

# An Overview of Risk Management at Canadian Banks

*Meyer Aaron, Jim Armstrong, and Mark Zelmer*

**T**he Bank of Canada is interested in developments in risk management at Canadian banks because of the critical role that banks play in the Canadian financial system.

This report provides a brief overview of risk-management practices at Canadian banks. It is based, in part, on recent interviews conducted with some Canadian and foreign banks.

The business of banks has changed noticeably over the last 15 or 20 years (Calmès 2004). Although deposit taking and lending continue to be key business lines, banks have expanded into other areas, including investment banking and trading, insurance, trusts, brokerage, and mutual funds. An important consequence of this shift has been an increase in the exposure of banks to financial markets.

In light of this exposure, banks have adopted sophisticated risk-management practices. Boards of directors now play a more active role in ensuring that risks are well understood and in overseeing risk exposure. They also ensure that management has appropriate strategies, systems, and controls in place to manage risk. Indeed, banks have adopted sophisticated risk management as a core function, and risk-management principles are now used across banking organizations to allocate capital, price products, and invest in new markets.

## Managing the Major Risks

### General trends

Like any other business, banking involves taking calculated risks to generate profits. Today, Canadian banks face a diverse range of risks. In this report, we focus on credit risk, market risk, liquidity risk, and operational risk.

Canadian banks have always faced these categories of risk. But the underlying complexity and importance of certain risks has increased as a result of market pressures and the business strategies adopted by the banks. For example, market risk has grown in importance and has become more complicated to manage. Back offices and other parts of banks are facing challenges in keeping up with the pace of innovation in front offices.<sup>1</sup>

This trend towards increasing complexity, coupled with advances in information technology, is driving the rapid adoption of quantitative models, where appropriate, and a move towards a more integrated approach to risk management within banks.<sup>2</sup> But the day-to-day choices in risk management essentially depend on the type of risk, the availability of instruments to transfer or mitigate the risk, and where the risk resides on the balance sheet.

A bank's balance sheet—together with off-balance-sheet arrangements—can be divided into financial instruments that make up its trading book and those that make up its banking book. The trading book includes instruments held for shorter-term trading and other financial market activities. The banking book includes most loans and securities held for longer investment horizons. Both “books” normally contain similar types of financial instruments and risks. They tend to be managed differently, however, because of their differing time horizons.

1. Part of this complexity arises from the growing importance of very complex legal documentation governing transactions, as well as from issues of whether the trade on the books matches the trade outlined in the confirmation.
2. Sometimes referred to as enterprise-wide risk management or ERM (Standard & Poor's 2006).

## Credit risk

Credit risk refers to the potential for loss if a borrower or a counterparty to a transaction fails to meet its obligations as they fall due. Credit risk remains the most important risk that banks have to manage. Large banks tend to allocate roughly half of their economic capital to this risk.

Historically, credit risk was lodged mainly in the banking book. However, with the growth in holdings of corporate securities and derivatives, credit risk in the trading book has increased.

Diversification is a first line of defence against major credit losses. In the banking book, diversification is used to avoid concentration of credit risk with a particular borrower, or group of borrowers, or with a particular industry or region.

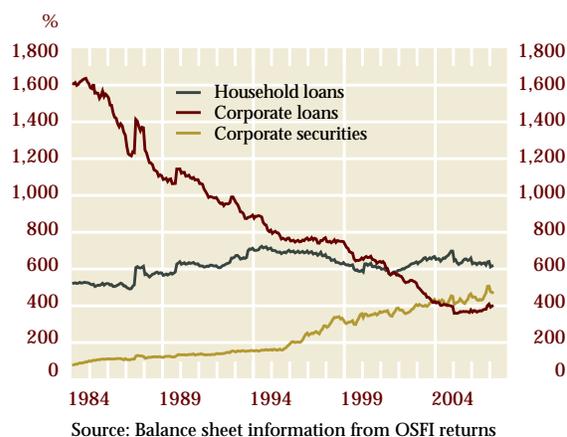
The trading book houses both credit risk related to the issuers of securities and counterparty risk incurred from derivatives contracts. The former is mitigated through single-name and sector limits, as well as, more recently, credit derivatives. The latter is mitigated through various arrangements, such as netting agreements and collateral. Similarly, diversification across counterparties and products avoids the concentration of credit risk in the trading book.

Banks have systems in place to monitor their exposure to any one group or related set of counterparties/borrowers to ensure that this exposure does not exceed chosen limits relative to their capital base. Exposures to single names and sectors are managed largely on a consolidated basis, regardless of whether the risk arises from different instruments or from different books (banking or trading). Chart 1 presents the trend in major categories of bank credit exposure relative to capital. In recent years, bank lending to the household sector has risen relative to corporate lending.<sup>3</sup> However, holdings of corporate securities have also risen; these are held mainly in the trading book.

### *Exposure to households and small business enterprises (SMEs)*

Management of exposure to households and SMEs involves numerous borrowers that, taken

**Chart 1 Trend in Bank Major Asset Categories Relative to Tier 1 Capital**



3. The risk involved in some of this lending to households is mitigated through mortgage insurance.

as a portfolio, have fairly uniform credit-risk properties. This permits banks, because of “the law of large numbers,” to rely on statistical models that incorporate certain key risk variables to assess borrower creditworthiness.<sup>4</sup> This helps to streamline the process for credit approval and enforce uniform standards across the many lending offices of large institutions.<sup>5</sup>

Banks also securitize some of their household assets, such as residential mortgages, consumer loans, and credit card loans, to shed balance sheet assets and reduce exposure to these sectors, while retaining a relationship with household or small business clients.

### *Exposure to large corporations and institutions*

Large exposures to corporate credit and to other institutions are more “lumpy” and, thus, less amenable to assessment through basic statistical models. Consequently, banks continue to rely on in-depth credit analysis of individual borrowers to assess their creditworthiness, with results graded by probability of default and loss-given-default. This is similar to the approach of the credit-rating agencies.

The larger the exposure, the more scrutiny it attracts within the bank, with the largest exposures reviewed and approved by the board of directors. Part of credit-risk management has traditionally been through the terms and conditions associated with individual loans. These may include pledging of securities for collateral. There may also be various performance covenants that help banks monitor the creditworthiness of borrowers over time and that trigger renegotiations if credit quality deteriorates.

Recent developments in markets for credit-risk transfer (CRT) have enhanced the ability of banks to better manage large corporate exposures through financial instruments, while allowing them to maintain client relationships. CRT techniques include securitizations, loan syndications, secondary loan sales and, more recently, credit derivatives (Reid 2005). Canadian banks have expertise in these techniques,

although banks tend to be more active in using them in offshore markets—notably those in the United States—given the relatively small size of these markets in Canada.<sup>6</sup>

There have been important developments in modelling the credit risk of large corporate exposures. The emergence of Credit VaR (Value at Risk) models and other techniques, such as the Moody’s KMV approach (based on the Merton model), provide banks with a quantitative framework for calculating the economic capital required to backstop their exposure to credit risk.<sup>7</sup> Banks have invested considerable time and effort in ensuring that their internal ratings process is more formalized and documented so that they can easily defend how they arrived at an internal rating decision. This has been reinforced by Basel II with its emphasis on risk-based capital (Box 1).

Growth in market-based activities has increased large credit exposures in the trading book, arising from holdings of credit instruments and from counterparty exposures.<sup>8</sup> Chart 2 shows the trend in trading book assets and liabilities. Banks employ both derivatives and offsetting transactions in cash markets (such as short selling of similar securities) to manage credit risk in the trading book.

This has resulted in a growing reliance on collateral to mitigate the counterparty risk involved in derivatives contracts and other financial transactions. Collateral takes the form of cash or high-grade securities, like government debt, that have low credit risk and are very liquid. This has led to increased demand for high-grade securities, which has occasionally affected the liquidity of underlying markets. This has likely contributed to a broadening out in the range of eligible collateral beyond government securities, particularly the use of cash collateral (very short-term instruments), which is now the

4. The subprime segment of the mortgage market has proven to be less amenable to the same modelling techniques. But this market is small in Canada. See Highlighted Issue on page 6.

5. The use of credit-scoring models is a fairly recent development in Canada.

6. The securitization technique is relatively well developed in Canada.

7. Credit VaR is typically defined as an estimate of the loss related to credit-rating transitions, over a given horizon (usually one year), that is statistically unlikely to be exceeded at a given probability level.

8. OSFI recently conducted a review of bank exposures to hedge funds and concluded that banks’ exposures are relatively small and that risk-management practices are adequate (OSFI 2007).

## Box 1

## Basel II and Bank Risk Management

In June 2004, the Basel Committee on Banking Supervision released its report titled “International Convergence of Capital Measurement and Capital Standards: A Revised Framework” (Basel II). The revised Basel II framework will be implemented for Canadian banks effective 1 November 2007, following a one-year parallel run with the existing capital-adequacy regime. Basel II is designed to achieve a closer alignment of regulatory capital requirements with underlying risks by introducing significant changes to the treatment of credit risk, as well as by introducing a new capital charge for operational risk. The underlying principles of the new framework are intended to be suitable for application to banks of varying levels of complexity and sophistication. The framework will allow qualifying banks to determine capital levels consistent with the manner in which they measure, manage, and mitigate risk.

Basel II rests on three pillars: minimum capital requirements, supervisory review, and market discipline. Risk management is given a key role in the first pillar of the new framework—minimum capital requirements—in terms of emphasizing the measurement and management of risks, and providing banks with incentives to adopt more advanced risk-management techniques. The new framework provides a spectrum of methodologies, from simple to advanced, for the measurement of both credit and operational risk. (Those applied to market risk are largely unchanged from the 1996 market-risk amendment to the original Basel Capital Accord.)

For credit risk, banks may choose between the standardized approach, the foundation IRB (internal-ratings-based) approach, and the advanced IRB approach. Under the standardized approach, banks use risk weights based on ratings assigned by a recognized external credit-assessment institution, such as a rating agency, to calculate required regulatory capital.

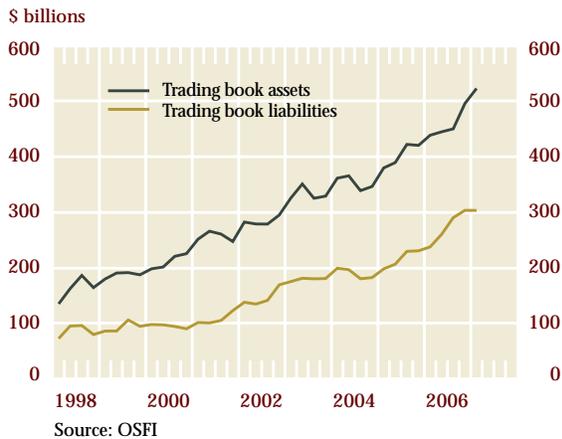
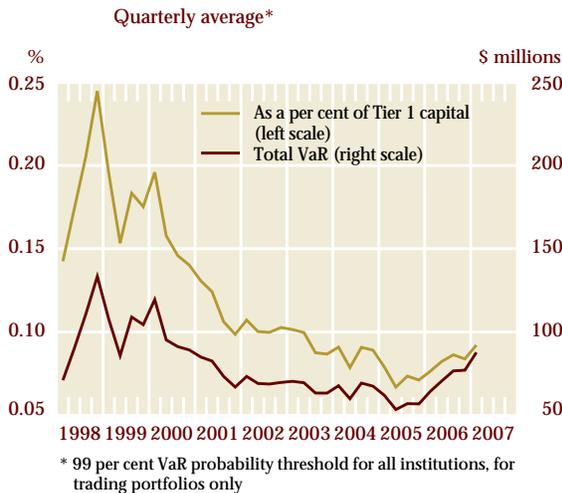
Under the two IRB approaches, banks use their own internal assessments and risk models to arrive at the key risk drivers needed to calculate capital risk weights, to varying degrees. For banks using the foundation IRB approach, probability of default (PD) must be internally generated with other risk factors provided by supervisors. By contrast, banks using the advanced IRB approach are required to estimate probability of default, loss-given-default (LGD), exposure at default (EAD), and maturity (M) for each exposure.

Similarly, for operational risk, Basel II offers three progressively more complex methods: the basic indicator approach, the standardized approach, and the advanced measurement approach (AMA). Most major Canadian banks are planning to adopt the advanced IRB approach for credit risk and the standardized approach for operational risk.

The second pillar of Basel II focuses on the supervisory review process. It allows banking supervisors (Office of the Superintendent of Financial Institutions in Canada) to set minimum capital requirements that exceed those outlined in Pillar 1, depending on the risk profile of the bank. This assessment process may involve reviews of bank risk-management processes and stress tests. Meanwhile, the third pillar is aimed at strengthening market discipline by requiring enhanced disclosure of risk information by banks in Canada and abroad.<sup>1</sup>

---

1. In Canada, advanced IRB and AMA banks will be required to meet advanced disclosure requirements in 2008.

**Chart 2 Trend in Bank Trading Book****Chart 3 Trend in Bank VaRs**

primary collateral instrument in over-the-counter derivatives markets (BIS 2007).

## Market risk

Market risk represents the potential for adverse changes in the prices or volatility of financial assets and liabilities.<sup>9</sup> While market risk is typically not the largest risk that Canadian banks face, it has risen in importance over the past two decades and poses unique challenges, given the complexity of the financial instruments from which it is derived and the markets where they trade. The complexity of new products and strategies derived from market activities has increased the banks' reliance on quantitative methods that employ a number of assumptions and sophisticated statistical theory to price products and manage their exposures.

Most banks continue to use the toolkit of model technology generically referred to as value at risk (VaR) for measuring and managing their exposure to market risk at the portfolio level. Technically, VaR represents the maximum expected dollar loss that could be experienced, given a specified confidence level, over a specified time horizon.<sup>10</sup> While originally developed to measure market risk in the trading book, this approach has, to some extent, been extended to other areas, such as market risk in the banking book and even credit risk.

Chart 3 shows the recent trend in bank VaRs, calculated as an aggregate of the major Canadian banks. Note that reported VaRs tend to be small compared with the gross value of trading book assets reported in Chart 2. This is because the VaR reflects the netting of various offsetting balance sheet and off-balance-sheet items and can be reduced by diversification.

The reported VaR numbers have recently started to rise, reversing the declining trend that had been in place since the start of the decade. Given the declining trend in volatility, the rising VaRs are likely driven by larger exposures. However, the chart shows that VaRs remain at a low

9. Market risk is normally considered to include foreign exchange risk, interest rate risk, equity risk, and commodity risk.

10. For example, suppose a bank reported 1-day VaR of \$10 million at 99 per cent. This means that, 99 days out of 100, the trading portfolio should not lose more than \$10 million.

proportion of Tier 1 capital. Reported VaRs of major Canadian banks tend to be smaller than those of many of their global peers.

A review of bank annual reports suggests that the majority of their trading book assets and liabilities (excluding derivatives) are valued based on observable prices. For the most part, however, over-the-counter derivatives are valued based on modelled prices; exchange-traded derivatives normally have quoted prices. According to the banks, the majority of these modelled values are based on observable parameters (e.g., yield curves or implied volatility on a stock index), with the remainder having significant unobserved parameters (e.g., default correlation). For more on this issue, see CSFI (2006).

### Liquidity risk

Liquidity risk is the risk that a bank cannot meet a demand for cash or fund its obligations because of its inability to liquidate assets or raise funds in a timely manner at a reasonable price. While banks may have access to central bank lender-of-last-resort facilities in extremis, they are expected to make arrangements to meet their liquidity needs in all currencies relevant to their business (Bank of Canada 2004).

Effective management of liquidity risk at banks is essential to ensuring that core businesses continue to function under adverse circumstances. In today's interconnected markets, liquidity risk presents certain challenges from a conceptual and measurement point of view. Indeed, the management of liquidity risk takes on an even greater significance when its interaction with, and potential amplification of, market and credit risk during periods of market stress is considered.<sup>11</sup>

Banks typically manage liquidity on a global consolidated basis. As with other types of risk, diversification of funding sources is one element of managing liquidity risk. Banks diversify these sources across maturities, customer types,

markets, currency, and regions. They monitor the balance between their core deposits (comprising customer accounts and term deposits), which are more stable, and wholesale deposits, which are usually more volatile and for shorter terms.<sup>12</sup> Relatively new techniques, such as securitization, have helped to diversify funding sources.

Banks also set and adhere to limits with respect to the key elements of liquidity risk, such as minimum thresholds for very liquid assets. They maintain contingency plans for liquidity and conduct regular stress testing to gain confidence in their ability to operate under a liquidity crisis.

### Operational risk

Operational risk can be defined as the risk of loss resulting from inadequate or failed internal processes, people, and systems or from external events. It is important to note that these risks have been around for a very long time and are inherent in the way a bank runs its business. However, practices for managing operational risk have assumed a greater profile because of new requirements under Basel II, which inject more formality into the measurement of operational risk, and in the wake of foreign bank failures that occurred as a result of breakdowns in operational controls.

Operational risk can take various forms. It can involve people (incompetence or fraud), system failures (breakdowns in systems or technology), and process failures (i.e., back-office problems).

By its nature, operational risk, which is present in all activities, is difficult to avoid. In contrast to financial risks, such as credit risk and market risk, there are few traded instruments to help mitigate this risk, although in some cases it can be managed through insurance contracts. Operational risk is typically managed through rigorous internal processes and controls. Banks have a long history of extensive and well-documented formal procedures. Moreover, internal audit groups play an active role in testing internal controls, with support from external auditors.

In the course of our interviews, banks indicated that their expansion into various financial markets is demanding more power and

11. It is worth noting some commentary in a recent Bank of England *Financial Stability Report* in the context of the U.K. banking system. "The severe crystallization of credit, market and liquidity risk in combination could lead to a material erosion of UK banks' capital, with potential knock-on effects to supporting markets, institutions and infrastructures" (Bank of England 2006).

12. Wholesale funding entails issuing relatively large deposits to institutional and corporate depositors.

sophistication from IT systems. This, in turn, poses challenges for gathering information from disparate sources and legacy systems that are expensive to replace. Some banks are shying away from some of the most complex financial products, apparently because of the challenges in understanding the associated risks. Instead, they are spending time and resources looking for ways to streamline their supporting infrastructure, including IT.

The recent trend towards strengthening corporate governance, noted earlier, has been very helpful in dealing with operational risk. Examples include the greater involvement of boards of directors and the growing role of independent directors in risk governance. There has also been a growing focus on business contingency planning (BCP) to cope with potential external shocks to business, such as terrorism and pandemics.

Several banks are building databases on various types of operational risk incidents to allow them to better understand and measure this type of risk. Some Canadian banks are actively involved in a banking industry initiative to develop industry-wide databases on operational risk events that can be used to develop more sophisticated measures of operational risk.

## Issues and Challenges

We will now briefly address some important issues and challenges related to bank risk-management practices going forward.

### Limitations of risk models

Quantitative models have limitations that can restrict their scope. They require a large amount of high-frequency data to estimate distributions. Hence, they tend to excel in the management of market risk, given the large amount of data available on financial asset prices. They are more difficult to implement for credit, liquidity, and operational risk.

These models, such as VaR, tend to be very sensitive to model parameters, such as market volatility and correlations between risks (which are difficult to estimate). Certain types of risk, such as liquidity risk, currently can be incorporated in only a rudimentary manner, while other risk factors (such as competitive responses and feedback effects) are difficult to model.

Lastly, most risk models assume that future distributions will be the same as the distributions estimated from historical data. These limitations may make it difficult to apply these models in crisis events that have systemic impacts (Bouchaud and Potters 2003; Danielsson 2002). For example, VaR is “backward looking,” being based on historical experience, and may not accurately capture risk if volatilities and correlations suddenly change in a crisis event.

Banks are well aware of the shortcomings associated with quantitative models. Judgment is always involved to a greater or lesser extent, so that the process never becomes purely mechanical. Given the growing importance of models, banks have well-developed processes in place for managing model risk.<sup>13</sup> These include strict procedures for model development, independent validation (including backtesting and stress testing), and implementation.<sup>14</sup> Banks also have procedures in place to prescribe reserves against model risk.<sup>15</sup>

### The growing importance of stress tests

Banks are also addressing the problems and limitations of quantitative models through a wide variety of stress tests.

Stress testing is used to assess the impact of uncertainties arising from model limitations or data availability. It involves using the models to evaluate the impact on the chosen risk measure of “what if” scenarios involving extreme events.<sup>16</sup> For example, for market risk, it can help to gauge the impact of sudden changes

13. Model risk can be broadly defined as the risk of error in estimates caused by inadequacies in the model or its implementation (Dowd 2005).

14. Backtesting and stress testing are obligatory under Basel I and II. They are among many procedures used by supervisors to evaluate the reliability of bank risk models.

15. With regard to mitigating model risk, it is interesting to note that some banks suggest that a constructive consequence of the growing reliance on collateral to manage counterparty risk is the need for counterparties to mutually agree on collateral valuation, providing an independent form of model validation.

16. The Basel Accord and Basel II require banks to have a program for rigorous stress testing, including significant past events. A summary of the BIS stress-testing survey was included in the June 2005 issue of the *Financial System Review* (p. 21).

from current norms in volatility or correlations. Thus, stress tests frequently contribute to the setting of risk limits.

Stress tests at large Canadian banks tend to vary in terms of degree of development by type of risk. They appear to be most developed with respect to market risk and structural interest rate risk (interest rate risk residing in the banking book) and perhaps less developed for liquidity risk and credit risk. However, stress testing for credit risk is rapidly evolving, propelled by changing international standards, largely related to Basel II, which comes into effect in Canada in late 2007 (Box 1).

Banks run stress tests based on both hypothetical and historical scenarios. Under a hypothetical scenario, one or more risk factors are shocked to simulate extreme events. In a historical scenario, movements in risk factors are based on observations of actual prior periods of financial stress.<sup>17</sup> Banks are not quite at the point where they can reliably take into account correlation effects across the major categories of risk. However, the field continues to evolve.

Banks state that they view the results from these stress tests as valuable for better understanding the risk profile of an institution, for setting risk limits, and as a communication tool to assist management in linking strategic planning with risk management. They are also used in the supervisory process to evaluate the reliability of bank models.

### **Integrated risk management**

Important challenges remain for Canadian and foreign banks in areas such as moving towards a full-enterprise, risk-management system that links information on different risk types and across the banking and trading books, so that banks can have a holistic perspective on their risk exposures. Like their foreign counterparts, Canadian banks have been working towards—but have not yet achieved—the integration of measures for market risk, credit risk, and liquidity risk through stress tests to obtain a more complete view of total exposure to financial

risk. At this stage, formal macroeconomic models are not widely used.<sup>18</sup>

Clearly, the greater integration of risk management is an important challenge for large and complex Canadian and other global banks going forward, and they continue to devote significant resources to achieving it.

While endeavouring to address the problem of integration, risk models will continue to grow in complexity as banks develop and utilize sophisticated financial products to meet the needs of their clients. The challenge is for risk practices to keep up with rapid changes in products and strategies.

### **Conclusion**

The competitive pressures in banking are increasing the pace of innovation and the complexity of the business. Like their foreign counterparts, Canadian banks are coping with these pressures in diverse ways and have developed improved governance practices and risk-management infrastructures that meet their differing business strategies.

Interviews with foreign banks suggest that the practices of Canadian banks are broadly in line with those of their global peers. Furthermore, the banks—like their global counterparts—have made significant progress in improving risk-management practices. This has been motivated largely by business needs, but Basel II has also played a role in building momentum for change within the industry. Past experience points to the need for continuous vigilance in internal controls and risk management by the banks.

Risk-management practices are also affecting the global financial system. Over the past decade, the financial system has shown considerable resilience during a number of market and credit episodes, adding credence to the view that risk management has made the financial system more robust (Kohn 2005). This view should, however, be tempered by the reality that these events occurred during a period of largely favourable macroeconomic conditions.

17. Commonly used historical scenarios include the 1987 stock market crash, the 1994 bond-market decline, and the 1998 Russian default/LTCM crisis.

18. However, Canadian banks are participating in a macro stress-test exercise this year as part of an update of the IMF's assessment of the stability of the financial system through the FSAP program.

## References

- Bank of Canada. 2004. "Bank of Canada Lender-of-Last-Resort Policies." Bank of Canada *Financial System Review* (December): 49–55.
- Bank of England. 2006. "Shocks to the UK Financial System." *Financial Stability Report* (July): 14–23.
- Bank for International Settlements (BIS), Committee on Payment and Settlement Systems. 2007. "New Developments in Clearing and Settlement Arrangements for OTC Derivatives." (March).
- Bouchaud, J.-P. and M. Potters. 2003. *Theory of Financial Risk and Derivative Pricing*. Cambridge U.K.: Cambridge University Press.
- Calmès, C. 2004. "Regulatory Changes and Financial Structure: The Case of Canada." Bank of Canada Working Paper No. 2004-26.
- Centre for the Study of Financial Innovation (CSFI). 2006. *Banking Banana Skins*. (June).
- Danielsson, J. 2002. "The Emperor Has No Clothes: Limits to Risk Modelling." *Journal of Banking & Finance* 26: 1273–96.
- Dowd, K. 2005. *Measuring Market Risk*. Hoboken N.J.: John Wiley & Sons Inc.
- Kohn, D.L. 2005. Panel discussion: "Financial Markets, Financial Fragility, and Central Banking." Remarks at the 2005 Economic Symposium at Jackson Hole, Wyoming, sponsored by the Federal Reserve Bank of Kansas City.
- OSFI. 2007. "Remarks by Julie Dickson, Acting Superintendent, Office of the Superintendent of Financial Institutions Canada (OSFI) to the Senate Standing Committee on Banking, Trade and Commerce." (January).
- Reid, C. 2005. "Credit Default Swaps and the Canadian Context." Bank of Canada *Financial System Review* (June): 45–51.
- Standard & Poor's. 2006. "Assessing Enterprise Risk Management Practices of Financial Institutions." *Commentary Report*. (22 September).