Assessing Vulnerabilities in the Canadian Financial System

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- Ongoing monitoring of vulnerabilities in the Canadian financial system is essential for assessing threats to financial stability and providing authorities with the necessary information for considering policy actions.
- The Bank of Canada regularly evaluates vulnerabilities in the Canadian financial system, such as (i) the degree of leverage, (ii) funding and liquidity issues, (iii) the pricing of risk, and (iv) opacity, in four main areas—financial sector entities, shadow banking, asset markets and the non-financial sector.
- The Bank's approach to vulnerability and risk assessment builds on research related to amplification mechanisms and contagion through the financial system. It is comprehensive in terms of drawing on a wide range of data, innovative tools and other information. Nevertheless, important gaps in data, models and knowledge remain.
- The task of assessing financial system vulnerabilities is a dynamic one that will evolve with the constantly changing financial system, the availability of new information and the development of improved assessment techniques.

Introduction

Recent experience has reminded us that financial crises are extremely costly in terms of their negative effects on economic well-being. As such, it is incumbent upon authorities to understand the mechanics of financial system stress in order to prevent, or contain, financial crises. This knowledge can also help authorities to improve the overall stability and efficiency of the financial system.

Financial crises or, more generally, systemic stresses occur when trigger events interact with vulnerabilities to cause stress in the financial system. A vulnerability is a pre-existing condition that can amplify and propagate shocks throughout the financial system. A trigger is the adverse shock that can spark systemic stress if the financial system is sufficiently vulnerable. Given a set of vulnerabilities and triggers, financial system risks can be assessed on the basis of expected loss to the system; i.e., the probability that the risk will materialize and the expected impact if it does. To use an everyday example, consider the following:

> A large crack in a tree is a vulnerability because a trigger, such as a storm, could cause the tree to topple and cause extensive damage to nearby buildings, electrical wires and roadway access. Yet, if no storm occurs, such a risk event may not arise. Indeed, the tree may endure and eventually strengthen through growth. The likelihood of a severe storm, and the factors that contribute to various outcomes if the tree did fall over, determine the seriousness of this risk.[1]

Since shocks are very difficult to predict, and policymakers can often do little about their realization, focusing explicitly on identifying and measuring vulnerabilities is the most effective means for informing and directing the assessment of financial system risks. However, to detect vulnerabilities, it is necessary to know what to look for and where to look. This is not straightforward, since modern financial systems are dynamic and complex, and relevant information is not always available. In this report, we describe the approach used at the Bank of Canada to overcome some of these challenges.

To identify and evaluate vulnerabilities, Bank staff have implemented a methodology that is framed around the most common types of vulnerabilities and where they could appear in the financial system. These vulnerabilities were chosen based on past global experience,

1 This example was provided by Stephen S. Poloz, Governor of the Bank of Canada, during the press conference marking the release of the June 2014 *Financial System Review* (Poloz 2014a).

as well as analysis conducted in academic and policy circles. The methodology incorporates a structured review of a wide array of information from various parts of the financial system, which is critical for discovering new behaviours and conditions, or known ones in unexpected places.

Operationalizing this approach requires quantitative and qualitative indicators, as well as analytical tools to process the information contained in them. It also requires judgment that reflects market intelligence about new and existing products, participants, activities and behaviours, and institutional knowledge about global influences and the regulatory environment. Regular discussions with the Bank's federal partner agencies on financial system vulnerabilities and risks are another key input. The result of this exercise is the identification of key areas of vulnerability in the Canadian financial system.

Methodology for Assessing Vulnerabilities

The Bank's approach to the explicit identification and evaluation of vulnerabilities draws from the body of research related to amplification mechanisms that lead to contagion (i.e., the spread of distress in one part of the financial system to other parts of the system).[2] In particular, our methodology is influenced by the work of Adrian, Covitz and Liang (2013) and Andrew Lo's four Ls of systemic risk: leverage, liquidity, linkages and losses.[3]

We classify vulnerabilities into two categories: cyclical vulnerabilities that evolve with the financial cycle and structural vulnerabilities that are inherent features of the financial system.[4]

The bulk of this report focuses on the following cyclical vulnerabilities:

(i) **Leverage** refers to the degree to which assets are funded by debt.

(ii) **Funding and liquidity** reflects the liquidity and maturity mismatches between the liabilities and assets of entities. We also include the degree of illiquidity in asset markets.

(iii) **Pricing of risk** captures the extent to which market valuations and compensation for risk taking are not appropriate.

(iv) **Opacity** refers to the degree to which information is not available about institutions and markets, such as asset holdings, counterparty exposures, prices and volumes traded, and the characteristics of financial products.

Past crises as well as academic research have highlighted that the potential for asset fire sales, asset price corrections and other forms of contagion is exacerbated when these vulnerabilities become excessive. Accordingly, authorities may seek to reduce or contain these vulnerabilities through regulation or other means of motivating different behaviour.

In addition, other features of the financial system that are relatively slower to evolve could contribute to the transmission of shocks (**Box 1**). We label these structural vulnerabilities, as follows:

(i) **Domestic interconnectedness** measures linkages across the financial system that create the potential for contagion. These include common exposures as well as direct and indirect linkages across entities and activities.

(ii) **External exposure** captures channels that could propagate shocks originating outside Canada.

(iii) **Complexity** refers to complicated business models, organizational structures, technical systems, and financial products or relationships.

It may not be possible, or desirable, to alter these features, since they can mitigate risks and/or increase efficiencies in normal times. Nonetheless, structural vulnerabilities, such as the degree of interconnectedness between banks, can be of systemic importance. For example, stresses at a highly connected institution are more likely to affect other entities in the financial system. Thus, including structural vulnerabilities in the assessment helps to fully quantify the contribution of cyclical vulnerabilities to systemic risk.[5]

The Bank identifies vulnerabilities in four main areas: financial sector entities, shadow banking, asset markets and the non-financial sector.[6] These sectors are not completely distinct from each other but, together, they provide broad coverage of the financial system. For example, financial markets capture the outcome of interactions between financial entities, while certain activities of financial entities are also captured within

2 The literature includes Allen and Gale (2000); Geanakoplos (2003); Brunnermeier and Pedersen (2009); Adrian and Shin (2010); and He and Krishnamurthy (2012).

3 The four Ls are discussed in Bisias et al. (2012).

4 The distinction between the two types is not sharp, and many vulnerabilities can have both cyclical and structural aspects. However, for analytical convenience and to facilitate regular monitoring, we assign vulnerabilities to one of these two groups, based largely on the frequency at which the vulnerabilities evolve.

5 The Basel Committee on Banking Supervision has identified size; complexity; interconnectedness; lack of available substitutes or financial institution infrastructure for the services they provide; and global, cross-jurisdictional activity as criteria that determine whether a bank is systemically important (BCBS 2011).

6 Financial market infrastructures (FMIs)—multilateral systems that facilitate payment clearing or settlement—are not included here as a separate sector, although they are an important part of the financial system. FMIs support financial activity and are linked to all other areas of the financial system. As such, they are assessed mainly in the context of structural vulnerabilities.

Box 1

Structural Vulnerabilities in the Canadian Financial System

Modern financial systems are highly interconnected, complex and global in nature. These structural features are the result of the interactions among types of institutions, market practices, rules and regulation. In normal times, these features make the financial system more resilient to idiosyncratic shocks and create opportunities for diversifying risk. But in adverse periods they can be a means of propagating shocks; hence, we consider them structural vulnerabilities. We focus on three key structural vulnerabilities.

Domestic interconnectedness refers to direct and indirect linkages across entities and activities in the financial system, including common exposures. These connections contribute to the safety and efficiency of the system in normal times, but they also have the potential to pose systemic risk in periods of stress. Financial market infrastructures (FMIs)—the payment clearing and settlement systems that facilitate financial transactions—are a particularly relevant example. FMIs expedite transactions for participating financial entities, such as banks and investment dealers, allowing consumers and firms to purchase goods and services, make financial investments, and transfer funds. However, if one participant in the FMI chain fails, the ability of other participants to meet their own obligations could be adversely affected, potentially causing a series of failures that ultimately impairs the functioning of the financial system

External exposure refers to the propensity of any component of the financial system to be affected by an event or condition outside of Canada. Cross-border financial linkages between Canada and other countries provide important benefits to Canadian households, businesses and governments but can also transmit vulnerabilities and shocks back to Canada. Domestic banks, for example, have substantial foreign exposures that can strengthen their ability to support the Canadian financial system and economy during localized periods of stress. However, these exposures also increase the banks' susceptibility to global risk events.

Complexity refers to complicated business models, organizational structures, technical systems, and financial products or relationships. It can arise naturally through financial innovation and risk diversification, as well as from extensive domestic interconnectedness or external exposures. Although complexity can be associated with positive elements of the financial system, it can also be a source of contagion should problems arise. For example, larger, more complex financial institutions typically engage in a wide range of financial activities, often through a number of affiliated subgroups, as a means of diversifying their revenues and offsetting sector- or geography-specific losses. This can be beneficial for shareholders and efficient for the financial system, but it can also expose financial institutions to more types of risks than simple credit losses. In addition, there is a greater likelihood for those risks to be misunderstood because complexity can impede monitoring by management, counterparties and regulators.

the shadow banking sector. Despite this overlap, such comprehensive coverage is desirable because it ensures a holistic view of vulnerabilities in the system and helps overcome measurement issues.

Implementing the Methodology

Quantitative and qualitative indicators

A variety of quantitative and qualitative indicators form the basis of the Bank's monitoring process. We provide some illustrative examples of quantitative metrics in **Table 1** that help inform our evaluation of the degree of cyclical vulnerabilities arising in key sectors of the financial system. These examples may pertain to certain subsectors, but the complete assessment takes into account a broader range of indicators from all subsectors.

Quantitative data are supplemented by qualitative information gathered from a range of sources, including regulatory bodies (both domestic and international), ratings agency reports, and industry participants. In addition, market intelligence, which includes market commentary, dialogues with buy-side and sell-side industry participants, and surveys, is used to complement quantitative evidence and to ensure that vulnerabilities are assessed as comprehensively as possible.

Further, a variety of empirical models can help assess vulnerabilities. Models are useful tools for quantifying vulnerabilities when direct measurement is not possible. However, when interpreting results, the assumptions underlying the model need to be kept in mind, and results should be considered in the context of other relevant information.

Given this structure for assessment, we provide a few examples of how we measure vulnerabilities in each of the four identified sectors.

Table 1: Typical quantitative indicators used to monitor cyclical vulnerabilities in the Canadian financial system

	Vulnerabilities			
Sectors	**Leverage**	**Funding and liquidity**	**Pricing of risk**	**Opacity**
Financial sector entities	▪ Ratio of assets to equity ▪ Regulatory leverage ratio	▪ Regulatory liquidity measures ▪ Ratio of loans to deposits ▪ Liquidity of investments	▪ Return on equity ▪ Underwriting standards	▪ Amount of risk disclosure
Shadow banking	▪ Ratio of assets to equity	▪ Terms of assets and liabilities	▪ Underwriting standards ▪ Haircuts ▪ Concentration of risk	▪ Financial innovation (new products, new practices)
Asset markets	—	▪ Market liquidity metrics (e.g., bid-ask spreads)	▪ Asset valuations ▪ Implied and realized volatility ▪ Risk premiums	▪ Over-the-counter trading volumes
Non-financial sector	▪ Ratio of debt to income ▪ Debt-service costs ▪ Composition of debt	▪ Holdings of cash and liquid assets	—	▪ Proportion of unlisted corporations

(i) Financial sector entities

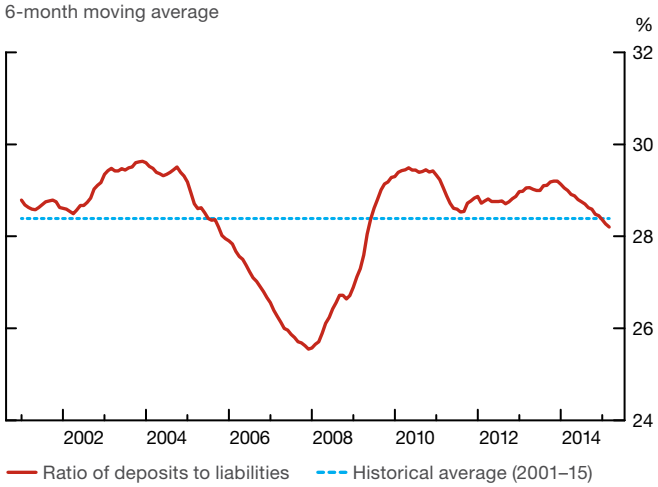
This sector covers domestic systemically important banks, smaller banks, credit unions, trust companies, life insurance companies and pension funds. These bank and non-bank financial entities are key components of a modern financial system. However, they can pose systemic risk if they are highly leveraged, rely excessively on unstable sources of funding or overinvest in illiquid assets. If a major institution experiences difficulties, there is increased potential for systemic loss, owing to its greater interconnectedness with the rest of the financial system.

As became apparent during the recent crisis, banks need stable sources of funding that do not dry up rapidly in times of market stress. One indicator of stable funding for chartered banks is the share of deposits in total liabilities (**Chart 1**). The chart shows that retail deposits as a share of total liabilities declined between 2005 and 2008 during the buildup to the financial crisis.[7] All else being equal, the more banks rely on deposits, the less vulnerable they are to shocks in funding markets. Other important indicators of funding liquidity for prudentially regulated institutions include regulatory and supervisory liquidity measures, such as the Liquidity Coverage Ratio, the Net Stable Funding Ratio and the Net Cumulative Cash Flow.[8]

To offset the impact of low interest rates, some entities, such as pension funds and life insurance companies, are investing more in illiquid assets (for example, real estate and infrastructure) than in the past. At the same time, they are making greater use of derivatives and repos for hedging and funding purposes, which may subject them to liquidity pressures if a stress event materializes.[9]

Chart 1: Retail deposits as a share of the liabilities of chartered banks

6-month moving average



Note: Only non-derivative liabilities are considered.

Sources: Regulatory filings of Canadian banks and Bank of Canada calculations

Last observation: March 2015

7 A larger stock of non-core liabilities indicates vulnerability to crises. See Hahm, Shin and Shin (2013).

8 For more details, please refer to the Liquidity Adequacy Requirements Guideline by the Office of the Superintendent of Financial Institutions (www.osfi-bsif.gc.ca/Eng/fi-if/rg-ro/gdn-ort/gl-ld/pages/lar_gias.aspx).

9 Box 5 in the December 2012 *Financial System Review* describes tools used for leveraged liability-driven investment strategies by pension funds.

Box 2

Vulnerabilities in the Asset-Backed Commercial Paper Market Exposed by the Financial Crisis[1]

The early period of the global financial crisis exposed a number of important vulnerabilities in the shadow banking sector that led to the collapse of the asset-backed commercial paper (ABCP) market in Canada in 2007. The crisis was triggered by investor concerns about U.S. subprime mortgages and the structured products backed by such mortgages.

ABCP programs, by design, lead to significant maturity mismatches, since long-duration assets are funded by short-term paper, which creates the potential for rollover risk that is typically mitigated by a liquidity backstop. Of the $116 billion of outstanding ABCP at the end of July 2007, $81 billion was sponsored by major Canadian commercial banks, while the rest ($35 billion) was third-party (non-bank) ABCP with liquidity backstops, largely from foreign banks.

In hindsight, using the methodology outlined in this report may have helped capture vulnerabilities in the ABCP market along the following dimensions.

Pricing of risk—Typically, bank-sponsored ABCP has been a traditional form of asset securitization where the underlying assets are a combination of consumer loans, such as mortgages, auto leases and loans, and credit card receivables. However, third-party ABCP was backed by leveraged and synthetic collateralized debt obligations, which in turn were backed by a variety of foreign-based assets, such as corporate bonds, asset-backed securities, mortgage-backed securities and credit derivatives. A comparison of the yields of bank-sponsored and third-party ABCP would have revealed that the spread between these notes was surprisingly narrow, suggesting that the market did not fully recognize the difference in risk between the two notes.

Opacity—The ABCP market was characterized by a lack of transparency about (i) the types of assets that were backing ABCP, (ii) the quality and liquidity of the asset portfolios of ABCP conduits, and (iii) the nature of the conduits' backup liquidity facilities.[2] As concerns about U.S. subprime mortgages arose, investors became more uncertain about their direct and indirect exposures, resulting in a loss of investor confidence.

Domestic interconnectedness—Stress in the ABCP market led ABCP conduits to draw on backup liquidity from sponsoring banks as investors started demanding redemptions. This created short-term funding pressures in the banking sector, resulting in contagion and the repricing of risk across domestic short-term funding markets.

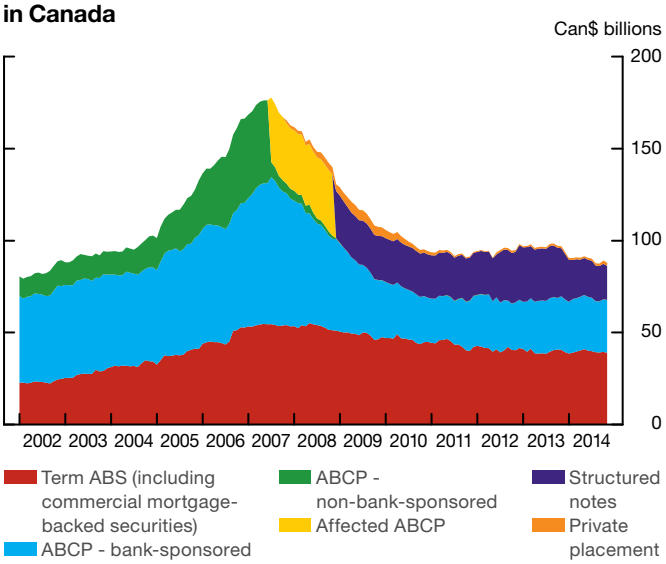
1 This section is based on information contained in Kamhi and Tuer (2007a, b); IIROC (2008); and the Bank of Canada *Financial System Review* (June, December 2007).

2 Liquidity facilities for third-party ABCP could be triggered only under the narrow conditions of a general market disruption.

(ii) Shadow banking

Shadow banking consists of credit intermediation outside the banking sector and involves significant liquidity and maturity transformation. It includes, for example, securitization and repo and securities lending, and extends to entities such as investment funds. Owing to the less regulated nature of the shadow banking sector, opacity is a particularly important vulnerability. For example, in private-label securitizations, relatively illiquid assets are pooled to create tradable securities such as asset-backed securities (ABS) and asset-backed commercial paper (ABCP) that can be used for funding. Securitization is potentially beneficial because it reduces funding costs and can increase the availability of high-quality assets. However, before the crisis, the rapid buildup in the amount of non-bank-sponsored ABCP outstanding in Canada was accompanied by a significant lack of information about the type and quality of the underlying assets (**Chart 2**). As a result, investors questioned the value of some instruments when concerns about U.S. subprime mortgages arose (**Box 2**).

Chart 2: Total private-label securitization outstanding in Canada



Source: Dominion Bond Rating Service Last observation: December 2014

A synthetic exchange-traded fund (ETF) replicates returns on an index by entering into a swap contract with a counterparty and covering the cost of the swap through interest earned on a pool of collateral. Opacity about an ETF's potential exposures to counterparty and collateral risk may concern investors in the event of an adverse shock (Foucher and Gray 2014).

(iii) Asset markets

Asset markets include financial markets—equity, bond, currency and money markets—as well as property markets, both residential and commercial. Excessive risk taking in the financial system can manifest in a variety of ways, including compressed risk premiums and overvaluation in asset markets. A sharp drop in asset prices could adversely affect entities that are highly leveraged. However, detecting signs of overvaluation is a challenging task because it is hard to determine fundamental values. Hence, a variety of valuation metrics are used. For example, a simple, commonly used method for identifying signs of stretched valuations in equity markets is to compare the deviation of the average price-to-earnings ratio across all stocks on the S&P/TSX Composite Index with its 10-year historical average (**Chart 3**). Another possibility is to use the Fed model, which compares the earnings yield on equities with the yields on government and corporate bonds to determine the relative valuations of these assets.[10]

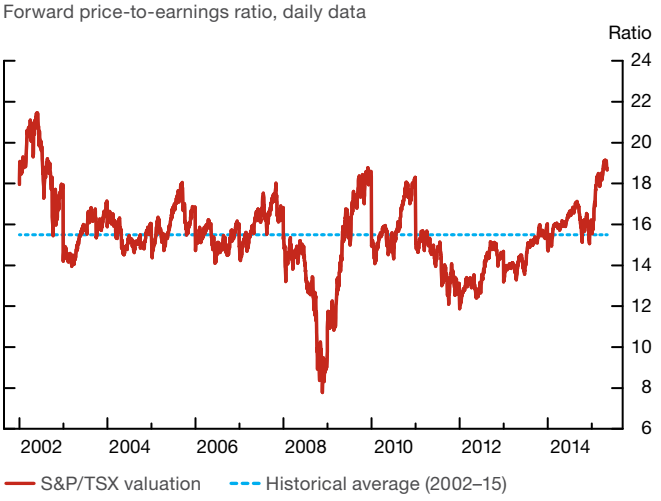
In property markets, the Bank examines measures of both stocks and flows, such as inventory levels, housing starts and resale activity, as well as house prices, to help detect potential imbalances in demand and supply at both the aggregate and regional levels. For example, the rate at which house prices are growing in different Canadian housing markets can suggest where the risk of overvaluation may be increasing or decreasing (**Chart 4**). The information from price measures is further refined through the calculation of simple price-to-income and price-to-rent ratios and compared with historical averages or trends. In addition, formal econometric models compare actual prices with current or expected long-run fundamental values implied by the models.[11]

(iv) Non-financial sector

This sector includes households, non-financial corporations and governments. Extensive debt in the non-financial sector increases its sensitivity to changes in asset prices, interest rates and income and heightens the potential for losses by financial intermediaries. The Bank monitors household debt and income levels; growth in the different components of household credit, household borrowing rates and debt repayment activity; and how these indicators are distributed. For example, it is useful to examine the debt-to-income ratio, a common indicator of household leverage, across different household income groups to determine the segments of the population where indebtedness may be concentrated and/or growing and, hence, which households are more vulnerable to a loss of their incomes (**Chart 5**). Another important element is to try to determine what parts of the financial system are most exposed to these vulnerable households.

Chart 3: Detecting stretched valuations in equity markets

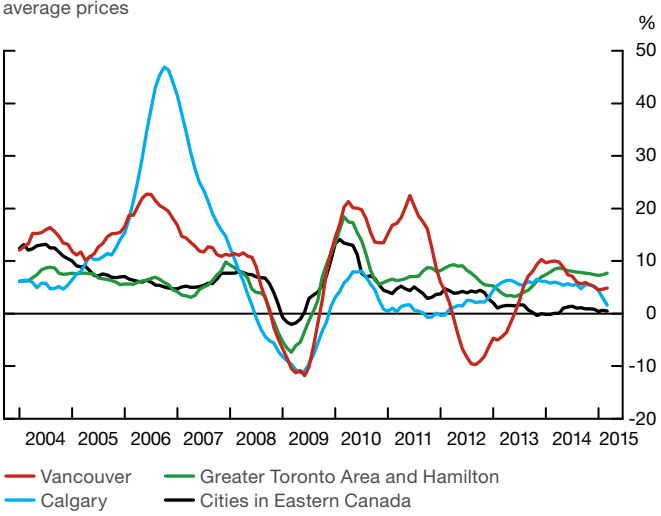
Forward price-to-earnings ratio, daily data



Source: Bloomberg Last observation: 11 May 2015

Chart 4: Growth of house prices in Canada

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



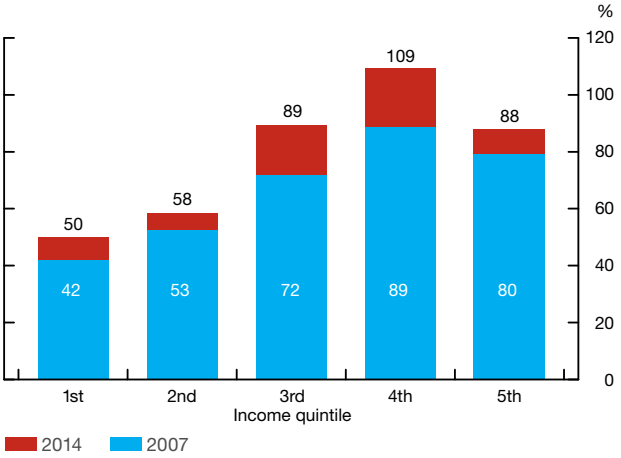
Source: Canadian Real Estate Association Last observation: April 2015

10 The Fed model is discussed in the *Humphrey-Hawkins Report*, released by the Federal Reserve on 22 July 1997 (see www.federalreserve.gov/boarddocs/hh/1997/july/reportsection2.htm).

11 Box 2 in the December 2014 *Financial System Review* discusses various approaches to estimating potential overvaluation in Canadian housing markets.

Chart 5: Median debt-to-gross income ratio for indebted households, by income quintile

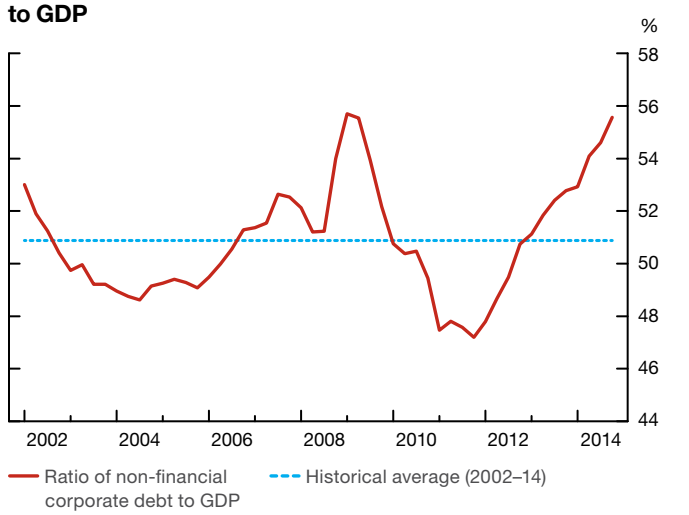
3-year moving average of the ratio of debt to gross income



Source: Ipsos-Reid

Non-financial corporate leverage can be evaluated at the firm level by different balance-sheet measures, such as the ratios of debt to equity or debt to assets, which indicate the extent to which internal financing can support external debt. At an aggregate level, the ratio of corporate debt to GDP is a measure of the extent to which the total debt of non-financial firms can be supported by economic activity (**Chart 6**). These indicators may convey different information. For example, balance-sheet measures of corporate leverage may fluctuate with movements in asset prices, while non-financial corporate debt in aggregate may fluctuate with economic cycles.

Chart 6: The ratio of total non-financial corporate debt to GDP



Sources: Statistics Canada and Bank of Canada calculations

Last observation: 2014Q4

Other inputs

Quantitative and qualitative indicators are complemented by a variety of analytical models. For example, dynamic term-structure models are used for estimating risk premiums in government and corporate bonds (Bauer and Diez de los Rios 2012). Bank staff also use a model of house price determination, based on 43 past house price cycles in 18 countries belonging to the Organisation for Economic Co-operation and Development, to estimate the amount of overvaluation in Canadian housing markets (Bauer 2014). Early-warning techniques are also used to identify vulnerabilities, by comparing current economic and financial indicators with data from periods leading up to past episodes of financial stress.[12] In addition, models can be used to determine how vulnerabilities might evolve under different macrofinancial conditions. For example, using microdata, the Bank's Household Risk Assessment Model estimates the degree to which the situation of vulnerable households (i.e., those with high debt-service ratios) could worsen following a sizable increase in interest rates and unemployment.[13]

The evaluation of cyclical vulnerabilities in each sector is made on the basis of all the qualitative and quantitative information collected and analyzed. In addition, the interactions of cyclical vulnerabilities with structural vulnerabilities—domestic interconnectedness, external exposures and complexity—are examined. For example, excessive risk taking by a highly interconnected entity, such as a systemically important financial institution (SIFI), has the potential to generate losses in the entire financial system. There are, however, policies in place (additional capital requirements and enhanced supervision for SIFIs) that would limit the impact. To fully consider all of the factors that affect the level of vulnerability, judgment is applied that takes into account existing safeguards, supervision regimes, upcoming regulatory changes and other mitigating measures.

To obtain an overall assessment by sector, this exercise is performed for all underlying subsectors. Then the vulnerability assessments for each subsector are aggregated into an overall level of concern for each sector along each of the four cyclical dimensions of vulnerabilities.

The risk-assessment process at the Bank of Canada

The Bank's Governing Council communicates its assessment of vulnerabilities and risks in the Canadian financial system twice annually in the *Financial System*

12 For more on the use of early-warning models at the Bank of Canada, see Pasricha et al. (2013).

13 The Household Risk Assessment Model is described in Faruqui, Liu and Roberts (2012).

Review. These views are based upon many important inputs. Twice a year, Bank staff formally present an assessment of key financial system vulnerabilities and risks, existing and emerging, to the Governing Council. Following the presentation, the Governing Council meets to discuss their own impressions about vulnerabilities and risks, and to identify the most important ones to communicate to external audiences. This is the starting point for drafting the Assessment of Vulnerabilities and Risks section of the *Financial System Review*. However, this formal process builds on other information and insights that are informally accumulated on an ongoing basis. For example, the Governing Council receives regular updates from Bank staff on new data and analysis, regulatory developments and market intelligence. In addition, members of the Governing Council share information and discuss issues with the Bank's federal partners, including at meetings of the Senior Advisory Committee.[14] Important information is also received through discussions with other organizations across the country and internationally; for example, Governing Council members participate in the Financial Stability Board's Standing Committee on the Assessment of Vulnerabilities, as well as various committees under the Bank for International Settlements.[15] The combination of formal, structured decision making with less-structured information gathering, analysis and discussions to arrive at an overall view on vulnerabilities and risks in the Canadian financial system is similar to the process at the Bank that supports the *Monetary Policy Report.*

Challenges

Many authorities, including the Bank of Canada, are working to improve the analytical underpinnings for assessing financial system vulnerabilities and risks. These efforts include addressing some important gaps in data, models and knowledge.

The Bank of Canada relies on a range of data sources, but certain data are not available at the desired frequency or level of disaggregation. Other important data may not even be collected. Canadian authorities are working together to expand and improve financial system data as part of a larger international effort to enhance the accurate assessment of risks to financial stability.[16] For example, more timely and comprehensive data on household balance-sheet positions, including detailed household portfolios and demographic and socio-economic variables, would provide a more accurate picture of the distribution and evolution of household debt, income and wealth.

Although the Bank's development and use of innovative models for analyzing financial stability have been recognized internationally, there is still considerable scope to increase the use of quantitative methods in assessing vulnerabilities and risks. For example, the International Monetary Fund views the Bank's stress-testing model, the MacroFinancial Risk Assessment Framework (MFRAF), as being "at the frontiers of systemic risk stress testing" (IMF 2014). Nevertheless, Bank staff continue to make significant improvements to the quantitative framework for risk assessment, which includes MFRAF and other models, by (i) incorporating feedback effects between the real economy and bank balance sheets, and (ii) developing a tractable mapping among the identification of vulnerabilities, the dynamics of macroeconomic and financial variables under a stress scenario, and their effects across the financial system.[17] This is a complex undertaking, given the numerous interlinkages and feedback effects in a dynamic financial system, that calls for extensive data, sophisticated techniques and computational power. The goal is to accumulate a set of tools that is as comprehensive as possible in terms of all sectors and all vulnerability measures.

More generally, the Canadian financial system is undergoing constant change; new entities are arriving, new markets are being established, and new activities and products are being created.[18] In addition, any assessment of vulnerabilities and risks will be inherently incomplete because people will find new and more sophisticated ways to take on or create risks. Continuous dialogue with the private sector is essential to understanding these developments. Ultimately, the framework for the assessment of vulnerabilities and risks must be flexible and forward-looking to be able to seek out and adapt to new information, analytical improvements and changes in the financial system.

14 The Senior Advisory Committee is a forum for exchanging information and discussing financial system policy issues, such as proposals for legislative changes, the financial stability framework, and the regulatory framework and supervisory approach. The members of the Committee are the Governor of the Bank of Canada, the Superintendent of Financial Institutions, the Chair of the Canada Deposit Insurance Corporation, the Commissioner of the Financial Consumer Agency of Canada and the Deputy Minister of Finance, who chairs the Committee. In Budget 2015, the federal government also indicated that "the Capital Markets Regulatory Authority will contribute to SAC deliberations after it has begun operating." See http://www.budget.gc.ca/2015/docs/plan/ch4-1-eng.html#_Toc417204278.

15 These include the Basel Committee on Banking Supervision, the Committee on the Global Financial System, the Committee on Payments and Market Infrastructures, and the Markets Committee.

16 The G-20 Data Gaps Initiative was established by the International Monetary Fund and the Financial Stability Board in the aftermath of the global financial crisis to improve the availability of financial system data.

17 While important sectors are currently included, the coverage is not yet complete across the financial system and, to date, the impacts are limited to those affecting domestic systemically important banks.

18 Governor Poloz discussed the future of financial intermediation and its implications for financial stability in his December 2014 speech to the Economic Club of New York (Poloz 2014b).

Conclusion

A structured and systematic approach is critical for identifying, monitoring and evaluating vulnerabilities and, in turn, formulating a comprehensive assessment of risks to the Canadian financial system. Using various indicators and analytical tools, the Bank regularly tracks and analyzes the degree of leverage; various liquidity and funding issues; the pricing of risk; and the extent of opacity within the financial sector, shadow banking, asset markets and the non-financial sector. It also considers vulnerabilities that are more structural in nature, such as complexity, domestic interconnectedness and external exposures that can further magnify the potential for contagion. The twice-yearly assessment of vulnerabilities considers a wide range of data, analysis and information from inside and outside the Bank, including from other authorities that have a role in maintaining financial system stability. The key findings of this assessment are summarized and used in regular discussions on risks to the financial system with the Bank's federal partners, and communicated to the public in the *Financial System Review*.

The Bank's assessment framework is a work in progress, and ongoing efforts are aimed at introducing greater quantitative rigour. Authorities around the world are also developing their approaches to the assessment of vulnerabilities and risks, and the Bank is sharing information as well as learning from their experiences.[19] Bank staff are working to identify and obtain more relevant data and to develop models of different areas of the financial system and their linkages. While this is a complex undertaking, it will ultimately help the Bank and other Canadian authorities to promote financial stability.

19 In April, the Bank hosted a workshop for central banks and authorities from around the world where the discussions focused on assessing vulnerabilities in and risks to the financial system.

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