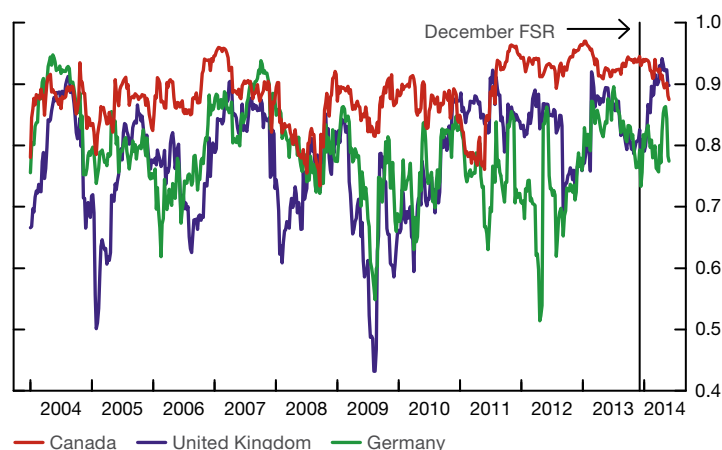
providers during periods of market stress.¹⁶ In addition, the rapid growth of mutual fund and exchange-traded fund holdings by retail investors, particularly in the more illiquid segments of the corporate bond market, suggests that investors may be underestimating the potential for market dislocation in times of high redemptions (Chart 18).

Across asset classes, these valuations may partly reflect lower expectations for real equilibrium rates and global economic growth, but may also indicate a broader search for higher returns.

¹⁶ Anecdotal evidence suggests that a decline in U.S. dealer inventories of corporate bonds, commensurate with a reduction in market-making, has occurred at a time when corporate bond issuance has been at record-high levels. This may be due in part to ongoing deleveraging and the transition to higher capital requirements for market-making activities in the context of slow economic growth since the financial crisis. During the mid-2013 period, when bond yields and credit spreads were increasing in Canada and in other developed markets, statistical measures of market illiquidity did not rise materially. However, some investors experienced difficulties in executing orders because bids and offers to trade, typically posted by dealers, had disappeared.

Chart 19: Canadian 10-year yields have tracked closely with those of the United States

24-week rolling correlation of changes in weekly average yields for 10-year government bonds



Sources: Bloomberg and Bank of Canada calculations

Last observation: 30 May 2014

The correlation between U.S. and Canadian long-term interest rates has increased since the financial crisis

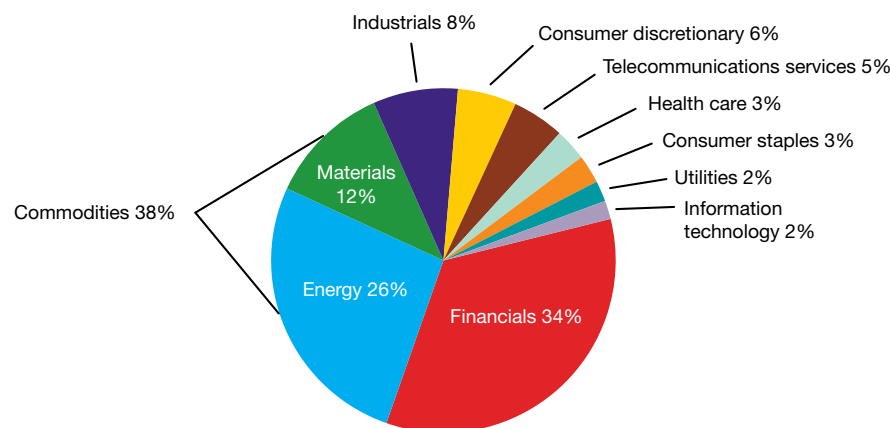
Yields on Canadian long-term government bonds tend to track movements in major sovereign markets, particularly those in the United States. Indeed, over the past several years, movements in Canadian and other advanced-economy sovereign yields have become more correlated with those of the United States (Chart 19). 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.¹⁷

Commodity prices remain important to Canada

Canadian financial markets have strong ties to global commodity markets, and movements in world commodity prices may have a significant impact on Canada's economy and financial system. Shares in commodity companies make up about 40 per cent of the market capitalization of the TSX index (Chart 20), and have been around this level since before the financial crisis.

Canadian banks also have sizable ties to the commodity sector, including through loans to foreign and domestic commodity companies and holdings of commodity-related securities. The Big Six Canadian banks account for about 70 per cent of total Canadian bank loans to the commodity sector, approximately half of which are to foreign mining and energy companies. A number of smaller banks are also active in commodity-related lending, and their exposures to the commodity sector are larger on a CET1 capital basis. Overall, for the eight Canadian banks with the largest exposures, loans to the commodity sector represent about 15 per cent of their CET1 capital, although there are significant differences across banks. The actual exposures are typically lower, because these loans may be subsequently hedged. Banks' loan portfolios also include loans to commodity-related industries, such as transportation and production. More generally, for those institutions with a concentration of activities in commodity-producing regions, investments may have been financed on the expectation that currently high commodity prices would persist.

¹⁷ For a 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, April 2014 *Global Financial Stability Report*, Chapter 1.

Chart 20: The commodity sector accounts for a significant share of Canada's equity market

Note: Percentages do not add to 100 because of rounding.

Source: TMX Group

Last observation: 5 June 2014

Canadian banks' exposure to external shocks is stable but important

Diversification of funding sources beyond domestic markets has significant benefits, but it exposes Canadian banks to funding and liquidity risks in times of global financial stress, particularly if short-term, foreign funding sources are used to fund illiquid Canadian-dollar assets.¹⁸ During such periods, foreign investors may be more likely to withdraw funding than domestic investors, given information asymmetries and home bias. A small but important proportion of D-SIB funding is raised in U.S.-dollar markets. In addition, euro-based funding has increased in recent years.¹⁹

The foreign exposures of Canadian banks can also channel external shocks back to Canada. The foreign claims of the Big Six banks remain at almost 40 per cent of their total assets.²⁰ Claims of the Canadian banking sector on the United States, the United Kingdom and EMEs (excluding China) make up a significant share of the total (Chart 21).²¹ In contrast, direct claims on entities from peripheral Europe and China are very limited. Canadian banks have some U.S.-dollar leveraged loan assets, including riskier covenant-lite loans, and these have been increasing over the past two years.

¹⁸ Canadian banks have a strong deposit base and are highly rated by investors and credit-rating agencies. They raise funds in foreign markets and transfer them back to Canada when the cost, relative to domestic funding, is lower. Wholesale funding accounts for about half of the liabilities of D-SIBS. This total consists of both short-term and long-term funding, and the relative proportion varies across banks.

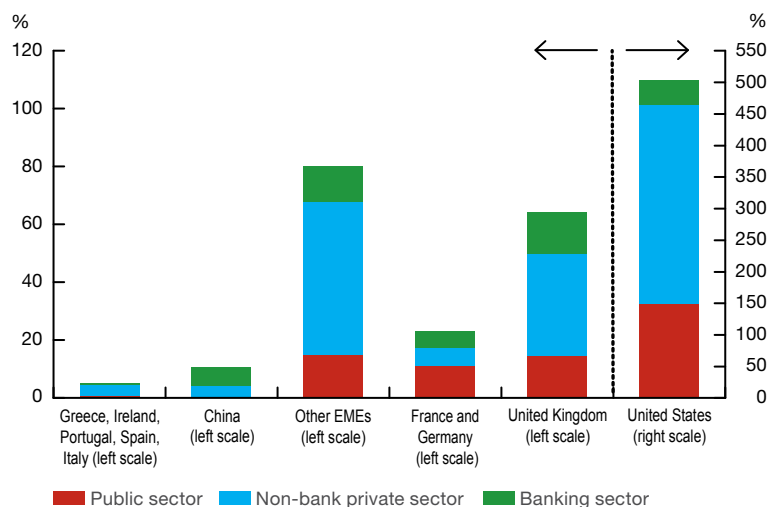
¹⁹ This is largely due to the depth of the European covered bond market and Canadian legislation, enacted in 2012, which includes provisions that effectively expand the universe of potential investors to include those outside of Canada.

²⁰ The foreign claims of the Big Six banks have also been stable as a proportion of shareholders' equity.

²¹ Foreign claims are measured on an ultimate-risk basis and include deposits, securities and loans.

Chart 21: Canadian banks have limited direct exposure to credit claims on entities from peripheral Europe and China

Foreign claims of Canadian domestic banks as a percentage of total Tier 1 capital, by sector, on an ultimate-risk basis



Note: Direct exposure is defined as direct foreign claims only (and excludes other contingent or potential exposures).

Source: Regulatory filings of Canadian banks

Last observations:
Foreign claims, March 2014 for all banks;
Tier 1 capital, March 2014 for December year-end banks and April 2014 for October year-end banks (Basel III basis)

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 December FSR and emanate mainly from the external environment.²² The discussion includes an assessment regarding the probability of the risk materializing and the expected severity of the impact if it does.

Risk 1: A Sharp Correction in House Prices

A serious, widespread correction in house prices resulting from a sharp increase in unemployment is the most important domestic financial system risk. The Governing Council judges that the probability of this risk is still low. However, the effect on the economy and financial system would be severe in the event that it did occur, and, as such, this risk is still rated as “elevated.”

As already discussed, the Bank expects a constructive evolution of imbalances in the housing sector, with housing activity broadly consistent with demographic requirements, debt-to-income ratios stabilizing and price increases moderating. Nonetheless, the stretched valuations in certain segments of the housing market and the elevated level of household indebtedness make Canada vulnerable to a macroeconomic shock, or a combination of shocks, that causes unemployment to spike higher, sharply reducing the ability of Canadian households to service their debts. Given the importance of housing to the Canadian economy and financial system, the impact of such a shock would be widespread, and there could be significant adverse feedback between economic and financial conditions that would amplify its impact.

²² The description of the risks has been modified to reflect the scenarios that pose important and plausible risks to the Canadian financial system. In particular, Risk 3 (stress emanating from China and other EMEs) now reflects greater concern about developments in China and their repercussions on emerging and advanced economies.

A housing market correction could be triggered by a number of lower-probability events

A rapid weakening in aggregate demand, whether driven by a domestic or an external macroeconomic shock, could lead to a sharp, widespread correction in house prices, although, based on current expectations for stronger global and domestic growth, the probability is relatively low. With a sharp jump in unemployment levels, loan arrears and defaults would rise. A downward spiral in house prices could ensue if overextended homeowners were forced to sell their homes. Commercial borrowers could face financial difficulties as well. A rise in defaults on uninsured mortgages and unsecured loans could trigger one or more smaller lenders to fail, putting additional pressure on housing demand and prices.

An increase in U.S. long-term interest rates (as discussed in **Risk 2**) could translate into significantly higher borrowing rates in Canada, but there is a lower probability that this trigger alone could cause a housing market correction. An increase in interest rates would affect mortgage holders and other borrowers in Canada at varying points over several years. If the increase is sufficiently large, it could lead to a rise in defaults and some decline in house prices.²³ However, an accompanying economic downturn and a decline in household income would be required to generate the full risk scenario.

A widespread correction sparked by supply-demand imbalances in one region would be even less probable. For example, there could be a sharp drop in the prices of Toronto condominiums and in related construction activity, owing to oversupply in the market. Although important economic impacts on the affected regions would result, these would not likely be sufficient to reduce aggregate household income and housing market activity. The effects could be broader and more significant in the event that such a localized housing correction spread to other segments and regions with stretched valuations, as homebuyers adjust their expectations downward regarding the future path of house prices, and as localized real estate losses affect lending in other markets.

A large-scale downturn in the housing market could have severe impacts

Although a low-probability event, a persistent, substantial decline in house prices and housing activity would adversely affect the Canadian financial system through a number of channels: financial sector links to the housing market, broader financial market impacts and negative feedback from the economy.

Canadian financial institutions would experience a general decline in revenues, and there would be an increase in loan losses. Defaults on mortgages and consumer debt could generate very large losses for certain institutions and mortgage insurers. The first effects would likely be felt by small, monoline mortgage lenders, owing to their significant presence in the non-prime loan market and the greater tendency for their loans to be uninsured. Smaller financial institutions with concentrated exposures to construction and real estate financing could also suffer deep losses.

²³ Rules for mortgage insurance require borrowers to satisfy debt-service criteria using the greater of the contract rate or the posted 5-year fixed rate, if they select a variable-rate mortgage or a term that is less than five years. Under current borrowing conditions, the posted rate is about 2 percentage points higher than the effective borrowing rate.

All financial sector entities could experience considerable funding challenges. If the mortgage delinquency rates of any issuers surpassed the 1 per cent threshold set by CMHC, they would lose additional NHA MBS funding.²⁴ Participants in the wholesale market could restrict funding if concerns arose regarding the health of the banking sector. In addition, funding pressures on larger banks could be passed on to smaller entities through a pullback of brokered deposits.

Under an extreme stress scenario, such as the one considered in Canada's 2013 FSAP, the Big Six banks could experience a significant decline in their CET1 ratios over a three-year horizon.²⁵ Smaller banks would likely experience a larger decline in capital, as their lending activities are less diversified.

Significant effects would also be felt through Canada's financial markets. Bank equity prices would drop, in line with concerns about the Canadian banking sector. Similarly, financial assets connected with the banking sector would be repriced. For example, uncertainty regarding the extent of exposures to riskier mortgage issuers could lead to an increase in yields for NHA MBS, despite their guarantee from the federal government. In an extreme case, investors could become concerned about the health of Canada's financial system, leading to a sharp rise in Canadian yields and a significant decline in Canadian equity prices.

This scenario would generate widespread reductions in household net worth, market confidence and consumer demand, with negative feedback effects on income and employment. The combination of declining revenues, increased losses and rising funding costs for banks would also likely lead to tighter credit conditions. This would not only reinforce the decline in residential investment, but would also reduce overall economic activity with adverse second-round effects on the financial system.

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

The second key financial system risk is significantly higher long-term interest rates in Canada and globally, resulting from an overshoot in U.S. long-term interest rates triggered by a reassessment by markets of U.S. monetary policy. The relatively smooth reaction so far to the Federal Reserve's tapering of asset purchases and the transition to more qualitative forward guidance²⁶ suggests a lower probability that future U.S. monetary policy adjustments will have outsized outcomes. However, if a jump in U.S. long-term interest rates were to occur, there would be a moderately severe

²⁴ Under CMHC rules, issuers must "Maintain sound mortgage loan servicing without excessive delinquency rates. Generally, the Issuer will not receive new NHA MBS Guarantee approvals if more than one per cent of the loans in its existing mortgage pools have been delinquent for three or more months (including loans in legal action). A lower delinquency ratio, however, will not assure the issuance of further commitments." See the *NHA Mortgage-Backed Securities Guide* at <http://www.cmhc-schl.gc.ca/en/hoficlincl/mobase/upload/NHA-MBS-Guide.pdf>.

²⁵ Under the FSAP stress scenario, Canada faces a severe and persistent recession during which the unemployment rate rises by close to 6 percentage points and house prices correct by 33 per cent. It is worth noting that since the FSAP stress test was conducted, the average CET1 ratio of Canadian D-SIBs has risen by more than 100 basis points, improving their ability to weather such a significant stress scenario. In addition, the regulatory capital framework includes a capital conservation buffer that acts to ensure that banks do not take actions that weaken their capital positions. For a discussion of stress-testing methodologies and the results from the 2013 Bank of Canada stress-testing exercise, see "Stress Testing the Canadian Banking System: A System-Wide Approach" in the Reports section of this issue.

²⁶ In its 19 March 2014 statement, the Federal Open Market Committee (FOMC) announced that, with the unemployment rate nearing 6.5 per cent (the single threshold for its forward guidance at the time), the FOMC's assessment for monetary policy would take into account a wide range of information, including measures of labour market conditions, indicators of inflation pressures and inflation expectations, and readings on financial developments.

impact on Canada through multiple channels, owing to the wider global financial and economic consequences. In light of all these factors, the Governing Council continues to rate this risk as “moderate.”

Unexpected changes to market perceptions of the path of U.S. monetary policy could trigger a sudden rise in global term premiums, surges in market volatility and sell-offs across asset classes, all of which could be exacerbated by the rapid unwinding of positions and structural changes in liquidity in some market segments. Close correlations of global term premiums would immediately transmit the interest rate shock to Canada, and Canadian investors could incur significant losses. Vulnerabilities in the housing and household sectors would also leave Canada exposed to a potential correction in house prices as secondary economic impacts take hold.

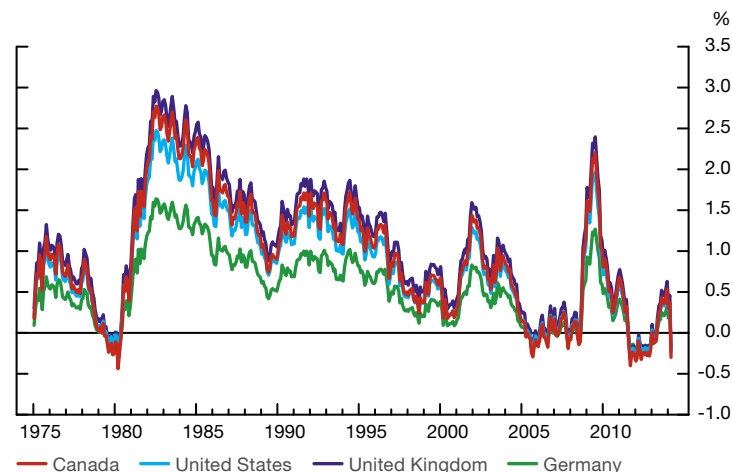
Vulnerabilities continue to build in global financial markets

Estimated term premiums are still well below historical averages (Chart 22), measures of market volatility remain suppressed (Chart 23), and there are signs that market participants have assumed larger and riskier exposures in order to generate higher returns. These global conditions could result in amplified market movements if accompanied by a shift in expectations.

The current environment of low term premiums and low market volatility in the United States can be explained by a number of factors. In part, it reflects market expectations that potential growth and real equilibrium interest rates will remain low over the long term. In addition, a lengthy period of policy rates at the lower bound and quantitative easing may have reduced term premiums and subdued movements in asset prices, resulting in low rates of realized volatility. Current low measures of implied volatility also indicate that there is reduced demand for protection against unexpected changes in asset prices. Investors may have become sanguine, assuming that any market turbulence in response to changes in U.S. monetary policy expectations will be relatively short-lived. A return to greater two-way price movements could lead to a sharp increase in volatility measures.

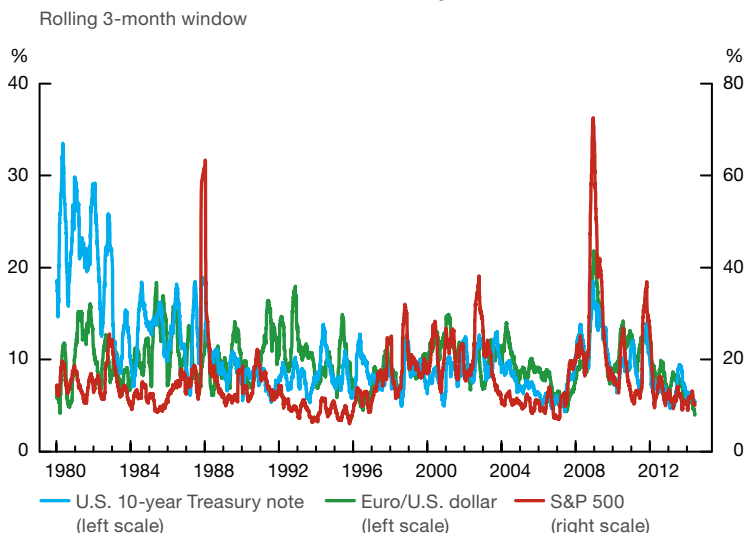
Chart 22: Global term premiums have room to increase

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



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

Last observation: March 2014

Chart 23: Realized volatilities of various asset prices remain near historical lows

Sources: Bloomberg and Bank of Canada calculations

Last observation: 5 June 2014

Low interest rates, combined with low volatility, may also motivate investors to take on greater risk in return for higher yields.²⁷ After reaching an all-time high in 2013, the pace of U.S. high-yield bond and leveraged loan issuance remains robust so far this year, and there has been further compression in spreads below historical averages.

Corporate borrowers in the United States may also be taking on excessive risks, making them more vulnerable to higher interest rates if the higher rates are not also accompanied by stronger economic growth. In the U.S. leveraged loan market, a growing number of lower-rated issuers are negotiating lighter covenants at a time when mergers and acquisitions are on the rise. More generally, looser underwriting standards are helping corporate borrowers to increase their leverage. The issuance of other fixed-income products that allow for high borrower leverage, such as payment-in-kind bonds, has also continued to increase in recent months.²⁸ Although maturity extension through refinancing continues to dominate issuance activity for both high-yield bonds and leveraged loans, a growing share of issuance is based on floating rates that, in combination with high debt levels, could have serious negative effects on the credit risk of borrowers in the face of interest rate shocks.

An abrupt rise in U.S. long-term interest rates could be amplified by a return to higher levels of volatility

While the probability is relatively low, mainly because the Federal Reserve is well aware of current market conditions and risks,²⁹ a sudden reassessment by markets of U.S. monetary policy could lead to an overshoot in U.S.

²⁷ This is reinforced by standard models for managing risk, such as value-at-risk (VAR) models, which would respond to low volatility measures by indicating that investment risk is below targeted levels.

²⁸ Payment-in-kind “toggle” bonds give the borrower the option to make interest payments in cash or additional bonds. This bond product is often considered to be riskier for investors because of its deep subordination and low recovery rate in the event of a borrower default. It can increase borrower leverage since in-kind payments increase the issuer’s liabilities.

²⁹ In his speech, “Challenges for Monetary Policy Communication,” on 6 May 2014, Governor Jeremy Stein explained some of the Federal Reserve’s considerations with respect to market reaction. See www.federalreserve.gov/newsevents/speeches/stein20140506a.htm. More recent implications for monetary policy were discussed by Bill Dudley, President of the Federal Reserve Bank of New York on 20 May 2014. See “The Economic Outlook and Implications for Monetary Policy,” available at <http://www.ny.frb.org/newsevents/speeches/2014/dud140520.html>.

term premiums and long-term interest rates.³⁰ Higher term premiums would lead to higher risk premiums on riskier assets, putting downward pressure on prices and prompting selling activity. Corporate spreads would widen, and this could be exacerbated by reduced secondary-market liquidity for corporate bonds that is associated with a decline in market-making activity by dealers. In a sell-off scenario, open-ended mutual funds and exchange-traded funds that invest in illiquid assets could be vulnerable to investor runs. In addition, the rapid unwinding of leveraged investment strategies, especially large positions held by institutional investors such as hedge funds, could amplify market movements.³¹ These conditions would generate greater market volatility overall, leading to an overshoot of risk premiums and significantly higher U.S. long-term interest rates.

Sharply higher U.S. long-term interest rates could have moderately severe effects on Canada

Because of strong integration across global financial markets, market movements in Canada and other advanced economies would likely follow those in the United States, with increased volatility and a widespread repricing of assets, particularly through the adjustment process. Aside from sustaining losses, it could also negatively affect investor confidence and lead to a significant increase in market funding costs for Canadian financial and non-financial corporations.

More importantly, higher U.S. rates would put upward pressure on Canadian long-term interest rates. This would increase debt-service costs for Canadian households, potentially leading to a rise in defaults on mortgages and some downward pressure on house prices. If U.S. economic growth were to weaken significantly as a result of tighter financial conditions, Canadian banks with business activities in the United States, including exposures to riskier segments of U.S. markets, could experience related losses. As trade with the United States declines, the Canadian economy could also suffer a downturn, which could trigger the housing market correction outlined in **Risk 1**. If the health of Canadian banks deteriorates in the process, a pullback in Canadian bank funding liquidity (for example, from U.S. money market funds) could exacerbate pressures on Canadian banks. Canadian life insurance companies and pension funds, which are major players in Canadian financial markets, would likely benefit in the long run from higher long-term interest rates, since the present value of their liabilities would decline. However, more adverse effects would occur in the short run in relation to rapid and volatile movements in asset prices and interest rates.

Higher long-term rates in the United States could trigger other key risks for the Canadian financial system, because long-term rates would rise in other countries as well. This would increase debt-service costs for vulnerable euro-area banks and sovereigns, and could lead to euro-area stress, as outlined in **Risk 4**. In addition, a sharp repricing of global assets could trigger an outflow of capital from EMEs, and tighter financial conditions in these economies. This could have implications for global economic growth, particularly if it occurs concurrently with a more pronounced slowdown in the Chinese economy. Broad EME stress would in turn affect the Canadian financial system through trade, commodity and financial channels. Although

³⁰ An abrupt shift in market expectations, for example, could stem from a modified profile for short-term policy rates, owing to stronger-than-anticipated growth or inflation.

³¹ For example, risk-parity funds use leveraged fixed-income strategies and typically have an exposure of 100 to 150 per cent to bonds, which is achieved through leverage. Some risk-parity funds take leverage as high as 500 per cent. As a sector, risk-parity funds are relatively small. However, other institutional investors, including large pension funds, may be mirroring such strategies.

highly improbable, if a hard landing in China, as outlined in **Risk 3**, occurs simultaneously with a sharp rise in U.S. long-term interest rates, the effects would be amplified to a very severe level.

Risk 3: Stress Emanating from China and Other Emerging-Market Economies

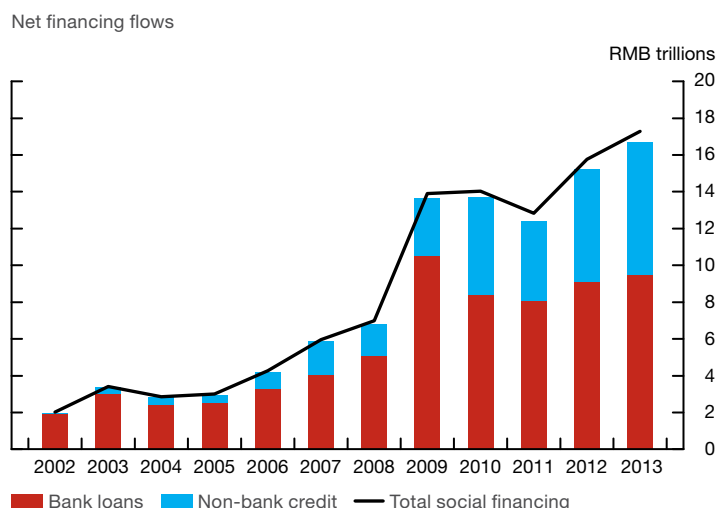
Financial and economic stress, caused by a serious financial disruption in China that leads to a significant slowdown in Chinese economic growth, represents the third key financial system risk for Canada. The probability of this risk materializing has increased since the December FSR, because vulnerabilities in China's financial system are growing. Major financial and economic stress in China would have widespread repercussions on global economies and financial systems, with a moderately severe impact on Canada. The higher probability, as well as the extent of the indirect effects back to and within Canada, warrants increasing the level of this risk to "elevated."

The trigger for this risk could be a series of defaults that begin in the shadow banking sector and rapidly spread across the Chinese financial system, leading to a deep credit squeeze that, in turn, could sharply reduce economic growth in China. The resulting decline in global commodity demand and prices would be transmitted back to Canada through its extensive exposures to the commodity sector. The shock to global aggregate demand could trigger a housing market correction in Canada and related stress in the domestic financial system, as outlined in **Risk 1**. This could also tip the euro area back into a crisis, as outlined in **Risk 4**, which would have impacts on Canada.

Fragilities in China's financial system are growing...

Although the pace is slowing, strong credit expansion, particularly outside of the major banks, has continued in China (**Chart 24**), and concerns about related vulnerabilities are increasing. Shadow banking activities, which are subject to less regulation and supervision, exhibit extensive maturity mismatches and high leverage and, potentially, a mispricing of risk.

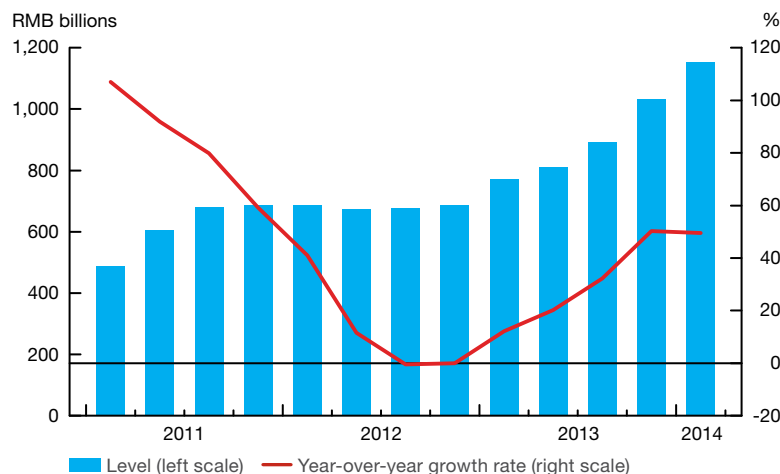
Chart 24: Strong credit expansion, particularly outside of the banking system, has continued in China



Note: Non-bank credit sources include trust loans, entrusted loans, bank acceptance bills, corporate bonds and non-financial institutions' equity sales.

Sources: CEIC and Haver Analytics

Last observation: 2013

Chart 25: Real estate investment by Chinese trust companies continues to grow rapidly

Sources: China Trustee Association and Haver Analytics

Last observation: 2014Q1

Trust companies, the largest group of non-bank entities in China, have extensive links to riskier areas of the economy, such as local government infrastructure projects and real estate development (Chart 25), as well as to the banking sector.³² The high degree of interconnectedness across the Chinese financial system suggests that a negative event in one area could quickly have sizable and widespread consequences.

The credit quality of private companies, state-owned enterprises and local governments appears to be worsening. Rapid real estate development, together with a deceleration of urbanization, is contributing to stalled projects and a buildup of inventories in certain regions (Chart 26). Although prices are starting to decline, real estate values are still high. There is also evidence that local governments are facing increased financial challenges, particularly as the proceeds from land sales fall off.³³

There have been several highly publicized credit events in China since the December FSR, including the near-default of a trust company investment product. With one-third of outstanding trust investment products maturing in 2014, there is potential for further defaults. At the same time, small and medium-sized banks, which are more vulnerable to slowing growth and rising bad debts, have seen a significant increase in their non-performing loans (Chart 27).³⁴

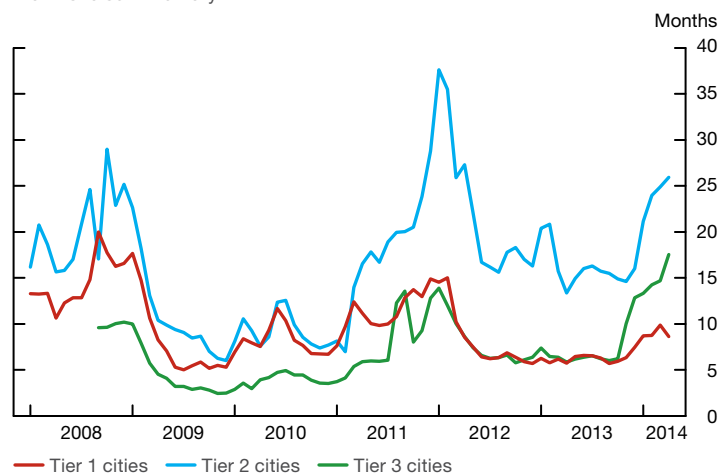
³² Trust companies engage in lending, asset management, real estate investment and private equity investment. They issue investment products, which they sell to wealthy and institutional investors, both directly and indirectly, using banks as sales outlets. Banks also issue investment products—so-called wealth-management products—and the proceeds are typically pooled and invested in trust company assets, such as loans, stocks and bonds. Banks also hold trust company assets, directly or indirectly, on their balance sheets. The full extent of banks' links to trust companies is uncertain, but it is likely that there is insufficient bank capital to cover these exposures.

³³ Local government debt is growing rapidly. Based on the December 2013 audit by the National Audit Office, local government debt was 64 per cent higher in June 2013 than it was in December 2010, implying annual average growth of 22 per cent—roughly double the growth rate of nominal GDP.

³⁴ Earlier in 2014, Jiangsu Sheyang Rural Commercial Bank experienced a run. There is no deposit insurance scheme in place for smaller banks. Although individually they are not considered to be systemically important, the situation prompted plans for the China Banking Regulatory Commission to conduct regional and national stress tests on small banks. Stress-test results from the IMF's 2011 FSAP for China were unable to capture the full extent of the risks to the banking system and how they could spread through the economy and financial system, owing largely to data constraints on the extent of sectoral exposures and on the types of borrowers.

Chart 26: Inventories of unsold properties in certain areas of China are rising

Months to sell inventory



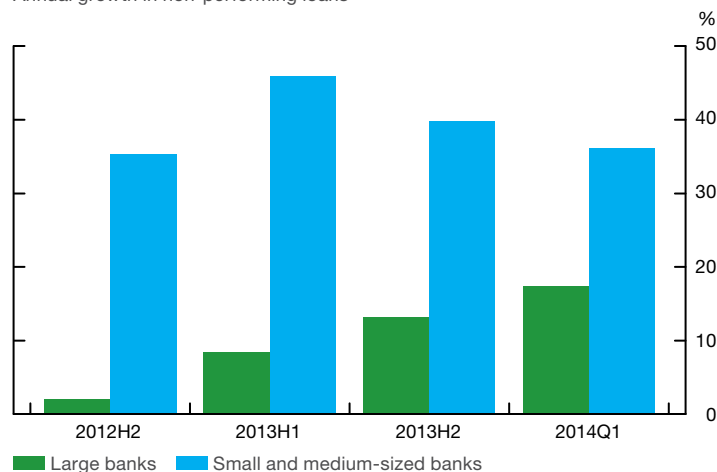
Note: Although there are no official definitions of Chinese city tiers, a common classification is: Tier 1 cities—Shanghai, Beijing, Guangzhou and Shenzhen; Tier 2 cities—secondary provincial capitals; Tier 3 cities—prefecture or county-level city capitals.

Source: Standard Chartered

Last observation: April 2014

Chart 27: There is a greater deterioration of credit quality at small and medium-sized banks in China

Annual growth in non-performing loans



Sources: Bloomberg and company reports

Last observation: 2014Q1

...while concerns about other EMEs have decreased

The resilience of other EMEs has risen marginally over the past six months, as several countries have taken specific measures to improve their fundamentals, and as foreign investors appear to be increasingly selective in their responses to EME problems. Nonetheless, the vulnerability of certain EMEs to financial and economic turmoil remains high.

A financial stress event in China could have serious economic implications

There is a greater probability that high levels of debt could provoke a major disruption to China's financial system as well as to its economy. Chinese officials have allowed selected defaults in order to reduce moral hazard—a strategy that requires balancing the risk of encouraging excessive shadow

banking activity through a perceived government guarantee against that of setting off a chain of failures across the shadow banking and banking sectors. There is also the risk that an increase in non-performing loans, including those related to property development and local government borrowing, could worsen the already weak position of some smaller Chinese banks and push some into insolvency.

In such a scenario, it is possible that financial system stress could lead to a credit crunch for China. The number of defaults and the speed with which they proliferate could challenge authorities, particularly in light of the opacity and complexity of the exposures and risks stemming from the shadow banking sector. Given the prominent role of credit in China's current growth model, the result could be a severe decline in economic growth.

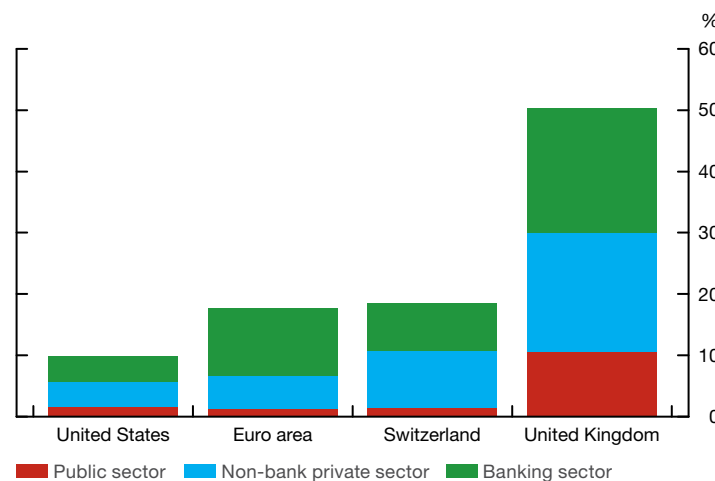
The effects of a hard landing in China would be felt globally

The Chinese financial system is relatively closed, limiting the *direct* effects on other financial systems, including Canada's. However, global banks do have foreign claims on China, with U.K. banks having the greatest exposures to the Chinese banking and non-financial corporate sectors (**Chart 28**). Problems could reverberate back to Canadian banks through their ties to U.K. banks. While other participants in the Canadian financial system may also be affected, the links are more difficult to measure.

More importantly, since China is a key driver of world growth, a hard landing in China would be felt across the globe through trade, financial and confidence effects. This could cause a widespread repricing of risk and increased volatility across global financial markets. The negative impacts on investor confidence could lead to an increase in market funding costs, including those of Canadian financial and non-financial corporations. Investor risk aversion could induce large movements into perceived safe havens, with large, negative effects on some equity and currency markets.

Chart 28: U.K. banks have relatively large direct exposure to China

Foreign claims as a percentage of total Tier 1 capital, by sector, on an ultimate-risk basis



Note: Direct exposure is defined as direct foreign claims only (and excludes other contingent or potential exposures).

Sources: Bloomberg and Bank for International Settlements

Last observations: 2013Q4 for U.S., euro-area and U.K. banks; 2013Q3 for Swiss banks

A steep drop in China's economic growth could also have a significant, negative impact on global commodity prices, in addition to other trade-related spillovers, which could indirectly affect financial systems worldwide. Those economies with closer ties to China would bear the greatest burden. In particular, commodity-producing EMEs could experience sharp slow-downs as foreign capital flows reverse, and increased inflationary pressures as exchange rates depreciate. In turn, regional linkages could spread the economic and financial impacts more broadly among EMEs. The effects could be amplified if this occurred in the context of higher U.S. long-term interest rates, as outlined in **Risk 2**. Severe economic and financial consequences could also arise in the euro area through trade and banking sector links, potentially reigniting a euro-area financial crisis (**Risk 4**).

Canada could face moderately severe impacts through a decline in the global demand for commodities

Canada's significant exposures to global commodity demand and prices would be a key channel for transmission back to the Canadian financial system and economy, and the impacts could be sizable. Canada's direct trade links with China and other EMEs are important.³⁵ Weaker demand for Canadian exports from other countries, in addition to lower commodity prices, could also induce extensive commercial loan losses at Canadian banks and other financial sector entities. Canadian regional economies that depend on the commodity or export sectors would experience a serious downturn that could lead to a correction in regional housing and real estate markets, as discussed under **Risk 1**. Smaller financial sector entities, with assets highly concentrated in these regions, could experience a significant level of defaults that could trigger failures.³⁶ Spillovers to the broader banking system could result from the effects on investor confidence, raising funding costs and leading to tighter credit conditions. In addition, Canadian equity markets would likely decline by more than global markets, given the significant weight of the commodity sector in the TSX. Feedback between adverse financial system and economic events would then develop.

Risk 4: Financial Stress from the Euro Area

The fourth key risk, financial stress caused by a renewed euro-area crisis, continues to be important for Canada's financial system. Significant vulnerabilities remain in the euro-area financial system and economy. Nonetheless, a number of positive developments in the euro area over the past six months have reduced the probability that this risk scenario will arise. The impact on Canada of severe financial stress from the euro area would be moderately severe. In light of these considerations, the Governing Council has lowered the risk rating from "high" to "elevated."

A renewed euro-area crisis could be triggered by a shift in market views regarding the adequacy of bank balance-sheet repair or a sudden economic shock related to geopolitical stress in Ukraine and Russia. Canadian exposures to the euro area and to global financial markets would transmit this shock to Canada. In addition, there would be an effect on the economy through trade channels, and if the impact was sufficiently severe, it could trigger a correction in house prices, as outlined in **Risk 1**.

³⁵ About 20 per cent of Canada's commodity exports are directed at EMEs. Canada's trade in commodities is particularly strong with Asia, driven mainly by China, and trade with this region has increased in recent years. EMEs account for about 12 per cent of Canada's total trade. In comparison, about 40 per cent of U.S. exports and about 50 per cent of total euro-area exports go to EMEs.

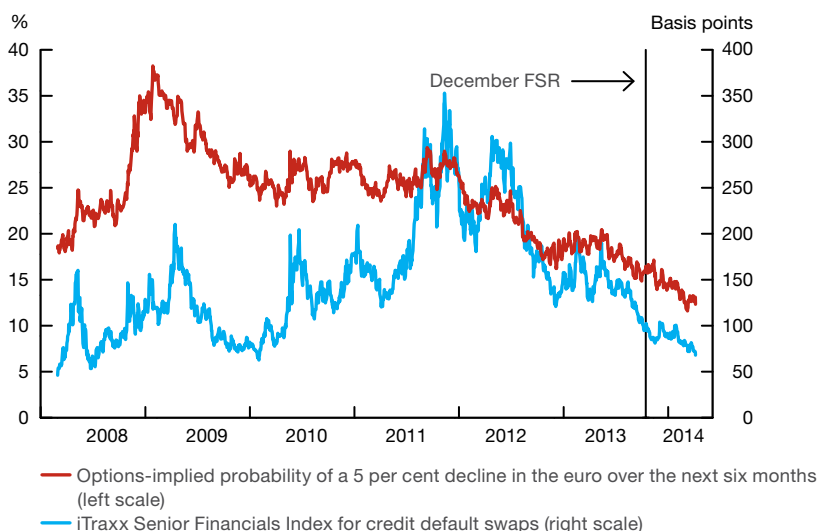
³⁶ This scenario is reminiscent of the situation that occurred in Western Canada in the 1980s with the default of the Canadian Commercial Bank and the Northland Bank.

Vulnerabilities in the euro-area financial system have declined since the December FSR...

Fragilities related to the banking sector and peripheral sovereign governments are decreasing, and market indicators of risk have declined (**Chart 29**). The banking union is moving forward, and euro-area banks have continued to make progress on balance-sheet repair in preparation for the ECB's comprehensive assessment.³⁷ Provisioning for bad loans has increased significantly. Asset quality has been stable at most core-country banks, while at peripheral-country banks it has begun to show signs of improvement. Banks, even in the countries most affected by the 2011–12 sovereign debt crisis, have been able to raise debt and equity capital in the market.³⁸ CET1 capital ratios have improved at most major banks, driven by retained earnings, new capital issuance, cost-cutting measures and the shedding of capital-intensive assets. In addition, the repayment of funds from the ECB's long-term refinancing operations (LTROs) has increased since the December FSR. However, the number of non-performing loans has risen, and bank revenues remain depressed, consistent with weak economic conditions.

Peripheral sovereign governments are faring better. Portugal is set to formally exit its international financial program, and Greece has received continued financing under its program. The economic recovery is slowly gaining hold, and credit ratings have improved. Investors appear hopeful, and demand for peripheral sovereign bonds has pushed down spreads over German Bunds to the levels prevailing before the 2011–12 sovereign debt crisis (**Chart 30**).³⁹ To some extent, this may also reflect the global search for greater yield by investors and a reallocation out of emerging-market investments. Increased market expectations for central bank support of peripheral sovereign debt under a quantitative easing program could push long-term yields even lower.

Chart 29: Market indicators of euro-area risk have declined



Sources: Bloomberg, Reuters and Bank of Canada calculations

Last observation: 5 June 2014

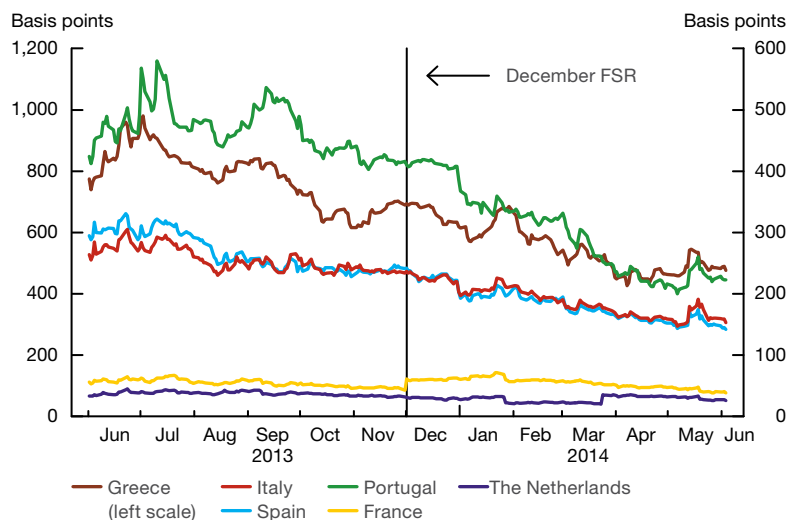
³⁷ The ECB's release of the rules related to its asset-quality review and stress-test parameters indicates its intention to carry out a thorough exercise. See Box 1 in the December 2013 FSR for further discussion of the steps being taken to strengthen the banking sector.

³⁸ Over the past several months, the four largest banks in Greece (Piraeus Bank, National Bank of Greece, Alpha Bank and Eurobank) have all successfully raised funds from markets.

³⁹ In April, the Greek government issued its first bond since 2010. The issue was heavily oversubscribed.

Chart 30: Peripheral sovereign spreads have declined

Spreads between 10-year sovereign bonds and 10-year German Bunds



Source: Bloomberg

Last observation: 5 June 2014

...yet significant vulnerabilities remain

The euro-area recovery nonetheless remains fragile, and debt problems linger throughout the public and private sectors. Economic activity remains weak and unemployment high, particularly in Spain and Greece. Several peripheral countries are already facing declining price levels, resulting in rising real interest rates and debt burdens. These factors continue to sustain the self-reinforcing feedback loop between weak macroeconomic activity, weak bank balance sheets and elevated sovereign risk. Necessary reforms are proceeding slowly, and reform fatigue or complacency could stall further progress. Persistently weak inflation is creating market concerns about the possibility of deflation and the effects on expectations and economic activity, and many small and medium-sized enterprises are struggling to obtain needed credit.

The European Central Bank has indicated its commitment to support lending to the real economy and increase inflation to its target level to facilitate adjustment across euro-area members. To this end, it has recently cut its key interest rates, pushing the deposit facility interest rate into negative territory, and has announced a series of targeted longer-term refinancing operations.⁴⁰ In addition, the ECB, together with the Bank of England, has recently proposed options that authorities could support to revitalize securitization markets across Europe and encourage the issuance of loans to smaller and medium-sized corporations.⁴¹

Financial system stress in the euro area could be triggered by domestic or external factors

There is a moderate probability that a trigger event will ignite financial system stress in the euro area: for example, investors could suddenly become concerned about the health of one or several banks, or stress outside the euro area could cause the economic recovery to stall or reverse, adversely affecting banks and sovereigns.

⁴⁰ See http://www.ecb.europa.eu/press/pr/date/2014/html/pr140605_3.en.html.

⁴¹ See "The case for a better functioning securitisation market in the European Union" at <http://www.bankofengland.co.uk/publications/Documents/news/2014/paper300514.pdf>.

Unexpected results from the ECB's comprehensive assessment of banks' balance sheets could generate a severe negative reaction from investors.⁴² In particular, a sizable capital shortfall for a major bank in a country such as Spain or Italy could cause extensive financial system stress, since their fiscal situations are still strained and a credible backstop across the euro area is not yet available.⁴³ Although sizable efforts have already been made to increase provisioning and the recognition of non-performing loans, the adequacy of these efforts across the banking system remains uncertain. In addition, improved sentiment for peripheral sovereign debt could reverse abruptly, particularly if markets are also disappointed with ECB policy measures. This could lead to a sharp increase in debt-service costs for both banks and sovereigns, resulting in a dangerous debt spiral that could spread across the financial system.

A materialization of stress from outside the euro area could also lead to renewed financial stress in the region. An intensification of political tensions in Ukraine and the international response⁴⁴ could have spillover effects on the euro-area economy and financial system.⁴⁵ Disruptions in energy supplies would raise prices, adversely affect industrial production, and weigh on business and consumer confidence and spending. Banks from Austria, France, Germany and Italy, which have the highest exposures to Russia, particularly to the non-bank private sector, would be the hardest hit.⁴⁶ In addition, the development of economic or financial problems in China or other EMEs to which euro-area banks are most exposed could also affect the region harshly.

A euro-area financial crisis would have broad repercussions for Canada

For Canada, the overall impact of a renewed euro-area crisis would have a moderate level of severity. Initial global reaction would include a flight to safety, a widespread retrenchment from risk and a broad repricing of assets, which could cause a general decline in Canadian equity prices and increases in the yields on fixed-income securities. Canadian banks could face a withdrawal of wholesale funding and a severe tightening of market funding liquidity as global funding conditions for banks deteriorate. To some degree, the stronger position of Canadian banks relative to their European peers might allow short-term investment funds to flow into Canada,

⁴² The ECB's review of 128 European banks, which account for 85 per cent of bank assets across 18 euro-area countries, is being carried out in collaboration with the national authorities of the member states. The review consists of an asset-quality review and a stress test. It began in November 2013 and will be completed in October 2014.

⁴³ On 15 April 2014, the European Parliament approved regulation for the Single Resolution Mechanism (SRM), which will allow failing banks to be wound down in a predictable and efficient way with minimum recourse to public money. A Single Resolution Fund (SRF), financed by euro-area banks, will be built up over an eight-year period, and even when fully funded will fall short of the asset value of the euro area's largest banks. These initiatives will not be in force until 2015 for the SRM and 2016 for the SRF. The European Stability Mechanism (ESM) remains the permanent crisis-resolution mechanism for euro-area countries.

⁴⁴ In response to continued Russian involvement in Ukraine, Western governments have imposed sanctions targeting Russian individuals and corporations. To date, Western sanctions include asset freezes, travel bans, Russia's suspension from the G-8 and cessation of talks with the Organisation for Economic Co-operation and Development (OECD), as well as talks between the European Union and Russia. If Russia continues to renege on its commitment to de-escalate the situation in Eastern Ukraine, Western officials have promised sectoral sanctions on Russia, possibly targeting its energy and banking sectors.

⁴⁵ The IMF indicated that "intensification of sanctions and countersanctions may lead to larger spillovers. Contagion could spread through the real (trade, remittances) and financial (asset valuation, banking) channels. Moreover, an extended period of geopolitical tensions could affect confidence in both advanced and emerging Europe." See IMF, "Central, Eastern, and Southeastern Europe Regional Economic Issues," April 2014.

⁴⁶ These exposures amount to 40 per cent of the CET1 capital of French banks, but less than 15 per cent for Austrian, German and Italian banks.

mitigating some of the effect. However, the impairment of euro-area assets on the balance sheets of U.K. and U.S. banks, to which Canadian banks have sizable exposures, could lead to second-round effects.

A euro-area crisis would also lead to a decline in global economic growth, which would, to a lesser extent, have a negative impact on Canada's exports, world commodity prices and, ultimately, on Canadian economic growth. This effect would be compounded by tighter credit conditions for Canadian households and businesses as the banking sector incurred losses. Such widespread effects on Canada's financial system and economy could also trigger a sharp correction in the Canadian housing market, as outlined in **Risk 1**.

Potential Emerging Vulnerabilities and Risks in the Canadian Financial System

This issue of the FSR has highlighted the key vulnerabilities and risks for the Canadian financial system. The process remains dynamic, and the discussion is not meant to be exhaustive. For example, there are other areas of the financial system that may exhibit more moderate vulnerabilities about which the Governing Council is not overly concerned but nonetheless is monitoring. In addition, there may be potential new vulnerabilities and risks that could destabilize the financial system. Although not currently considered to be conditions that could propagate risks to the Canadian financial system, the following areas have some potential to develop into systemic factors.

The commercial real estate (CRE) market: This sector is highly cyclical and sensitive to rising interest rates. Outside of Canada, there are indications that a real estate boom in some countries may be motivated by regulatory arbitrage by foreign investors and that underwriting standards for CRE loans may be declining. In Canada, authorities continue to monitor the domestic CRE market, especially with respect to the growing role of less-regulated financial entities in this sector, such as real estate investment trusts and mortgage investment corporations (MICs). Some of these funds use significant leverage, which could serve as an amplification mechanism for a shock to the CRE market. Other types of investment funds have also increased their presence in commercial, as well as residential, mortgages in recent years. It is important for authorities to monitor these changing sources of CRE financing, given the riskier nature of the market.

Cyber attacks: Cyber espionage, through breaches of core technology systems, plus attacks to disrupt key, Internet-related business functions are on the rise globally. With the high reliance on technology and the importance of financial market infrastructure in Canada, a large, coordinated cyber attack within the financial sector could materially impede the functioning of Canada's financial system. Public and private sector initiatives to strengthen business continuity in the face of such operational risk events are ongoing.⁴⁷ In addition, efforts to expand and formalize the exchange of information are aimed at enhancing cyber defences among Canadian financial sector entities.

⁴⁷ For a discussion of these efforts, see the Safeguarding Financial Stability section in the December 2013 FSR.

Safeguarding Financial Stability

Notwithstanding the vulnerabilities and risks highlighted in this FSR, the Canadian financial system is judged to be resilient, and will continue to benefit as international policy measures stemming from the G-20 agenda for financial regulatory reform are implemented, both domestically and globally.

The recent IMF FSAP results for Canada highlight the strength and resilience of the Canadian financial system (Box 3).

Strengthening the regulation and supervision of the global financial system

Canada and other countries are undertaking policy measures that specifically address the vulnerabilities and risks that pertain to their own financial systems. In addition, work continues to proceed at the international level to increase the resilience of global and domestic financial systems in the context of the G-20 reform agenda.

Within the four priority areas of reform being shepherded by the Financial Stability Board (FSB),⁴⁸ much has been accomplished in terms of policy development. However, more work remains to be done as global standards are transformed into national legislation and rules. In addition, given the comprehensive nature of the reforms, it is likely that some adjustments will be needed over the agreed transition periods.

The first phase of international standard setting is nearing completion

Building the resilience of financial institutions

To make banks more resilient, the Basel III framework significantly increases the quantity and quality of capital held by banks and incorporates a new countercyclical capital buffer. The framework also includes a requirement for the amount of high-quality liquid assets that banks need to hold to withstand liquidity shocks under the Liquidity Coverage Ratio (LCR). In addition, there is a backstop Leverage Ratio, which was borrowed from the effective Canadian bank regulatory framework. The goal is to make bank capital ratios more consistent and comparable across banks.

Since the December FSR, requirements for LCR disclosures have been finalized. In addition, a framework and disclosure requirements were also issued for the Leverage Ratio. Other significant milestones reached by the Basel Committee on Banking Supervision since the last FSR include the finalization of its supervisory framework for measuring and controlling banks' large exposures (excluding intra-group exposures) and completing work on the capital treatment of banks' exposure to central counterparties.

Looking ahead to the G-20's Brisbane Summit later this autumn, the goal is to complete the Basel III framework by finalizing the Net Stable Funding Ratio—a new medium-term liquidity requirement to prevent excessive maturity mismatches at banks—and by developing a concrete plan to reduce the excessive variability in risk-weighted capital calculations.

⁴⁸ These four areas of reform are: (i) building the resilience of financial institutions; (ii) ending the problem of "too big to fail"; (iii) transforming shadow banking into transparent and resilient market-based financing; and (iv) ensuring that over-the-counter derivatives markets are continuously open.

Box 3

Results of the Financial Sector Assessment Program for Canada

The International Monetary Fund conducted an FSAP for Canada in 2013.¹ The FSAP report notes that the Canadian financial system successfully weathered the financial crisis and continues to exhibit a high degree of resilience. The banking system is well capitalized and has a low proportion of non-performing loans. Canada is credited with having a strong regulatory and supervisory framework, bolstered by a credible system of safety nets. An extensive stress test of the major financial institutions shows them to be resilient to a severe stress scenario. Targeted prudential and macroprudential measures appear to be effective in addressing the main stability concerns of elevated house prices and high levels of household debt.

Canadian authorities are considering the implications of the report and the potential for its recommendations to be addressed.

Key points and recommendations

- The FSAP team noted the quality of regulation and supervision in Canada, with the banking, insurance and securities sectors all exhibiting a high level of compliance with international principles. In particular, the report noted the strong international reputation of the Office of the Superintendent of Financial Institutions (OSFI), as well as its experienced and highly trained supervisors, early adoption of international standards such as Basel III, and excellent relationships with other federal agencies and overseas counterparts.
 - Canadian authorities' stress-testing frameworks are advanced and incorporate leading practices such as those in the Bank of Canada's MacroFinancial Risk Assessment Framework (MFRAF) model.² The FSAP report contains a number of recommendations to improve stress testing even further by: (i) collecting longer and more granular time-series data on a greater range of items; (ii) using econometric model-based approaches in forecasting income and balance-sheet items; (iii) incorporating economic concepts in the determination of credit-risk input parameters; (iv) establishing a stress-testing framework for liquidity that incorporates Basel III metrics; and (v) subjecting all major federal and provincial entities to common stress-testing frameworks.
 - Canadian authorities have also adopted effective measures to rein in the risks posed by elevated housing prices and household indebtedness through such means as implementing changes to the rules for government-backed mortgage insurance and shortening the maximum amortization period for mortgage loans with high loan-to-value ratios. The assessment team recommends further gradual reduction in the government's exposure to mortgage insurance over time.
- A common theme throughout the FSAP report is the need to increase coordination and communication among regulators at all levels to enable them to properly monitor, identify and deal with emerging risks in the Canadian financial system. For example, shortcomings were found in risk identification and enforcement in securities regulation, which FSAP inspectors suggest could be addressed by improving inter-provincial (and federal) coordination to obtain a more complete view of the risks. The FSAP team therefore made the following recommendations with respect to gaining a more comprehensive view of systemic risks in Canada. These recommendations will be reviewed by Canadian authorities along with the rest of the FSAP results.
- Co-operation among federal and provincial supervisors should be enhanced, and all systemically important financial institutions should be subject to intense supervision.
 - A clear mandate should be assigned to an entity to (i) monitor systemic risk to facilitate macroprudential oversight; and (ii) carry out system-wide crisis preparedness.
 - The collection and dissemination of financial sector data should be expanded with a view to enhancing the coverage, regularity and availability of time series.

¹ The full assessment report (including the complete list of recommendations) is available at <http://www.imf.org/external/pubs/cat/longres.aspx?sk=41299.0>.

² For details, see "Stress Testing the Canadian Banking System: A System-Wide Approach," in the Reports section of this issue.

Ending the problem of “too big to fail”

The FSB has developed the Key Attributes for Effective Resolution Regimes, which when enacted, will allow the largest financial institutions to be resolved, and thereby maintain their critical operations, without disrupting the rest of the financial system or drawing on the public purse. In Canada, the federal government committed to a bail-in regime of domestic systemically important banks in the March 2013 budget. For the Brisbane Summit, policies will be proposed by the FSB for better aligning legal requirements across jurisdictions and for promoting effective co-operation during the cross-border resolution of large multinational banks.

Transforming the shadow banking sector

To transform shadow banking into resilient market-based finance, the FSB, in coordination with other agencies, has developed a policy framework to reduce systemic risk in these activities. Specific policies aim to:

- mitigate the spillovers between traditional banks and the shadow banking system;
- reduce the vulnerability of money market funds to “runs”; and
- address incentive problems in securitization by mandating minimum retention requirements for originators.

In Canada, we have established a central counterparty for clearing repo transactions. To complete the work on shadow banking, policies for minimum haircut thresholds for repo and securities-lending transactions will be specified at the Brisbane Summit.

Ensuring that OTC derivatives markets are continuously open

To ensure that financial markets stay continuously open, new rules reduce systemic risk and increase market transparency in over-the-counter (OTC) derivatives markets. To operationalize the rules for OTC derivatives for cross-border transactions, remaining inconsistencies in national regulatory approaches must be resolved. It is important that regulators defer to each other’s rules when they deliver similar outcomes. Canadian authorities are actively engaged with the U.S. Commodity Futures Trading Commission to ensure that when rules deliver similar outcomes, each jurisdiction may defer to the other’s rule.

The next phase will focus on implementation and outcomes

After the Brisbane Summit, the focus will be on the consistent implementation of minimum global standards across jurisdictions to ensure similar prudential outcomes. This phase of the reform agenda will be the most challenging. To ensure consistent implementation, the FSB will coordinate a comprehensive multi-stage framework to monitor the implementation of the range of reforms against agreed timelines. In addition, rigorous peer reviews will be conducted by teams of independent experts, to help catalyze action and foster a “race to the top.” Progress reports will also be published on a comparable country-by-country basis to encourage compliance through peer and market pressures.

The implementation of these reforms will do much to increase the stability of the Canadian and global financial systems, by reducing the likelihood and impact of future crises and achieving an open, integrated and resilient global financial system.

International bodies and national authorities must remain vigilant for unintended consequences of reforms

As the global regulatory reform agenda moves forward, it is important to not only monitor for consistent implementation, but also for any unintended consequences of the reforms, especially on market functioning. More rigorous prudential requirements for the banking sector,⁴⁹ differences in regulation across multiple jurisdictions, and calibration issues, such as potential conflicts among the various regulatory initiatives or effects that are different than anticipated, all have the potential for unintended negative consequences on global financial systems.

For example, there have been concerns that increased regulation, as well as quantitative easing and foreign reserves management, may be reducing the availability of high-quality assets that could be used as collateral. Work by the Bank for International Settlements and others has concluded that rising supply should eventually be able to meet increased demand, although localized shortages could occur for specific countries or institutions.⁵⁰ In addition, market responses, such as collateral transformation and asset securitization, may also effectively increase supply, while activities such as cross-asset margining and linking arrangements between central counterparties could result in more efficient use of collateral. However, these market responses may lead to other financial system vulnerabilities by increasing complexity and interconnectedness.

Another possible unintended consequence of reforms is the potential fragmentation of the global financial system due to differences in the application of rules between national and foreign participants and to ring-fencing of banking system activities or capital and liquidity. This could interrupt cross-border financing activities and potentially lead to a greater concentration of risk in a smaller number of countries. In addition, differences in regulations across jurisdictions could not only create an uneven playing field, but could also encourage regulatory arbitrage and, ultimately, a “race to the bottom,” as riskier activities migrate to less-regulated jurisdictions.

While it is too early to assess the full impacts of global regulatory reforms, it will be important to monitor and share information across sectors and jurisdictions.

⁴⁹ The report, “Making Banks Safer: Implementing Basel III,” in this issue, discusses some of these challenges in greater detail.

⁵⁰ See, for example, the report, “The Market for Collateral: The Potential Impact of Financial Regulation,” in the June 2013 FSR.

Reports

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

Introduction

This section of the *Financial System Review* features three reports on financial system initiatives: making financial benchmarks more robust; implementing the stronger Basel III capital and liquidity framework for banks; and using stress tests to assess financial system risks.

In Reforming Financial Benchmarks: An International Perspective, Thomas Thorn and Harri Vikstedt examine the efforts being taken internationally and in Canada to enhance the governance and integrity of financial benchmarks. The report provides an overview of how interbank interest rate benchmarks are set and describes the weaknesses in the process that were exposed by the financial crisis. It also explains recent policy developments designed to make global and Canadian interbank benchmarks more robust.

Making Banks Safer: Implementing Basel III, by Éric Chouinard and Graydon Paulin, reviews the progress to date in implementing Basel III, the new framework of global regulatory standards for the banking sector developed by the Basel Committee on Banking Supervision. The report highlights the expected net benefits of implementing Basel III, as well as the challenges in ensuring international consistency in measuring the risk-weighted capital of banks. It includes a discussion on how implementing Basel III has affected the banking system in Canada and other important jurisdictions, and demonstrates the need for ongoing assessment of the effects on the financial system and the macroeconomy.

Stress testing is an important tool used by financial authorities and entities around the world to evaluate potential risks to the financial system. In **Stress Testing the Canadian Banking System: A System-Wide Approach,** Kartik Anand, Guillaume Bédard-Pagé and Virginie Traclet discuss different stress-testing approaches, with emphasis on the innovative and analytically rigorous model developed by the Bank of Canada: the MacroFinancial Risk Assessment Framework (MFRF). They also present the stress-test results obtained in the context of the 2013 Canada Financial Sector Assessment Program led by the International Monetary Fund, including the important contributions made by the use of MFRF in the exercise.

Reforming Financial Benchmarks: An International Perspective

Thomas Thorn and Harri Vikstedt

- Robust benchmarks are of fundamental importance to financial markets, providing objective measures of prevailing market prices on which standardized contracts can be based. They are especially important to derivatives markets, since derivatives are an essential hedging tool for financial institutions and other market participants; the notional value of these instruments amounts to hundreds of trillions of dollars worldwide, including over \$10 trillion in Canada.
- Allegations of the manipulation of some global financial benchmarks and, in some cases, admissions of wrongdoing have captured the attention of the world's financial press, clearly highlighting the need to address the incentive problems and weak governance affecting some benchmarks.
- Central banks and other public authorities around the world, including those in Canada, are working together to improve financial benchmarks by ensuring that they meet robust international standards. However, given the central role that these benchmarks play in today's financial system, any substantive changes to them need to be globally coordinated and their broader financial stability implications carefully considered.

Introduction

Allegations of manipulation have propelled financial benchmarks from the back pages of financial contracts to the front pages of the financial press. This has not only demonstrated a clear need for reform, it has highlighted the importance of such benchmarks within the financial system. Indeed, it is difficult to imagine modern financial markets without derivatives, floating-rate loans and notes, and financial indexes—all enabled by financial benchmarks. At their core, financial benchmarks are

rates or prices that are referenced or used in a variety of financial contracts to determine a value or payment, based on the prices prevailing in the underlying market, at a specific time in the future. For example, an individual or firm may borrow money today and pay the lender interest based on the market interest rates, as measured by a financial benchmark, over the course of the loan.

Benchmarks have facilitated the standardization of financial products through more stable and transparent pricing, which has also stimulated the rise in derivative instruments to help firms better manage their underlying risk exposures. The rapid development of derivatives markets since the 1980s, and their reliance on underlying financial assets or benchmarks to determine value, has led to the degree of dependence on benchmarks that is observed today. In many cases, the size of the markets referencing financial benchmarks overshadows the market on which the rates are based, increasing the economic incentive to influence rates.¹ While this incentive has been kept in check to some degree by existing rules against market manipulation, recent events have demonstrated that more steps need to be taken to enhance the governance of financial benchmarks and ensure that they continue to be representative of the prices in their underlying markets.

Robust benchmarks are essential to promoting the safety and stability of the global financial system. Therefore, public authorities and the financial industry are now collaborating globally to improve the reliability, resilience and governance of financial benchmarks to restore the confidence of both markets and the public in these rates.

¹ For example, over US\$500 trillion in financial contracts and instruments reference the key global interbank interest rate benchmarks.

This report provides background on the recent policy developments related to financial benchmarks, focusing primarily on the global interbank interest rate benchmarks that were at the centre of the manipulation that motivated the recent reviews. The report begins with a discussion of the role of financial benchmarks and then examines global reform efforts and the issues faced by policy-makers. It concludes with a review of the recent developments in domestic policy with respect to the principal Canadian interest rate benchmark, the Canadian Dollar Offered Rate (CDOR).

The Role of Financial Benchmarks

Financial benchmarks allow market participants to anchor the payment or valuation of financial contracts to an agreed-upon rate or price. **Box 1** presents a generic framework for the governance and submission of financial benchmarks.

Benchmarks, particularly interbank interest rate benchmarks, have facilitated the standardization of financial contracts, leading to lower transaction costs and enhanced market liquidity, and have allowed for the efficient redistribution of risks in the financial system (see **Box 2** for more on interbank interest rate benchmarks).

Box 1

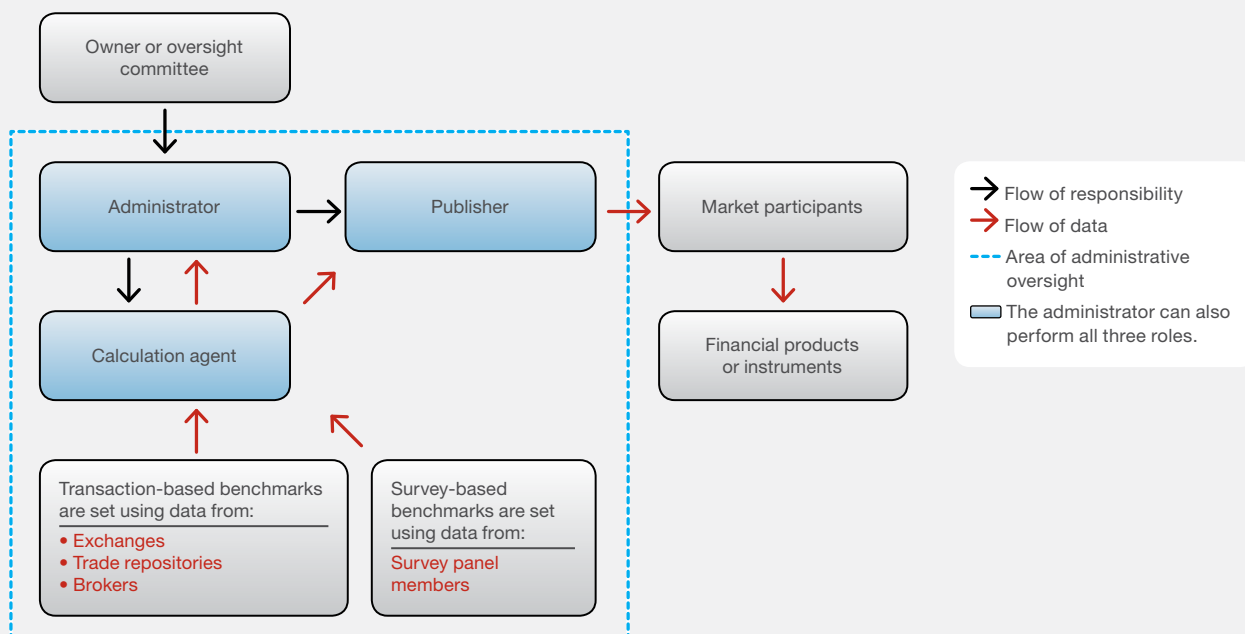
General Framework for Financial Benchmarks

In general, benchmarks are established by the owner of the benchmark or the committee that oversees it (**Figure 1-A**). The owner or oversight committee either becomes or appoints the benchmark administrator, the entity responsible for all aspects of the benchmarking process, including setting rules and standards for the benchmark and ensuring that submitters comply with them. The administrator can also be charged with calculating and publishing the benchmark, except when these functions are delegated to other entities. In those cases, it is the administrator's role to monitor the contractor's performance.

Broadly, benchmarks can be based entirely on market data (i.e., transaction-based benchmarks) or on the opinions

of a number of market participants (i.e., survey-based benchmarks). However, even in the latter case, the submissions should typically be related directly or indirectly to transactions in the underlying markets. In both cases, the calculation agent receives raw data that are potentially subject to certain screening parameters and calculates the rate according to predefined rules. These rules stipulate, for example, whether any input data are to be excluded, so as to eliminate potential outliers, and specify the calculation methodology to be applied. The publishing agent, in turn, provides the benchmark rates (and possibly the original individual submissions) to its subscribers or to the public.

Figure 1-A: Governance and submissions framework for financial benchmarks



Source: Bank of Canada

Box 2

A History of Interbank Benchmarks

Interbank interest rate benchmarks emerged in the late 1960s and 1970s to facilitate bank lending as cross-border bank funding markets, which had been shuttered since the Great Depression, began to reopen. Regulatory changes, later followed by an influx of petrodollars, had fuelled rapid growth in the market for U.S.-dollar-denominated deposits outside the United States (i.e., eurodollars), leaving banks, primarily those in London, flush with deposits. To put these deposits to work, banks increased their interbank lending and issuance of syndicated loans (loans offered to a single borrower by a group of banks). Syndicating such loans allowed banks to reduce their credit exposure to a single borrower. To better facilitate this syndication process, some banks in London began to offer loans based on the weighted average rate at which the syndicate banks were willing to lend funds to one another plus a spread based on the borrower's credit standing, an idea that proved immensely popular and helped the syndicated loan market to grow even larger.

The reopening of interbank lending markets and the growth in syndicated loan markets contributed to the creation of interest rate derivatives to manage the risk exposures arising from this type of banking activity, including products such as interest rate swaps and eurodollar futures contracts. However, to commoditize these products, a common, transparent benchmark against which to price them became

necessary, since these products would otherwise require far more effort to price. The British Bankers' Association (BBA) and the Bank of England, together with other entities, began working to address this issue in 1984. The result was a set of recommended terms and conditions for interest rate swaps, including the fixing of BBA interest settlement rates, which were the predecessor of the London Interbank Offered Rate (LIBOR). LIBOR was officially published for the first time about two years later, on New Year's Day in 1986, initially for three currencies (the U.S. dollar, the Japanese yen and the pound sterling). Other major jurisdictions quickly established their own benchmarks for interbank interest rates, including the Tokyo Interbank Offered Rate (TIBOR) and, most recently, the Euro Interbank Offered Rate (EURIBOR), which was developed with the introduction of the euro.

Canadian banks fashioned a somewhat similar rate to use in pricing (often syndicated) loans backed by bankers' acceptances (BAs), the Canadian Dollar Offered Rate (CDOR). CDOR and LIBOR began to diverge in 1998, however, when the administrator of LIBOR, the BBA, asked submitting banks to base their submissions on the rate at which they were able to borrow funds in the unsecured interbank market. In contrast, CDOR remains the average rate at which banks are willing to lend funds against issuances of BAs, and CDOR submitters continue to be directly involved in the BA issuance process.

A loss of confidence or credibility in some of these benchmarks could therefore have a profound impact on the liquidity of the markets referencing them, potentially giving these benchmarks systemic importance. Recent headlines may have shaken that confidence, but confounding expectations that there could be reduced use of these rates, the aggregate net open interest in eurodollar and EURIBOR futures contracts²—some of the most liquid contracts in the world—has returned to the record-high levels it reached before the 2007–09 financial crisis.

Weaknesses Exposed in Survey-Based Benchmarks by the Financial Crisis

A weak governance framework, especially regarding submissions, can leave a benchmark vulnerable to manipulation. The most obvious example of this is the possibility that panel members on survey-based

benchmarks³ will skew their submissions to influence the value of a benchmark setting to maximize the profit from positions referencing the rate. In fact, shortly after the financial crisis, allegations emerged that some key global interbank interest rate benchmarks had been manipulated through skewed submissions by their survey members (Vaughan, Finch and Ivry 2013). This occurred during the turmoil in interbank lending markets precipitated by the crisis, which resulted in fewer transactions against which the submissions could be verified. While this manipulation primarily touched the survey-based interbank benchmarks—LIBOR, EURIBOR and TIBOR⁴—allegations of the manipulation of liquid transaction-based foreign exchange benchmarks have recently come to light as well.

³ Panel members are market participants that contribute quotes to a survey-based benchmark. These firms are selected by the administrator to ensure that a representative sample of the market is captured by the benchmark rate.

⁴ These are the most important international survey-based interbank interest rate benchmarks. LIBOR is the London Interbank Offered Rate and TIBOR is the Tokyo Interbank Offered Rate.

² EURIBOR is the Euro Interbank Offered Rate.

For most survey-based interbank benchmarks, the submissions of individual banks are made public and are viewed by market participants as a direct reflection of the submitters' credit risk. Submitters therefore have an incentive, which was particularly evident during the crisis, to understate their borrowing rates in order to influence the market perception of their creditworthiness. To the extent that submissions were biased, the impact would differ across market participants depending on whether they were a borrower or a lender.

Wheatley Review of LIBOR

In 2012, allegations of manipulation in some LIBOR rates led the U.K. Financial Services Authority to appoint Martin Wheatley to review the benchmark.⁵ The goal of the review was to investigate various aspects of LIBOR and to provide recommendations on how to make it less susceptible to manipulation.⁶

The Wheatley Review concluded “that the issues identified with LIBOR, while serious, can be rectified through a comprehensive and far-reaching programme of reform; and that a transition to a new benchmark or benchmarks would pose an unacceptably high risk of significant financial instability, and risk large-scale litigation between parties holding contracts that reference LIBOR” (HM Treasury 2012). Among the results of the review were:

- Several LIBOR maturities and currencies were eliminated, since there were very few transactions underpinning them.⁷ This included the elimination of the Canadian-dollar LIBOR rates. Since they were not widely used, their elimination had no market impact.⁸
- The publication of individual submissions was delayed by three months to reduce the incentive for submitters to understate their funding costs, particularly during times of stress.⁹
- A code of conduct was implemented for submitters that requires panel banks to tie their submissions to transactions, where possible, and provides guidelines for internal controls, records retention and external auditing.

Finally, in response to one of the suggestions by the Wheatley Review for strengthening the governance framework for LIBOR, the British Bankers'

Association ceded its role in administering LIBOR to the IntercontinentalExchange Group (ICE) through a public tender process.¹⁰

One of the broader impacts of the Wheatley Review was the attention it drew to the potential effects on financial markets of the elimination of a benchmark through the sudden disappearance of the underlying market on which the rate is based. Contracts referencing benchmarks typically have “contingency clauses,” which provide alternative means of valuing the contract if the normal benchmark is unavailable. In most cases, the contingency clauses are written to address the short-term unavailability of a benchmark rate (e.g., owing to some operational interruptions), but not the total disappearance of the benchmark.¹¹ The Wheatley Review's final report suggested that market participants review their standard contracts to ensure that they contain adequate contingency provisions in case LIBOR is no longer available—a prudent recommendation for any contract referencing a benchmark.

Global Policy Response

As concern about financial benchmarks grew, public sector authorities around the world began working together to determine the best way to make these benchmarks less susceptible to manipulation without harming the markets referencing them (Table 1). This has been a formidable task, since many of the benchmarks are integral to the functioning of the financial system.¹² Modifying or replacing these rates is not a straightforward task, especially given the large number of long-maturity legacy contracts referencing them. Changing the underlying economic characteristics of a benchmark by, for example, moving from an unsecured interbank rate to one secured by government collateral requires a complete and thorough analysis of the impact that such a step would have on the financial system as a whole. And while transaction-based benchmarks are often viewed as less susceptible to manipulation because they are based on actual transactions rather than on survey results, there may not always be a sufficiently liquid market available to support a purely transaction-based interbank interest rate benchmark. Transaction-based rates could also face problems during periods of stress, when transaction volumes tend to be lower.

5 A number of other jurisdictions, including Canada and the European Union, have launched reviews of their interbank benchmarks, with recommendations similar to the Wheatley Review.

6 The Wheatley Review was not intended to investigate claims of manipulation or fraud, a job that was left to the appropriate regulatory authorities.

7 The number of LIBOR currencies was reduced to 5 from 10, and the number of reported tenors was reduced to 7 from 15.

8 See the June 2013 announcement of changes to LIBOR at <http://www.bbalibor.com/news/announcement-of-Libor-changes>.

9 It also removed the ability of submitters to rely on or reference rates from other banks from the previous day when calculating their rate submission.

10 ICE purchased NYSE Euronext, the firm that was originally selected to take over as the administrator of LIBOR. The announcement of the purchase is available at <http://ir.theice.com/investors-and-media/press/press-releases/press-release-details/2013/IntercontinentalExchange-Completes-Acquisition-of-NYSE-Euronext/default.aspx>.

11 In most cases, these clauses refer to ways to replicate the calculation of the benchmark on a bilateral basis by polling a more limited set of banks.

12 For example, they act as the internal transfer rate used by many banks to distribute funds.

Reflecting these concerns, two main global initiatives have been launched to address the underlying issues associated with financial benchmarks: the IOSCO Principles for Financial Benchmarks and the Official Sector Steering Group created by the Financial Stability Board (FSB).

IOSCO Principles

In July 2013, the International Organization of Securities Commissions (IOSCO), a global group of regulators that includes the Ontario Securities Commission and Quebec's Autorité des marchés financiers, published its Principles for Financial Benchmarks, a set of global best practices for these instruments. These Principles have been endorsed by the Group of Twenty (G-20) and the FSB. IOSCO members are expected to review the processes for the major financial benchmarks established in their jurisdictions against the Principles by January 2015.¹³

Developed in consultation with the industry, the IOSCO Principles strongly favour the use of transactional data or executable quotes—inputs that come from actual market transactions rather than from opinions. For survey-based benchmarks, the Principles require that contributors establish a hierarchy of the different types of data they use when constructing their submissions. For example, a firm determining its contribution to an interbank benchmark might first take into account the previous day's interbank transactions, followed by other relevant transactions, and finally, other relevant economic factors, based on the submitter's expert judgment.

The Principles also outline a number of key roles related to financial benchmarks: benchmark administrator, submitters, calculation agent and publisher (Table 2), and specify the key responsibilities for the entities tasked with these roles (IOSCO 2013). IOSCO's governance framework is designed to address the conflicts of interest faced by firms in the benchmarking process, and to increase the transparency around the determination of the benchmark. Since a "one-size-fits-all" approach would not be appropriate in light of the heterogeneity of financial benchmarks, IOSCO encourages regulators and market participants to take into account the economic characteristics of the underlying benchmarks when applying the Principles.

As a set of minimum global standards, the IOSCO Principles are not legally binding, but IOSCO nonetheless encourages countries to legally require compliance with the Principles where it is deemed necessary. However, even if a jurisdiction chooses not to use the law to enforce the Principles, its domestic markets may be affected if other jurisdictions decide to do so. For example, the European Commission is currently

Table 1: Reforming financial benchmarks: Global policy response

2012	
2 July	Wheatley Review of London Interbank Offered Rate (LIBOR) begins
1 Aug	Investment Industry Regulatory Organization of Canada (IIROC) begins review of Canadian Dollar Offered Rate (CDOR)
28 Sept	Wheatley Review of LIBOR published
01 Oct	European Securities and Markets Authority (ESMA) and European Banking Authority (EBA) begin review of the Euro Interbank Offered Rate (EURIBOR)
2013	
10 Jan	IIROC review of CDOR supervisory practices published
11 Jan	ESMA and EBA publish EURIBOR report
18 Mar	Bank for International Settlements releases report on reference-rate practices (BIS 2013)
17 July	International Organization of Securities Commissions (IOSCO) publishes Principles for Financial Benchmarks
29 Aug	Financial Stability Board (FSB) announces creation of the Official Sector Steering Group (OSSG) and the Market Participants Group
18 Sept	European Commission publishes final proposal for benchmark rules
2014	
13 Jan	Office of the Superintendent of Financial Institutions (OSFI) announces regulatory role for CDOR
June	OSSG to report to FSB
2015	
Jan	IOSCO assessments due

Source: Bank of Canada

Table 2: IOSCO-defined roles in the benchmark-setting process

Entity	Role
Owner and/or oversight committee	<ul style="list-style-type: none"> appoints administrator, calculation agent and publisher ensures that the administrator meets internationally accepted requirements
Administrator	<p>Responsible for all aspects of the benchmark-determination process, including:</p> <ul style="list-style-type: none"> developing and determining the benchmark establishing credible and transparent governance, oversight and accountability procedures monitoring the compliance of submitters and other parties (i.e., calculation agent and publisher, if the administrator does not take on these roles)
Calculation agent	<ul style="list-style-type: none"> checks for errors in submissions calculates benchmark setting based on submissions according to a specified methodology
Publisher	<ul style="list-style-type: none"> makes benchmark settings available to subscribers or to the public
Submitters	<ul style="list-style-type: none"> determine submissions and transmit them to the calculation agent abide by the code of conduct set by the administrator (for survey-based benchmarks)

Source: Adapted from the IOSCO Principles for Financial Benchmarks (IOSCO 2013).

¹³ The FSB's Official Sector Steering Group has commissioned IOSCO to conduct an early review of the most widely used financial benchmarks against the IOSCO Principles by June 2014 (FSB 2013).

considering a proposed law that would prohibit entities in the European Union from trading products that reference benchmarks that do not meet the IOSCO Principles (EC 2013). This could potentially affect the liquidity of any products referencing such benchmarks and directly influence the trading activity of financial firms with operations located in the European Union.

FSB Official Sector Steering Group

Given the systemic importance of the key interbank benchmarks and the potential for cross-border issues to develop, the G-20 asked the FSB to ensure that benchmarks are assessed consistently across jurisdictions and to foster coordination on benchmark reform between authorities (FSB 2013). To achieve these goals, the FSB created an Official Sector Steering Group (OSSG) of regulators and central banks from the countries with the most widely used interbank reference rates. The OSSG's work includes an assessment of three major global financial benchmarks—LIBOR, EURIBOR and TIBOR—against the IOSCO Principles, focusing on governance and the processes for determining the benchmarks. The OSSG will present its findings to the FSB by June 2014.

The FSB also asked the OSSG to establish and guide the work of a Market Participants Group (MPG) of industry representatives.¹⁴ The MPG was charged with exploring options for robust, IOSCO-compliant alternatives for the most widely used interest rate benchmarks. In addition, the MPG investigated issues associated with transitioning trillions of dollars in legacy contracts to these new alternative benchmarks, including the legal and accounting implications of doing so.

Canadian Policy Response

Even though there have been no reports that Canadian financial benchmarks have been manipulated, Canadian authorities, together with the financial industry in Canada, are taking steps toward improving the governance framework for domestic benchmarks.

One such step is the ongoing effort to reform CDOR to ensure that it is compliant with the IOSCO Principles. Unlike many global interbank benchmarks, CDOR is a committed (i.e., executable) lending rate that is actively referenced by the major Canadian banks in their lending facilities for bankers' acceptances (BAs). After treasury bills, BAs account for the second-largest segment of the Canadian money market, with approximately Can\$66 billion outstanding. Having a committed rate reduces some of the incentives to manipulate rates that have been present in other global benchmarks, especially since borrowers can choose when, and at what maturity, to borrow.

Nonetheless, given that over Can\$10 trillion worth of financial products reference CDOR, there could exist some incentive to influence the submitted rate. Hence, there should be strong internal controls in place for CDOR submissions.

The Investment Industry Regulatory Organization of Canada (IIROC) reviewed CDOR's supervisory practices in 2012.¹⁵ In contrast to the Wheatley Review of LIBOR, the focus was primarily on the governance of supervisory practices around the submission, rather than a broader review of the underlying BA market (IIROC 2013). The review found that while submitters had the same basic understanding of CDOR, they each made slightly different assumptions in determining their submissions.¹⁶ While IIROC found the supervisory practices for CDOR submitters adequate overall, they recommended some improvements, including more explicit documentation related to CDOR's calculation methodology, definition and transparency. Further internal controls to prevent potential manipulation, as well as documented criteria for being a CDOR submitter, were also proposed. Since the publication of this report, Canadian authorities have been working with IIROC and the CDOR panel member banks to address IIROC's concerns and to ensure that CDOR is compliant with the IOSCO Principles.¹⁷

Reflecting the fact that BA-based lending is a banking activity, all CDOR submissions now originate from the bank side, rather than from the dealer side, of the submitter's institution. Consistent with this move, the Office of the Superintendent of Financial Institutions assumed the responsibility for supervising the effectiveness of the governance and risk controls associated with banks' CDOR submission processes (OSFI 2014). Subsequently, in its recent budget, the federal government announced its intention to amend the Bank Act to include a regulation-making authority covering bank submissions to financial benchmarks. The number of submitters has also been reduced to seven banks, with all remaining panel members now operating as both active issuers and market-makers in Canadian-dollar BAs. While the size of the panel is small relative to other international interbank interest rate benchmarks, the seven CDOR panel members issue BAs daily and account for close to 99 per cent of the outstanding BAs (Chart 1).

¹⁵ The Bank of Canada participated as an observer.

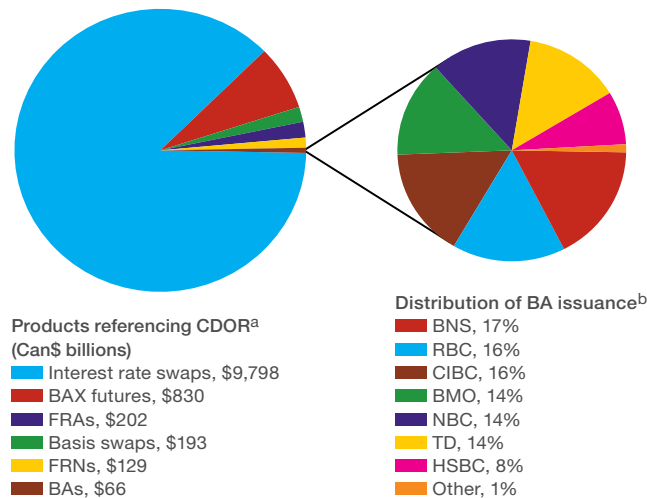
¹⁶ This arises because each bank's submission is a function of the way it funds itself and therefore takes into account specific factors relevant to its funding strategy.

¹⁷ This work is being done through the Head of Agencies, a public sector coordination group that discusses issues related to Canadian capital markets. It includes the Alberta Securities Commission, Autorité des marchés financiers, the Bank of Canada, the British Columbia Securities Commission, the Department of Finance, the Office of the Superintendent of Financial Institutions and the Ontario Securities Commission.

¹⁴ The Bank of Canada is represented on the OSSG, and Canada is also represented on the MPG.

The CDOR panel members also worked in consultation with IIROC and the Bank of Canada to develop and publish an industry code of conduct for CDOR, outlining the responsibilities of the submitting banks

Chart 1: Instruments referencing CDOR



- a. Bankers' acceptances futures (BAX) outstanding are from the Montréal Exchange on 20 March 2014; basis swaps outstanding are from the Depository Trust and Clearing Corporation on 7 April 2014; forward rate agreements (FRAs) outstanding are from the Bank for International Settlements (BIS) on 30 June 2013; floating rate notes (FRNs) outstanding are from the BIS on 20 March 2014; and interest rate swaps outstanding are from the BIS on 30 June 2013. No adjustments have been made for double counting.
- b. BA issuance numbers for the Bank of Montreal (BMO), Bank of Nova Scotia (BNS), Canadian Imperial Bank of Commerce (CIBC), HSBC Bank Canada (HSBC), National Bank of Canada (NBC), Royal Bank of Canada (RBC), and the Toronto-Dominion Bank (TD) are from OSFI on 31 January 2014.

Source: Bank of Canada

and minimum standards for internal controls, as well as the methodology for determining CDOR submissions.¹⁸ The CDOR panel member banks have also begun the process of establishing an IOSCO-compliant administrator.¹⁹ An administrator is expected to be formally appointed by the end of 2014. OSFI has also recently released a draft guideline on governance and internal controls surrounding the CDOR rate submission process.²⁰ While not yet completely implemented, these actions represent significant steps toward making the CDOR benchmark IOSCO-compliant and addressing the weaknesses described in the IIROC review.

Conclusion

Public sector authorities around the world are developing and implementing their responses to the allegations of manipulation that have emerged for many financial benchmarks. These efforts seek to ensure that benchmarks are robust without compromising their intended economic role, while also taking into account the complex issues that can arise in transitioning to alternative benchmarks. Canada is no exception: our public sector authorities are working closely with the industry to ensure that our financial benchmarks are robust and meet international standards.

¹⁸ The code of conduct is available at <http://docs.iiroc.ca/DisplayDocument.aspx?DocumentID=D2D9A8334FA6414AA79CD1FC3C252966&Language=en>.

¹⁹ The Canadian Bankers Association has released a tender notice for selecting an administrator for CDOR and CORRA, available at <http://www.cba.ca/en/component/content/category/93-cdor-corra-administrator-tender-notice>.

²⁰ OSFI's draft guideline is available at http://www.osfi-bsif.gc.ca/Eng/fi-if/rg-ro/gdn-ort/gi-lid/Pages/e20_let.aspx.

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Making Banks Safer: Implementing Basel III

Éric Chouinard and Graydon Paulin

- Although the internationally agreed phase-in of the Basel III framework for bank regulation is still in the early stages, the quantity and quality of bank capital have already increased substantially.
- Enhanced implementation monitoring is critical to building credibility in the updated Basel framework and, ultimately, to ensuring its effectiveness.
- It is imperative to reduce the variability in estimates of risk-weighted assets across banks internationally through a combination of improved modelling guidance by the Basel Committee and, to foster market discipline and avoid misperceptions, enhanced transparency by banks.
- Implementation monitoring must be complemented by assessments of the contributions of Basel III to financial system stability, including careful consideration of any unforeseen adverse effects.

Introduction

Evidence from the recent financial crisis, most notably from the experience of countries such as Canada that did not experience bank failures, clearly indicates that a resilient banking sector is a necessary condition for achieving sustained economic growth. It is therefore essential that Basel III, the strengthened framework of international standards for bank capital adequacy and liquidity developed by the Basel Committee on Banking Supervision (BCBS) and endorsed by the G-20 Leaders, is implemented fully and in a timely manner.

While it is widely agreed that more stringent capital and liquidity standards will make the financial system safer, concerns have been raised about the pace and consistency of Basel III implementation. These concerns pertain to both the resulting regulatory burden on banks and the scope for regulatory arbitrage. This report explores issues associated with the implementation of Basel III in Canada and in other major

jurisdictions. It begins with an overview of Basel III and then summarizes the evidence showing that, as currently calibrated, the benefits of the updated framework substantially outweigh its costs. It goes on to review the steps taken to implement Basel III and examine how the banking system is already safer, even though implementation is far from complete. The report concludes with an overview of the peer-review program introduced to support the consistent implementation of the Basel III standards in all jurisdictions. Although the jurisdictions assessed to date have been judged to have domestic rules that are broadly compliant with the Basel III standards, analysis conducted by the Basel Committee suggests that banks are not calculating risk-weighted assets consistently.

Basel III: An Overview

Basel III is a fundamental component of the G-20's financial reform agenda (Table 1). It raises the bar relative to the prudential framework that was in effect before the global financial crisis in several important ways. In particular, by placing common equity at the core of the capital requirements and imposing standards to ensure that the other types of capital instruments allowed are truly loss absorbing, Basel III greatly enhances the quality of capital. It also introduces many innovative safeguards that were not previously part of supervisors' tool kits. These include:

- a capital conservation buffer that promotes corrective actions through restrictions on dividend and bonus payments when a bank's common equity Tier 1 capital ratio deteriorates;
- a countercyclical buffer that, at the discretion of the relevant authorities, requires banks to hold more capital in good times to prepare for downturns in the economy, thereby adding a macroprudential element to the framework;

Table 1: Overview of key G-20 financial reforms

Objective	Basel III	Other reforms
Building more resilient financial institutions	<ul style="list-style-type: none"> Minimum capital requirements Liquidity standards Leverage ratio 	<ul style="list-style-type: none"> Minimum capital requirements (insurance)
Ending “too big to fail”	<ul style="list-style-type: none"> Identification of systemically important banks (global and domestic) Capital surcharges 	<ul style="list-style-type: none"> Identification of systemically important financial institutions other than banks (global only) Key Attributes for Effective Resolution Regimes Higher loss absorbency More intense and more effective supervision
Addressing systemic risks from shadow banking		<ul style="list-style-type: none"> Bank interactions with shadow banking entities Securities lending and repos Money market funds Securitization
Making over-the-counter derivatives markets safer		<ul style="list-style-type: none"> Enhanced margin and capital requirements for non-centrally-cleared trades Trade repositories Exchange trading of standardized contracts

Source: Bank of Canada

- capital surcharges of 1 per cent to 3.5 per cent of risk-weighted assets for global systemically important banks, which vary according to the banks’ degree of importance and are intended to take into account the externalities that their failure would impose on the economy;
- a set of principles for the identification of domestic systemically important banks by national authorities that include requirements for enhanced loss absorbency;
- a minimum leverage ratio that complements capital requirements by protecting against risks that may not be adequately reflected in risk weightings;¹ and
- the first international standards for bank liquidity and funding, designed to promote the resilience of a bank’s liquidity-risk profile to both short-term liquidity shocks (the Liquidity Coverage Ratio) and excessive maturity mismatches in funding (the Net Stable Funding Ratio).

The agreed transition period for Basel III (which extends to the end of 2018) allows banks in the jurisdictions most affected by the crisis ample time to rebuild capital buffers. Moreover, the Basel rules are international minimums rather than a “one-size-fits-all” approach. Jurisdictions can adopt more stringent standards or bring their own regulations into line with the new standards more quickly. For example, since the failure of a major bank would have disproportionately greater consequences for jurisdictions with very large banking

sectors relative to their domestic economies, more stringent requirements may be prudent. What ultimately matters is that all of the jurisdictions raise the bar for capital and liquidity sufficiently. The Basel Committee’s Regulatory Consistency Assessment Programme is designed to promote full adherence through peer reviews.

Anticipated Net Benefits

Basel III represents an important adjustment for the global banking industry, with implications for borrowers and national economies more broadly. While higher capital and liquidity standards are designed to contribute significantly to financial stability, there will be costs involved, since equity is a more expensive form of financing than debt, and liquid assets typically yield lower returns. Nonetheless, when considering the costs associated with implementing Basel III, it is essential to keep in mind the enormous negative impact of financial crises: empirical evidence suggests that the median cumulative loss of past financial crises was 63 per cent of national GDP (BCBS 2010).

Quantitative estimates of the expected benefits of Basel III from a rigorous impact assessment conducted by the BCBS and the Financial Stability Board (FSB) are very high, even under conservative assumptions that likely underestimated such benefits (FSB-BCBS 2010). The most salient benefits identified are that financial crises would occur less frequently and would be less severe if they did occur. It is also probable that the macroeconomic cycle will be less prone to booms and busts.

Analysis conducted at the Bank of Canada (2010) supports the finding that the potential gains are large, even for countries that already have a sound financial system.

¹ In January 2014, the Basel Committee agreed to continue monitoring the implementation of the 3 per cent leverage ratio on a semi-annual basis. The final calibration, and any further adjustments to the definition, will be completed by 2017, with a view to migrating to a Pillar I (minimum capital requirement) treatment on 1 January 2018.

In a highly interconnected world where financial problems in one region rapidly spill over into others, reducing the incidence of foreign crises is just as important as pursuing domestic goals.

There are potential economic costs as well, both during the initial transition period and in the longer term, when the new standards are fully in place. For example, banks may seek to pass on the costs associated with higher capital and liquidity requirements through lower deposit rates or higher lending rates or service fees.² Concerns have also been raised about the possible impact of Basel III on financial market functioning.

Despite these possible costs, the studies all found a significant net benefit from safer and more resilient banking systems. Netting the long-run benefits for G-20 economies of less frequent financial crises with the associated costs results in average net benefits of 30 per cent of GDP (or about €10 trillion) in present-value terms (FSB-BCBS 2010). For Canada, the net gain from a modest increase in the capital ratio was conservatively estimated at 13 per cent of GDP in the 2010 study. A strengthened domestic financial system means that Canada will be more resilient in the face of adverse contagion effects from abroad.

Further monitoring will be needed as the adjustment to Basel III becomes more advanced to ensure that the framework's net benefits are indeed positive and to look for adverse unintended consequences that would need to be addressed.

Implementing Basel III

All of the G-20 economies have prepared the necessary rules (in legislation or through other appropriate means, such as guidelines) to implement the updated Basel framework by the agreed deadline, if not sooner (BCBS 2014b). For example, both the European Union and the United States issued final Basel capital regulations in June and July 2013, respectively. Recall that, although implementation began last year, the BCBS agreed to phase in the new requirements over a six-year period ending in December 2018. In addition, while the new risk-based capital requirements have been completed, other components of Basel III, such as the Net Stable Funding Ratio (NSFR) liquidity metric, are not yet finalized.

In some instances, the country requirements and timelines exceed the international minimums, reflecting the strength of the domestic banking system and the importance of maintaining financial stability. In Canada, the Office of the Superintendent of Financial Institutions (OSFI) has moved forward with the implementation of

the finalized components of Basel III, bringing domestic rules into line with the new international standards.³ The capital requirements were fully implemented at the beginning of 2013, without recourse to the available transition period. An exception is the capital charge on the credit valuation adjustment (CVA) for derivatives where, given the global nature of the market, implementation began in January 2014 and is being phased in over five years.⁴

No Canadian bank has been identified as globally systemically important (G-SIB) by the Basel Committee and the FSB.⁵ However, in line with principles established by the BCBS, OSFI has designated Canada's six largest banks as domestic SIBs (D-SIBs).⁶ As a result, these banks are subject to closer supervision and are expected to adopt enhanced disclosure standards. As well, they will face an additional 1 per cent risk-weighted common equity Tier 1 capital requirement at the beginning of 2016. Enhanced disclosure requires D-SIBs to generally adhere to global best practices, including adopting the recommendations of the Enhanced Disclosure Task Force.⁷

In May 2014, OSFI published the final version of its Liquidity Adequacy Requirements (LAR) Guideline. The Liquidity Coverage Ratio (LCR) will be fully implemented in 2015, with the requirement set at 100 per cent (and thus not using the transition period).⁸ The NSFR, which is still under development, will be implemented in line with the Basel schedule (likely in 2018).⁹ Finally, intraday liquidity metrics, which provide a useful additional monitoring mechanism (though not a requirement or standard), will be implemented according to a similar schedule.

³ Canadian banks were expected to fully meet the common equity capital requirements at the beginning of the 2013–18 internationally agreed phase-in period. The updated Capital Adequacy Requirements (CAR) Guideline can be found on the OSFI website at http://www.osfi-bsif.gc.ca/Eng/fi-if/rg-ro/gdn-ort/gi-lid/Pages/car_index.aspx.

⁴ The CVA is an adjustment made to the value of a derivative to reflect the credit risk of the counterparty. The capital charge on the CVA is designed to protect against deterioration in the counterparty's creditworthiness. OSFI's announcement of this capital charge can be found at http://www.osfi-bsif.gc.ca/eng/docs/cva_let.pdf.

⁵ The FSB publishes an updated list of G-SIBs annually. The most recent list was issued in November 2013 (see http://www.financialstabilityboard.org/publications/r_131111.pdf).

⁶ These are Bank of Montreal, The Bank of Nova Scotia, Canadian Imperial Bank of Commerce, National Bank, Royal Bank of Canada and The Toronto-Dominion Bank. In June 2013, Quebec's Autorité des marchés financiers designated the Desjardins Group as a D-SIB, and in February 2014, the B.C. Financial Institutions Commission similarly designated the Central 1 Credit Union as a systemically important financial institution.

⁷ The most recent report by the private sector task force is available at http://www.financialstabilityboard.org/publications/r_130821a.htm.

⁸ The Basel III transition phase for the LCR sets a requirement of 60 per cent in 2015, rising to 100 per cent on 1 January 2019. Information on the LAR is available at http://www.osfi-bsif.gc.ca/Eng/fi-if/rg-ro/gdn-ort/gi-lid/Pages/LAR_gias.aspx.

⁹ An existing liquidity metric used by OSFI, the Net Cumulative Cash Flow (NCCF), will be maintained. The NCCF focuses on a different time horizon and is designed to identify gaps between contractual inflows and outflows for various time periods, up to 12 months.

² These effects would likely be mitigated, however, by the reduction in banks' financing costs, which would tend to occur as the banking system becomes less risky.

OSFI has also indicated that its existing leverage requirement, the assets to capital multiple, which has been in place since the 1980s, will be replaced by the Basel III leverage ratio. A new leverage guideline will be published later this year, with public disclosure beginning in early 2015. OSFI has noted that it will continue to apply more stringent leverage requirements on an institution-by-institution basis, as necessary.¹⁰

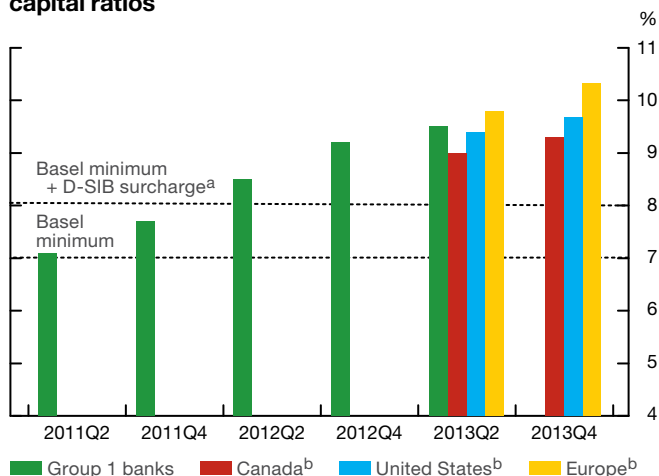
While these components represent the core of Basel III, other aspects of the international bank capital requirements remain under study for possible improvement (for example, strengthened requirements for bank exposures related to securitizations, as well as exposures in the trading book, are currently being discussed). These elements will be implemented, as appropriate, once international agreement has been reached and the details finalized.

Early Evidence of More Resilient Financial Institutions

It is clear from the Basel Committee's monitoring that global banks are adjusting to higher standards. Using a broad sample of large, internationally active banks (approximately 100 "Group 1" banks), the average common equity Tier 1 Basel III capital ratio has risen steadily over the past several years (Chart 1).¹¹ By mid-2013, it had reached 9.5 per cent, well above the required minimum. Only five banks in this group (none of them Canadian) had not yet met the global standard of 7 per cent capital (plus the G-SIB capital buffer, where appropriate). With respect to liquidity, the weighted average LCR was 114 per cent of the required level. Again, there is considerable variation across individual banks, but the BCBS (2014a) notes that 72 per cent of the banks in its sample met or exceeded the LCR minimum requirement of 100 per cent. Finally, the leverage ratio (defined as Tier 1 capital divided by total assets, using Basel III definitions) was 4.3 per cent on an aggregate basis, well above the tentative required minimum of 3 per cent.¹²

In early 2013, all of the Canadian D-SIBs exceeded the minimum common equity capital requirement (including the 1 per cent D-SIB surcharge), and capital levels have continued to rise since then. By the end of 2013, capital stood at a weighted average of 9.3 per cent, with a range of 8.7 per cent to 9.9 per cent across banks.

Chart 1: Basel III fully phased-in common equity Tier 1 capital ratios



a. D-SIB surcharge for Canadian banks
b. Data for selected large banks (available as of 2013)

Sources: Bank for International Settlements, regulatory filings of Canadian banks and Bloomberg Last observation: 2013Q4

Similar data are not yet publicly available for the Basel III liquidity metrics and the leverage ratios of the major banks. Nevertheless, domestic banks are well aware of the forthcoming requirements and are taking steps to ensure that their business and funding operations are consistent with them.

Banks have a range of options available for increasing their capital ratios, including earnings retention, capital issuance and asset reduction through deleveraging. It is important to recall that some deleveraging may be essential so that banks can correct past business errors and rationalize business lines to re-establish sustainable business models. Nevertheless, an overreliance on deleveraging could have adverse effects on lending and on economic activity. Analysis by the BIS (Cohen and Scatigna 2014) suggests that much of the recorded improvement in the advanced economies in fact came from internally generated capital (supported in some instances by reduced dividend payouts). Bank assets have expanded in aggregate over the post-crisis period, although to a lesser degree in Europe, given the severe economic and financial stress experienced there beginning in 2011. Other evidence (Bridges et al. 2014) suggests that while credit growth may be somewhat reduced during a period of significant capital increases, this effect is temporary and loan growth subsequently recovers.

In Canada, total credit continued to expand in the post-crisis period, even as banks built up their capital levels (Chart 2). This is in contrast to the levelling off in credit experienced in the United States and much of Europe, which coped with significant disruptions in their banking sectors. It remains difficult to ascertain to what extent

¹⁰ The Canadian approach to the new leverage and liquidity requirements is discussed further in Zelmer (2014).

¹¹ These data are from BCBS (2014a) and assume full implementation without using transition arrangements. Note that the BCBS reports data only on an aggregate basis, based on confidential submissions from individual banks. The most recent data are for 2013Q2.

¹² Although banks will be required to publish their leverage ratios beginning in 2015, they will not have to meet a required minimum until 2018. The final calibration of the leverage ratio will be determined before full implementation.

Chart 2: Evolution of credit to the private non-financial sector

Total credit level (normalized at 2000Q1=1)

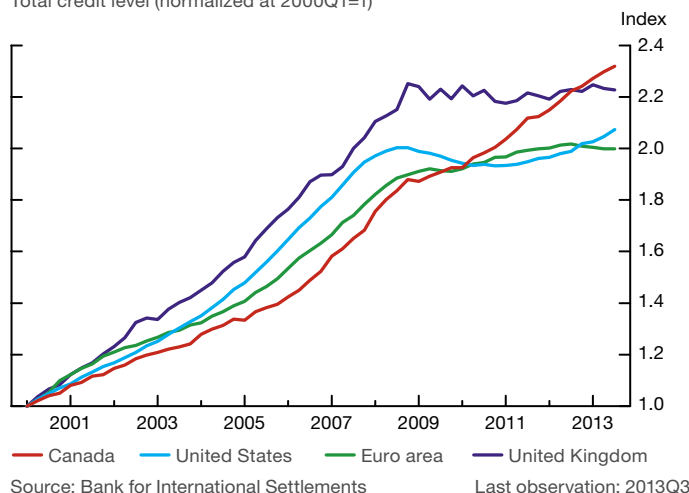
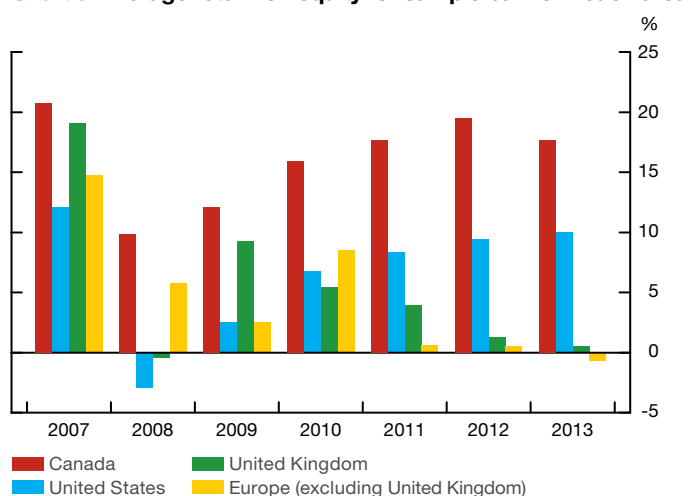


Chart 3: Average return on equity for sample banks in each area



the weak growth in lending reflects the broader macro-economic challenges these countries have faced, which has subsequently constrained loan demand.

The Canadian banking system has performed comparatively well since the financial crisis, with sustained strong profit levels (Chart 3).¹³ Benefiting from their resilience to the crisis, Canadian banks have been able to fund themselves at attractive rates, both domestically and in foreign markets such as the United States. This has facilitated the process of improving their capital ratios based on the tougher standards. They are also adjusting to the prospective implementation of the new liquidity requirements by changing funding plans and re-examining the liquidity needs of their various business lines.

¹³ See Arjani and Paulin (2013) for a discussion of the factors that contributed to the strong performance of the Canadian banking system during and after the financial crisis.

Fostering a Race to the Top: Rigorous, Independent Monitoring

The Basel Committee's Regulatory Consistency Assessment Programme identifies shortcomings in national rule making to implement Basel III. The publication of these findings and the FSB's regular updates to the G-20 provide incentives for national authorities to address any identified gaps.

To date, the BCBS has conducted detailed assessments of the final requirements adopted by six jurisdictions: Australia, Brazil, China, Japan, Singapore and Switzerland. All have been judged as overall "compliant" with the Basel minimum standards. These jurisdictions have been willing to swiftly rectify many of the deviations identified during the assessment process. BCBS assessments of the requirements for Canada, the United States and the European Union will be completed over the course of 2014.

Beyond looking at how local regulators have translated Basel agreements into domestic regulations, the Basel Committee has also begun to examine whether the framework is producing consistent outcomes. Ultimately, the capital ratios reported by individual banks should provide a meaningful representation of their capital strength. Recent international evidence shows that banks are not calculating risk-weighted assets consistently (BCBS 2013a; 2013c). The key findings from the Committee's examination for both the banking and the trading books are:

- There is a material variation in risk weights for trading assets across banks (after adjusting for accounting differences and differences in the riskiness of bank portfolios).
- Certain modelling choices seem to be the main drivers of the variation in risk weights.
- The quality of existing public disclosure is generally insufficient to allow users to determine how much of the variation in reported risk weights is a reflection of underlying risk taking, and how much stems from other factors (e.g., modelling choices or supervisory discretion).

Note that the objective is not to achieve zero variation: modelling necessarily introduces variability. From a financial stability perspective, it is also desirable to maintain some diversity in risk-management practices to avoid the herd behaviour and market disruptions that may result if banks acted homogeneously. However, excessive variation in risk measurement that undermines confidence in the framework or raises the prospect of manipulation is clearly not desirable.

To date, consistency assessments suggest that the right balance has yet to be attained. The Basel Committee has not decided what actions it might take in response to the analysis, but some possible policy options could include improvements in public disclosure practices and more limitations on the modelling choices for banks. The Committee's study also provides national supervisors with a clearer understanding of how their banks' risk models compare with those of their international peers. National supervisors are therefore much better equipped to discuss the results with their banks and take action where needed.¹⁴

The Committee's work on risk weightings also relates to a broader concern that the Basel III framework has grown too complex in its pursuit of risk sensitivity. Some stakeholders have argued that more weight should be placed on the leverage ratio, whose calculation is not burdened by the need to estimate risk weights. However, it is dangerous to assume that banks engaging in complicated trading strategies and products across global markets can be supervised using simple rules, since the financial system itself is complex and the risk-management practices of banks are increasingly sophisticated. While the Basel Committee believes that a risk-based capital regime should remain at the core of the regulatory framework for banks, it recognizes that

the pursuit of increased risk sensitivity has considerably increased the complexity of the capital-adequacy framework and views the simplification of the Basel capital standards, where possible, as an important part of its agenda (BCBS 2013b).

Conclusion

Early evidence that the Canadian and international banking systems have already made good progress in implementing Basel III—particularly by augmenting the quantity and quality of capital—is excellent news. As this process continues, it is imperative to continuously assess the impact of the reforms on financial stability and their macroeconomic implications more broadly. Additional analysis and rigorous monitoring are essential, in part to identify any unexpected adverse consequences should they occur.

It is also critical that the minimum standards be rigorously respected across all jurisdictions to achieve the full benefits of the reforms and to maintain a level playing field. This is why the Basel Committee's enhanced efforts with respect to monitoring are so important. It is essential that, in future impact analyses and consistency assessments, authorities continue to improve prudential standards for the banking sector by supporting greater consistency in risk weights and by addressing the implementation gaps that have been identified.

¹⁴ The perspective of OSFI on the variation in risk weights, including their implications and potential mitigants, can be found in Zelmer (2013).

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Stress Testing the Canadian Banking System: A System-Wide Approach

Kartik Anand, Guillaume Bédard-Pagé and Virginie Traclet

- Stress testing is an important tool for evaluating risks to the financial system. The models used to conduct these tests are evolving to include more realistic features.
- The 2007–09 financial crisis demonstrated that, in addition to solvency risk, liquidity risk and spillover effects can generate losses for banks during times of stress. The Bank of Canada has developed an innovative stress-testing model—the MacroFinancial Risk Assessment Framework (MFRAF)—which captures the various sources of risk (solvency, liquidity and spillover effects) that banks face.
- We apply MFRAF to the stress-testing scenario used in the 2013 Canada Financial Sector Assessment Program led by the International Monetary Fund. We show that the aggregate capital position of Canadian banks is 20 per cent lower when liquidity and spillover risks are added to solvency risk. Nevertheless, the results still confirm the overall strength of the Canadian banking system.

Introduction

Over the past few years, financial sector authorities and financial institutions around the world have increased their use of stress testing to examine risks to the financial system. Stress testing assesses the impact of various potential risks to financial institutions and illustrates the channels through which these risks would be transmitted. While most stress-testing models focus on solvency risk (the risk of losses stemming from the failure of borrowers to repay loans or meet contractual obligations), the 2007–09 financial crisis showed that, in times of stress, liquidity risk and network spillover effects associated with interconnections among banks can also be significant. The Bank of Canada has developed an innovative stress-testing model, the MacroFinancial Risk Assessment Framework (MFRAF), which realistically captures the various sources of risk for banks—solvency risk, liquidity risk and spillover effects.

In 2013, Canada participated in a Financial Sector Assessment Program (FSAP), a comprehensive, in-depth analysis of the country's financial sector conducted by the International Monetary Fund (IMF) that included a stress-testing exercise to gauge the resilience of financial institutions to severe macrofinancial stress.¹ The FSAP stress scenario embodied the realization of two key risks to the Canadian financial system that had been identified in previous issues of the *Financial System Review*: (i) weaknesses in euro-area banks and sovereigns, and (ii) imbalances in Canadian household finances and the housing market. Several stress-testing approaches and models, including MFRAF, were used to estimate the impact of these risks on the Canadian banking system should they be realized. Overall, the results confirm the strength of the Canadian banking system as a whole, and the IMF views the resulting capital shortfall as manageable.

The results obtained with MFRAF show that, when liquidity risk and spillover effects are considered in addition to solvency risk, the aggregate capital position of banks declines by an additional 20 per cent.² This finding highlights the importance of a comprehensive approach to stress testing. As well, it creates an incentive for the Bank of Canada to further enhance MFRAF to improve its understanding of the potential effects of a severe stress scenario on the Canadian banking system.

The following three sections: (i) define stress testing and how it is used to assess risks; (ii) describe MFRAF; and (iii) present the results obtained with MFRAF in the context of the 2013 FSAP. The final section concludes with remarks on the direction of future research.

¹ For the conclusions of the 2013 Canada FSAP, see IMF (2014).

² The IMF views MFRAF as being “at the frontiers of systemic risk stress testing.” See IMF (2014), page 54.

Table 1: Stress testing: Comparing models and approaches

	Bottom-up stress test	Top-down stress test	
Key features	Run by individual banks	Run by authorities	
Testing for	Solvency risk	Solvency risk	MFRAF: solvency risk, liquidity risk and spillover effects
Strengths	<ul style="list-style-type: none"> Bank models capture a large amount of detailed data on their portfolios and exposures, which provide information on the specific drivers of their stress-testing results. Banks have different business models and exposures to risks: their stress-testing models capture these idiosyncrasies. 	<ul style="list-style-type: none"> Authorities use a common model to generate results for different banks, enabling comparison of the results across banks to better understand their respective vulnerabilities to specific shocks. Tests are usually applied on a bank-by-bank basis, but results can be aggregated to determine the “typical” impact of specific stress scenarios on the banking sector. 	<ul style="list-style-type: none"> Sources of risks affecting banks are taken into account in a consistent manner. Tests are applied on a bank-by-bank basis, but interactions between banks are captured. The framework can be used as a pure top-down model or as a “hybrid,” with inputs from a bottom-up stress test.
Limitations	<ul style="list-style-type: none"> Interactions with other banks during periods of stress and related network effects are not accounted for. Liquidity risk is not explicitly captured (beyond the effects of rising funding costs in times of stress). 	<ul style="list-style-type: none"> Tests provide fewer details regarding the drivers of results than in a bottom-up stress test. Tests use simple models based on observed historical relationships between key macrofinancial variables and banks’ indicators, making it more difficult to capture the idiosyncrasies of individual banks. Liquidity risk is not explicitly captured (beyond the effects of rising funding costs in times of stress). Interactions between banks are not explicitly taken into account; hence, there are no spillover effects. 	<ul style="list-style-type: none"> Tests provide fewer details on drivers of results than bottom-up stress tests. This approach requires large amounts of detailed balance-sheet data.

Source: Bank of Canada

Stress Testing: Definition, Uses and Components

Stress testing is a tool used by banks for purposes of internal risk management and by authorities to quantify the impacts that large but plausible negative shocks could have on the capital positions of banks (BCBS 2009). Stress tests do not take into account corrective management actions such as raising additional capital and implementing cost-cutting measures, which banks would typically take if such conditions were to materialize.³ In this sense, stress tests evaluate extreme outcomes.

There are two main approaches to conducting stress tests. In *bottom-up* stress tests, individual banks use their internal models. In *top-down* stress tests, regulatory authorities apply their own models. The chief advantage of a bottom-up stress test is that, since banks’ internal models capture each institution’s idiosyncrasies, it is possible to better understand the specific

drivers of the results for individual banks. In contrast, the main advantage of a top-down stress test is that, by using a common model for different banks, authorities can compare the results across banks to obtain insights regarding their respective vulnerabilities to the same shocks. However, weaknesses are also evident in both approaches. It can be more difficult, for example, to take into account the interactions between banks in a bottom-up stress test, while top-down tests tend to capture the characteristics of banks in less detail.

Table 1 summarizes the key strengths and limitations of the various stress-testing approaches.

Stress testing is being used more frequently by authorities around the world, but in different ways. In some jurisdictions, the focus is on the stress-testing results for individual banks. For example:

- In the United States, the Federal Reserve evaluates plans by large banks to make capital distributions and approves these plans only for institutions that demonstrate sufficient financial strength under a severe stress scenario.⁴

³ Management responses to financial stresses are part of the recovery plans that systemically important financial institutions are expected to design as part of the G-20 regulatory reform agenda. In Canada, the Big Six banks have been designated as domestic systemically important banks (D-SIBs) by the Office of the Superintendent of Financial Institutions and, consequently, are required to develop recovery and resolution plans. D-SIBs are required to hold a 1 per cent common equity surcharge starting in 2016 (i.e., they will be required to meet an 8 per cent CET1 ratio). See OSFI (2013a).

⁴ For example, in 2014, the Federal Reserve objected to the plans of five of the 30 participating banks. For details, see <http://www.federalreserve.gov/newsevents/press/bcreg/20140326a.htm>.

- In Europe, authorities have used stress tests to evaluate the resilience of individual European banks and to assess their recapitalization needs under stressed conditions. Before assuming its supervisory role in November 2014, the European Central Bank (ECB) will conduct and publish a stress test as part of its comprehensive assessment in order to rebuild investor confidence in the European banking sector.

In other jurisdictions, e.g., Sweden and Norway, authorities use stress tests to better understand how the banking sector would be affected by adverse macroeconomic developments (Sveriges Riksbank 2012; Norges Bank 2013). In Canada, stress testing is part of the tool kit used to assess risks for individual banks and for the banking sector as a whole. The Office of the Superintendent of Financial Institutions (OSFI) promotes internal stress testing as an important tool for banks to use in making decisions related to business strategy, risk management and capital management.⁵ In this context, OSFI reviews institutions' stress-testing programs as part of its supervisory review process and its review of the internal capital-adequacy assessment process for deposit-taking institutions. Moreover, OSFI and the Bank of Canada conduct an annual joint exercise to stress test the major Canadian banks to identify system-wide vulnerabilities that could materialize under adverse macrofinancial conditions, and use the results to inform assessments of risk for the financial system as a whole.⁶ This joint exercise is a bottom-up stress test: although the stress scenario and detailed instructions for applying the stress test are designed by the authorities, the banks use their internal models to calculate the impact of the stress scenario on their capital positions. The authorities analyze and compare the results provided by individual banks to determine the effects of the stress scenario on the entire banking sector, with a particular focus on understanding key drivers and the channels for the transmission of shocks.

Most stress-testing models, whether top-down or bottom-up, focus primarily on solvency risk.⁷ However, as the financial crisis demonstrated, banks can be significantly affected by two other sources of risk during periods of stress: liquidity risk and spillover effects. *Liquidity risk* results from the combination of funding-liquidity risk (the risk that individual banks are unable to roll over existing funding or to obtain new funding) and

market liquidity conditions (the conditions under which banks can sell and repurchase, or sell outright, assets in financial markets to meet their funding needs). During the financial crisis, interactions between funding liquidity and market liquidity created liquidity spirals, which particularly impacted institutions that relied heavily on wholesale funding and held highly illiquid assets (e.g., Northern Rock and Bear Stearns), ultimately affecting global financial stability.⁸ *Network spillover effects* occur when a bank is unable to fulfill its obligations to other banks, creating counterparty credit losses for those banks (e.g., the banks exposed to Lehman Brothers when it defaulted in September 2008).

In addition to accounting for solvency risk, MFRAF also incorporates liquidity risk and network spillover effects.⁹

MFRAF: Model Description

MFRAF consists of three distinct, but interdependent, modules that account for the three different risks that banks face.¹⁰ Figure 1 shows how these risks could materialize over a one-year horizon following a risk event—for example, a severe macroeconomic shock—and how they contribute to an aggregate decline in the capital positions of banks. This decline is measured by determining the banks' common equity Tier 1 (CET1) capital ratio, as follows.¹¹ First, banks' balance sheets are affected by credit losses due to corporate and household defaults six months into the first year (the interim date) and again at the end of the first year. Second, if investors have concerns about a bank's future solvency and/or its liquidity position, liquidity risk materializes at the interim date, potentially generating additional losses. Finally, at the end of the period, some banks may be unable to repay their interbank counterparties, given the solvency and/or liquidity losses that they have incurred, which leads to network spillover effects. MFRAF considers each bank individually but takes into account the interactions between banks through both liquidity and interbank exposures.

Overall, the three risks contribute to a decline in the capital positions of banks. By decomposing the decline in CET1 ratios into their solvency, liquidity and network

⁵ For details, see OSFI (2009).

⁶ This regular stress-testing exercise was implemented following a recommendation by the IMF during Canada's 2007 FSAP.

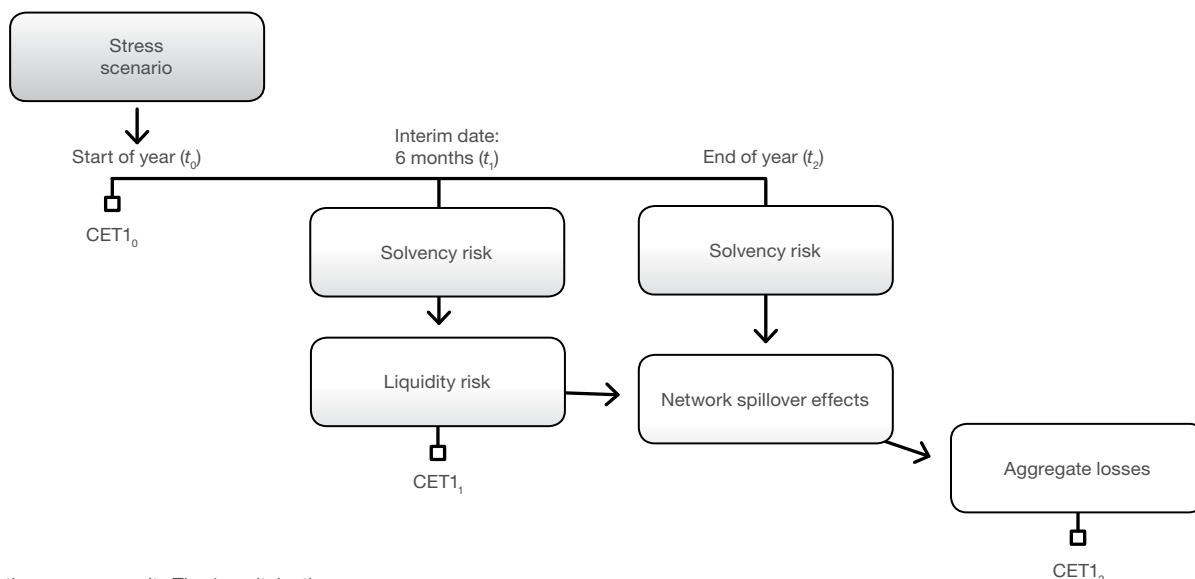
⁷ Nevertheless, a range of market risks (including funding liquidity) that are consistent with the stress scenario tend to be indirectly captured by these models. For example, when the stress scenario incorporates conditions of scarce funding liquidity and declining asset prices, the former would lead to rising funding costs and interest expenses for banks and the latter to mark-to-market losses on securities available for sale. These effects would ultimately influence banks' capital positions.

⁸ See, among others, Brunnermeier (2009) and Brunnermeier and Pedersen (2009). The Basel III liquidity framework was introduced to address the failures in liquidity-risk management that were exposed by the financial crisis. See Gomes and Wilkins (2013).

⁹ A number of other central banks (e.g., the Bank of England, the ECB and the Bank of Korea) are also developing stress-testing models that capture risks beyond solvency, although their methodologies differ.

¹⁰ See Appendix A for a more detailed description of the model and its calibration.

¹¹ The CET1 ratio is equal to common equity (the highest-quality capital) divided by total risk-weighted assets.

Figure 1: MFRAF: A modular approach to systemic risk

Note: CET1 is the common equity Tier 1 capital ratio.

Source: Bank of Canada

components, MFRAF contributes to a better understanding of the various determinants of risk for banks and the channels through which shocks would propagate.

Solvency-risk module

In MFRAF's solvency-risk module, banks' balance sheets are affected by credit losses that result from the failure of non-bank borrowers to repay their loans or to meet their contractual obligations under stress. For each bank, we derive a distribution of expected annual credit losses that takes into account the historical correlations of defaults across sectors, together with the loss-given-default rates and exposures at default to the different sectors to which banks lend.¹²

Liquidity-risk module

In MFRAF, banks can be affected by liquidity risk, either directly, through the funding decisions of their creditors, or indirectly, through information contagion. Both of these dynamics were observed during the financial crisis. Liquidity risk can materialize *endogenously* as a result of solvency risk and the liquidity characteristics of banks (reliance on unstable funding and/or low holdings of liquid assets). Following the realization of credit losses at the interim (six-month) date (Figure 1), the creditors of each bank must decide whether or not to roll over their funding to the bank (i.e., whether to "run"). This decision depends on two elements: (i) creditors' concerns over

the future solvency of the bank (which depends on the severity of the losses incurred by the end of the year and the bank's starting capital position) and (ii) the bank's liquidity characteristics.

Creditors assess a bank's solvency relative to a certain threshold (typically a supervisory threshold).¹³ In such assessments, they compare the value of the bank's liquid and illiquid assets with its liabilities that are susceptible to a run at the interim date. If the value of the liquid and illiquid assets is greater than the stock of liabilities susceptible to a run, the creditor judges that the bank has more than enough liquidity to meet the demands of all its creditors, and funding will be rolled over. If the reverse is true, there is a positive probability of a run; this probability is determined as the outcome of a coordination game.¹⁴ When liquidity risk materializes, banks experience additional losses.¹⁵

¹³ For the FSAP, we assumed that creditors have concerns about solvency when a bank's future CET1 ratio falls below OSFI's supervisory threshold of 7 per cent. It is important to note that falling under 7 per cent is not equivalent to failure: the threshold for the Basel III regulatory CET1 ratio is 4.5 per cent.

¹⁴ A coordination game is a situation in which agents realize gains when they all take the same action but make their decisions independently and are uncertain about the actions of other agents. In this coordination game, creditors compare the expected returns from running on the bank versus rolling over their claims. For an individual creditor, the return from rolling over its claims depends on the share of other creditors that also roll over their claims. In contrast, a creditor that decides to run obtains a fixed return (from investing instead in a risk-free asset).

¹⁵ For the FSAP, the liquidity losses were calibrated at 2.25 per cent of risk-weighted assets.

¹² The sectors include households (uninsured residential mortgages, home equity lines of credit and consumer loans), businesses (manufacturing, construction, accommodations, commercial real estate, agriculture, wholesale, financial institutions and small business loans) and governments.

Liquidity risk can also materialize because of information contagion, i.e., the risk that creditors will run on a bank with a sound balance sheet after observing the CET1 ratio of one or more other banks decline below 7 per cent.¹⁶ In this context, a bank's creditors update their beliefs regarding market liquidity conditions. In some instances, creditors may become more pessimistic, which leads them to have a less favourable view of the liquidity characteristics of their own bank and influences their decision on whether to extend funding. If the new-found pessimism is widespread, it may result in contagious runs such as those observed during the financial crisis.

The endogenous materialization of liquidity risk resulting from the interactions between solvency, funding and market-liquidity risk is a feature of MFRAF that sets it apart from other stress-testing models.

Network spillover effects

Following the realization of credit and liquidity losses, some banks may be unable to repay their full obligations to other banks. We consider interbank exposures to be subordinate to other debt, i.e., banks first settle other debt obligations before turning to their interbank counterparties.¹⁷

Application of MFRAF in the 2013 FSAP

FSAP stress scenario

The stress scenario used in the 2013 FSAP includes the materialization of the key risks identified in the *Financial System Review*, which could arise from two areas: (i) weaknesses in euro-area banks and sovereigns, and (ii) imbalances in Canadian household finances and the housing market.¹⁸ The stress scenario covered the five-year period from 2013 to 2017.

The stress scenario begins with a disorderly default in a peripheral euro-area country, which results in a severe and persistent economic recession and a renewed banking crisis in the euro area. This leads to a general retrenchment from risk in the global financial system and significant disruptions in global bank funding markets, causing important adverse confidence and wealth effects and a weakening global economy. The Canadian economy faces financial headwinds, a large negative foreign demand shock, falling commodity prices, rising uncertainty, and unfavourable effects on confidence and wealth that affect both businesses and households, leading to a sharp decline in domestic demand. Business investment and consumer spending decrease significantly. As Canadian households face negative wealth shocks, tighter lending standards, deteriorating employment prospects and heightened uncertainty, they significantly reduce their expenditures on consumption and residential investment. In this environment, house prices decline markedly. Consequently, Canada faces a severe and persistent recession.¹⁹ As shown in Table 2, the recession in the FSAP stress scenario is much more severe than any recession experienced by Canada over the past three decades.

Stress-test results

Overview

Four approaches were used in the FSAP to assess the impact of this stress scenario on Canadian banks: (i) a bottom-up solvency stress test conducted by the Big Six Canadian banks; (ii) a top-down solvency stress test conducted by OSFI; (iii) a top-down solvency stress test conducted by the IMF; and (iv) MFRAF, which was used as a "hybrid" model to complement the banks' bottom-up solvency stress test by capturing the impact of liquidity risk and network spillover effects.^{20, 21} In all four approaches, banks were not allowed to include any

Table 2: Key macroeconomic variables in the Financial Stability Assessment Program stress scenario

Macroeconomic variables	2013 FSAP	2007–09 recession	1990s recession	1980s recession
Real GDP contraction (peak to trough, per cent)	-5.9	-4.2	-3.4	-5.1
Duration of recession (number of consecutive quarters of negative growth)	9	3	4	6
Peak increase in unemployment rate (percentage points)	5.9	2.4	4.1	5.8
House price correction (peak to trough, per cent)	-33.0	-7.6	-10.1	-4.2

Source: Bank of Canada

¹⁶ Information contagion is a recent innovation in MFRAF. Its inclusion enhances the model's ability to capture an important transmission mechanism observed during the crisis. For details, see Anand, Gauthier and Souissi (2014).

¹⁷ To clear the interbank network, MFRAF uses the algorithm of Eisenberg and Noe (2001), in which banks repay their interbank counterparties a sum that is proportional to the amounts originally due, causing counterparty credit losses.

¹⁸ Note that this scenario was generated in early 2013 and was based on the level of risks observed at that time. Since then, those risks have declined.

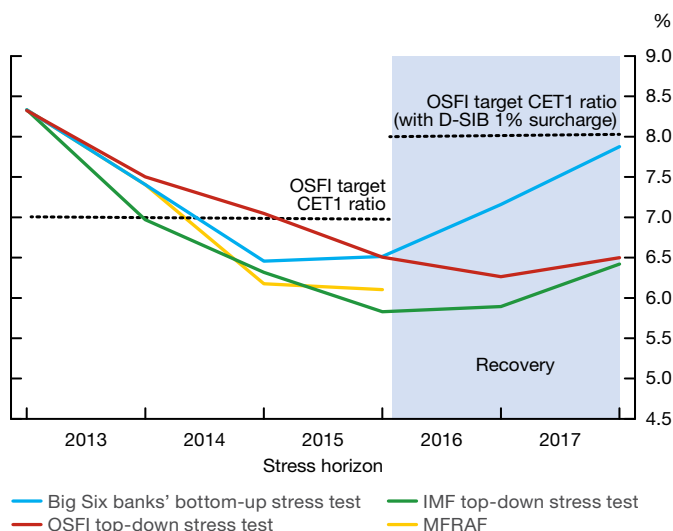
¹⁹ In this scenario, there is no liquidity injection by the central bank or extraordinary monetary policy stimulus.

²⁰ For more information on the features of the various models and detailed results, see IMF (2014).

²¹ In practice, using MFRAF as a hybrid to augment the bottom-up stress test means that various outputs provided by the banks in the bottom-up stress test are used as inputs for MFRAF.

Chart 1: Results of the IMF Financial Sector Assessment Program stress test

Aggregate CET1 ratio for the Big Six banks



Note: CET1 is the common equity Tier 1 capital ratio.

Sources: Bank of Canada, International Monetary Fund, Office of the Superintendent of Financial Institutions and major banks

corrective management actions, except for the Basel III capital conservation buffer, which dictates restrictions on capital distribution, depending on the level of the CET1 ratio.^{22, 23}

Chart 1 shows the dynamics of the aggregate CET1 ratio for the Big Six banks over the stress horizon under each of the four approaches. Although the bottom-up stress test and the OSFI and IMF top-down stress tests capture the impact of solvency risk, there are some differences in the results, which primarily reflect differences in modelling. Overall, under this stress scenario, solvency risk results in a decline of 170 to 250 basis points (from 8.33 per cent) in the aggregate CET1 ratio of banks. Although this is a large decline, it is not surprising, given the extreme severity of the stress scenario and the exclusion of corrective management actions from the exercise. Moreover, despite the severity of the scenario used, in Canada's 2013 FSAP, Canadian banks maintain a solid ability to generate capital, which is consistent with their past experience in times of stress. As outlined in its report, the IMF views the resulting capital shortfall in the FSAP stress scenario as manageable, emphasizing the overall resilience of the Canadian banking system.

The value added by MFRAF

The difference between the results obtained in the bottom-up stress test and those obtained with MFRAF stems from the marginal impact of liquidity risk and network spillover effects. Liquidity risk and network effects lead to an additional 40-basis-point decline in the aggregate CET1 ratio beyond the effect of solvency risk. Liquidity risk explains 65 per cent of this additional decline, and network effects account for the remaining 35 per cent.²⁴

These results illustrate the importance of liquidity risk and network spillover effects in times of stress: they add almost 20 per cent to the estimated impact of this stress scenario on banks. It is therefore important for authorities to account for these effects when assessing the potential impact of stress scenarios on the banking system.

Conclusion

Stress testing is an important component of the tool kit available to authorities, including the Bank of Canada, to assess risks to the financial system. However, it is important to highlight that, despite recent significant progress in the development of stress-testing models, stress testing remains challenging because it attempts to capture the effects of tail events.

In most stress tests, solvency risk explains a large share of the deterioration in the capital ratios of banks during periods of severe stress. As demonstrated by the recent financial crisis, however, liquidity risk and network spillover effects can generate substantial additional losses for banks. Hence, it is important to take them into account when assessing risks. To this end, the Bank of Canada has developed an innovative stress-testing model, the MacroFinancial Risk Assessment Framework (MFRAF), which incorporates various sources of risk for banks—solvency risk, liquidity risk and spillover effects.

Research is ongoing to improve MFRAF in two directions. First, the liquidity module could be enhanced by developing a model to link the evolution of market liquidity conditions with the behaviour of banks under stress (e.g., their decision to sell liquid or illiquid assets to meet their funding needs). Second, MFRAF should incorporate a model of risk-weighted assets to more accurately estimate the effects of solvency risk, liquidity risk and network effects on bank capital levels.

²² See the report by Chouinard and Paulin in this issue on pages 53–59.

²³ MFRAF was run for only the second and third years of the stress horizon because those years were the worst period of the stress scenario in terms of real growth and financial market conditions.

²⁴ Network effects have a limited impact because the big banks have relatively small interbank exposures, owing to the extensive use of collateralization and hedging.

Appendix A

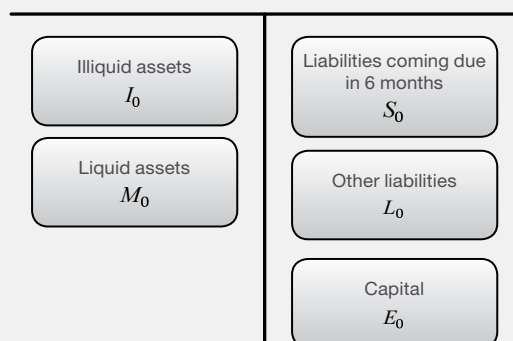
The MacroFinancial Risk Assessment Framework: Model Details and Calibration

In MFRAF, the assets for each bank at the start of the year are categorized into illiquid assets (I_0) and liquid assets (M_0).¹ Their liabilities include the stock of various liabilities that may be subject to a run in six months (S_0), other liabilities (L_0), and their common equity Tier 1 (CET1) capital (E_0) (Figure A-1).

In MFRAF, a bank's liquidity characteristics are summarized by its balance-sheet liquidity (λ), which is the ratio of the value of liquid assets (M_0) and illiquid assets (I_0) at the expected fire-sale discount ($\bar{\psi}$) under stress conditions to the stock of liabilities susceptible to a run (S_0) at the interim date:²

$$\lambda = \frac{M_0 + \bar{\psi} \times I_0}{S_0}.$$

Figure A-1: Typical bank balance sheet at the start of the year



Source: Bank of Canada

1 For technical details on the model, see Gauthier, He and Souissi (2010) and Anand and Bédard-Pagé (2014).

2 The term $\bar{\psi}$ captures the sentiments of creditors concerning the fire-sale discount that the bank will suffer if it liquidates its portfolio of illiquid assets.

Calibration

Running MFRAF requires a large amount of bank balance-sheet data. For the International Monetary Fund's 2013 Financial Stability Assessment Program (FSAP), MFRAF was used as a "hybrid" to complement the banks' bottom-up stress test. Hence, the data came primarily from the bottom-up stress tests and regulatory returns (Table A-1). The data on interbank exposures used in the network module are from a new regulatory return completed by major Canadian banks.

Running MFRAF also requires calibrating some elements of the model, primarily for the liquidity-risk module.³ The parameters for the liquidity-risk module were calibrated to be broadly consistent with recently introduced international liquidity standards.⁴ Liquid assets include cash holdings and government and other securities that can be pledged as collateral to the liquidity facilities of central banks. Illiquid assets refer to loans to the corporate and household sectors, as well as securities that cannot be pledged to central banks but can be sold for cash in secondary markets (subject to large haircuts calibrated to be consistent with stressed market liquidity conditions). The liabilities that may be subject to a run (S_0) are obtained by aggregating the different funding instruments and maturity profiles, taking into account their respective degrees of stability based on their nature and maturity (e.g., retail deposits are more stable than wholesale funding).

3 The liquidity calibration was agreed upon by Canadian authorities and the International Monetary Fund. To assess the sensitivity of the results to the liquidity calibration, a calibration that was twice as severe was also considered in the FSAP. Under this alternative liquidity calibration, the effects of liquidity risk are more pronounced.

4 For a discussion of the international liquidity standards, see Gomes and Wilkins (2013); for details about the standards, see BCBS (2013).

Table A-1: Data: Sources and calibration

	Variables	Source
Solvency-risk module	EAD, PD, LGD (by economic sectors) ^a	Bottom-up stress test, reported by banks
	Historical covariance matrix of defaults	Bank of Canada internal model
	Operating income	Bottom-up stress test, reported by banks
Liquidity-risk module	Liquid assets (M_0)	Regulatory data
	Illiquid assets (I_0)	Regulatory data
	Fire-sale discounts ($\bar{\psi}$)	Bank of Canada calibration, based on market expertise
	Liabilities subject to a run (S_0)	Regulatory data and Bank of Canada calibration based on international liquidity standards for the inclusion of funding instruments ranked by their stability
Network-effects module	Interbank exposures ^b	Regulatory data
CET1 ratio denominator	Risk-weighted assets	Bottom-up stress test, reported by banks

a. EAD = exposures at default; PD = probability of default; LGD = loss given default

b. All types of interbank exposures were included, after taking into account allowable netting agreements, admissible hedging practices and the value of collateral received. For more information, see OSFI (2013b).

Source: Bank of Canada

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Abbreviations

A more comprehensive list of financial and economic terms, as well as information on Canada's payment clearing and settlement systems, is available at www.bankofcanada.ca.

BA: bankers' acceptance	FOMC: Federal Open Market Committee
BBA: British Bankers' Association	FRA: floating rate agreement
BCBS: Basel Committee on Banking Supervision	FRN: floating rate note
BIS: Bank for International Settlements	FSAP: Financial Sector Assessment Program
CAR: Capital Adequacy Requirements	FSB: Financial Stability Board
CDOR: Canadian Dollar Offered Rate	G-20: Group of 20
CET1: common equity Tier 1	GDP: gross domestic product
CMHC: Canada Mortgage and Housing Corporation	G-SIB: global systemically important bank
CRE: commercial real estate	HELOC: home equity line of credit
CVA: credit valuation adjustment	ICE: IntercontinentalExchange Group
D-SIB: domestic systemically important bank	IIROC: Investment Industry Regulatory Organization of Canada
EAD: exposures at default	IMF: International Monetary Fund
EBA: European Banking Authority	IOSCO: International Organization of Securities Commissions
EC: European Commission	LAR: Liquidity Adequacy Requirements
ECB: European Central Bank	LCR: Liquidity Coverage Ratio
EME: emerging-market economy	LGD: loss given default
ESM: European Stability Mechanism	LIBOR: London Interbank Offered Rate
ESMA: European Securities Markets Authority	LTRO: long-term refinancing operation
EURIBOR: Euro Interbank Offered Rate	MFRAF: MacroFinancial Risk Assessment Framework
FMI: financial market infrastructure	

MIC: mortgage investment company	OTC: over-the-counter
MPG: Market Participants Group	PD: probability of default
NCCF: Net Cumulative Cash Flow	RMB: Chinese renminbi
NHA MBS: National Housing Act mortgage-backed security	SRF: Single Resolution Fund
NSFR: Net Stable Funding Ratio	SRM: Single Resolution Mechanism
OECD: Organisation for Economic Co-operation and Development	TIBOR: Tokyo Interbank Offered Rate
OSFI: Office of the Superintendent of Financial Institutions	TSX: Toronto Stock Exchange
OSSG: Official Sector Steering Group	VAR: value-at-risk
	VRM: variable-rate mortgage