



BANK OF CANADA

Financial System Review

December 2005



The Financial System Review and Financial Stability

The financial system makes an important contribution to the welfare of all Canadians. The ability of households and firms to confidently hold and transfer financial assets is one of the fundamental building blocks of the Canadian economy. As part of its commitment to promoting the economic and financial welfare of Canada, the Bank of Canada actively fosters a safe and efficient financial system. 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 institutional responsibilities.

The financial system is large and increasingly complex. It includes financial institutions (e.g., banks, insurance companies, and securities dealers); financial markets in which financial assets are priced and traded; and the clearing and settlement systems that underpin the flow of assets between firms and individuals. Past episodes around the world have shown that serious disruptions to one or more of these three components (whether they originate from domestic or international sources) can create substantial problems for the entire financial system and, ultimately, for the economy as a whole. As well, inefficiencies in the financial system may lead to significant economic costs over time and contribute to a system that is less able to successfully cope with periods of financial stress. It is therefore important that Canada's public and private sector entities foster a financial system with solid underpinnings, thereby promoting its smooth and efficient functioning.

The *Financial System Review* (FSR) is one avenue through which the Bank of Canada seeks to contribute to the longer-term robustness of the Canadian financial system. It brings together the Bank's ongoing work in monitoring developments in the system and analyzing policy directions in the financial sector, as well as research designed to increase our knowledge. The strong linkages among the various components of the financial system are emphasized by taking a broad, system-wide perspective that includes markets, institutions, and clearing and settlement systems. It is in this context that the FSR aims to

- improve the understanding of current developments and trends in the Canadian and international financial systems and of the factors affecting them;
- summarize recent work by Bank of Canada staff on specific financial sector policies and on aspects of the financial system's structure and functioning;
- promote informed public discussion on all aspects of the financial system, together with increased interaction on these issues between public and private sector entities.

The FSR contributes to a safe and efficient financial system by highlighting relevant information that improves awareness and encourages discussion of issues concerning the financial system. The Bank of Canada welcomes comments on the material contained in the FSR.

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December 2005

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Developments and Trends

Notes

The material in this document is based on information available to **25 November** unless otherwise indicated.

The phrase “major banks” in Canada refers to the six largest Canadian commercial banks by asset size: the Bank of Montreal, CIBC, National Bank, RBC Financial Group, Scotiabank, and TD Bank Financial Group.

Assessing Risks to the Stability of the Canadian Financial System

The *Financial System Review* is one vehicle that the Bank of Canada uses to contribute to the strength of the Canadian financial system. The Developments and Trends section of the *Review* aims to provide analysis and discussion of current developments and trends in the Canadian financial sector.

The first part of the Developments and Trends section presents an assessment of the risks, originating from both international and domestic sources, that could affect the stability of the Canadian financial system. Key risk factors and vulnerabilities are discussed in terms of any potential implications for the system's overall soundness. The second part of this section examines structural developments affecting the Canadian financial system and its safety and efficiency; for example, developments in legislation, regulation, or practices affecting the financial system.

The current infrastructure, which includes financial legislation, the legal system, financial practices, the framework of regulation and supervision, and the macroeconomic policy framework, significantly influences the way in which shocks are transmitted in the financial system and in the macroeconomy, and thus affects our assessment of risks.

Our risk assessment is focused on the vulnerabilities of the overall financial system, and not on those of individual institutions, firms, or households. We therefore concentrate on risk factors and vulnerabilities that could have systemic repercussions—those that may lead to substantial problems for the entire financial system and, ultimately, for the economy. In examining these risk factors and vulnerabilities, we consider both the likelihood that they will occur and their potential impact.

Particular attention is paid to the deposit-taking institutions sector, because of its key role in facilitating financial transactions, including payments, and its interaction with so many other participants in the financial system. For instance, these institutions assume credit risks with respect to borrowers such as households and non-financial firms. Thus, from time to time, we assess the potential impact that changes to the macrofinancial environment may have on the ability of households and non-financial firms to service their debts.

Risk factors and vulnerabilities related to market risks are also examined. The potential for developments in financial markets to seriously affect the financial position of various sectors of the economy and, ultimately, to disrupt the stability of the Canadian financial system is assessed.

Financial System Risk Assessment

Overview

This section of the Financial System Review examines the recent performance of the Canadian financial system and the factors, both domestic and international, that are influencing it. In each issue, one or more subjects of particular interest are discussed as highlighted topics.

Key Points

- In general, the financial health of Canadian financial institutions, households, and non-financial corporations remains robust.
- The Canadian financial system remains exposed to the risk of a disorderly resolution of global imbalances. While this risk is low over the near term, it remains a key consideration over the medium term.
- While global financial markets and asset prices have proven to be resilient in the face of several negative shocks, including the sharp rise in energy prices, the potential for a significant price reversal in riskier assets remains.
- Overall, the Bank of Canada concludes that the risk of a shock having a significant negative impact on the Canadian financial system is small.

Overall Assessment

Since the release of the last *Financial System Review* in June 2005, the global and domestic financial systems have remained sound.

Globally, benign macroeconomic conditions have supported financial stability. Healthy economic growth and low interest rates have helped financial institutions, non-financial corporations,

emerging-market economies, and the household sector to maintain or strengthen their financial positions, for the most part. Although key risks remain, the possibility that a shock could have a significant negative impact on the Canadian financial system is small.

Canadian developments

Despite the past appreciation of the Canadian dollar and substantial increases in energy costs, the overall financial situation of the Canadian non-financial corporate sector remains robust, based on an analysis of indicators available through the third quarter of 2005.

Similarly, the household sector appears to pose a low risk to the financial system, despite a continued rise in indebtedness and sharply higher energy-related expenditures. Indeed, updated simulations initially conducted for the December 2003 and 2004 *Reviews* continue to indicate that a return of policy rates to more normal levels should not materially impair the credit quality of household debt. The likelihood of a marked reversal in house prices in major Canadian markets also appears limited.

Overall, the credit quality of the assets of the Canadian banking sector has remained strong and close to recent cyclical highs. The quality of assets continued to contribute to the very strong financial results reported by major Canadian banks in the first half of 2005. In this context, the agreement by CIBC in the third quarter to settle the Enron class action litigation initiated against them has not materially altered the Bank's assessment of the soundness of the Canadian banking system. The strong capital position of the banking sector continues to provide institutions with a buffer should adverse economic or financial developments occur.

Other financial institutions in Canada, such as securities dealers, life, health, and property and casualty insurance companies, also continued to report robust profitability. The financial consequences of hurricanes Katrina, Rita, and Wilma are not expected to have a significant effect on the financial strength of Canadian insurers.

Global risks

Since the time of the last *Review*, financial markets have experienced a number of adverse shocks, including sharply higher energy prices and some concerns about a possible rise in inflation. Nonetheless, to date, financial markets seem to be adjusting to this period of greater uncertainty in an orderly fashion. Indeed, despite increases in uncertainty resulting from these and other shocks, global risk appetite remains robust.

On 21 July, China revalued the renminbi by 2.1 per cent and announced a mechanism permitting future changes to its exchange rate, which would be made with reference to a basket of currencies. The small revaluation will likely have little effect on the state of global imbalances.

While the current scenario regarding the stability of the global and domestic financial systems is benign, growing imbalances could pose challenges to financial stability in the future. Since June, global economic growth and favourable interest rate differentials have led to ample capital flows that have allowed smooth financing of global imbalances. This has, however, also increased the imbalances themselves and, thus, the possibility of a disorderly resolution remains a key risk over the medium term.

As well, the prices of riskier assets appear to reflect investor expectations of an extended continuation of favourable financial developments.¹ For instance, since June, credit spreads on corporate bonds and most emerging-market sovereign debt have remained near cyclical lows. This raises the concern that financial risks may be underpriced. Thus, the potential for a significant price reversal in riskier assets remains.

There is also a risk that the increases in gasoline and natural gas prices since June may cause a persistent rise in inflation in some countries. This could lead to a sharp reversal in the prices

of risky assets, if long-term bond yields rise sharply, or if global investor appetite for risk falls.

Major banks, which play a key role in the domestic financial system, appear well positioned to manage potential adverse movements in asset prices. As indicated above, the sector continues to be well capitalized. These institutions also maintain risk-management practices that should limit the negative impact of financial market volatility on their financial positions.

The implications of persistently low yields on long-term bonds are also a key risk consideration to monitor. Should the current factors driving the high current levels of desired global savings relative to business investment remain in place over the medium term, long-term bond yields could remain below those previously deemed appropriate in light of the economic fundamentals. Such an outcome would have implications for many financial system participants, and these are discussed in this *Review*.

Other potential sources of risk are judged to be less significant. These include the risk to the Canadian financial system posed by a correction in domestic and/or international house prices and the economic difficulties faced by some non-financial industries. Indeed, a relatively small number of industries, such as auto manufacturing, wood and paper products, and computer and electronic manufacturing, have experienced considerable financial stress over most of the period since 2001. With the further rise in the Canadian dollar since mid-2004 and substantial increases in the costs of energy and other raw materials, profits remained relatively weak in many of these industries towards the end of last year and during the first three quarters of 2005. Thus, the credit quality of their debt has worsened. It is unlikely, however, that Canadian financial institutions, which have well-diversified portfolios, would be strongly affected by the deteriorating credit quality in these industries.

Overall, the Bank of Canada concludes that the Canadian financial system remains sound.

1. Riskier assets include equities, corporate debt securities, and emerging-market debt.

Highlighted Issues

The potential impact on the domestic financial system of low long-term bond yields, as well as the financial position of the Canadian household sector, is discussed in this section.

Financial system implications of low yields on long-term bonds

Prepared by Christopher Reid

Given the current low yields on government bonds, many investors have sought to enhance their returns by increasing their investments in riskier assets. Previous issues of the *Review* have noted that a significant increase in government bond yields could have spillover effects in other markets, possibly triggering a sharp decline in the price of riskier assets, exacerbated by the illiquid nature of these assets. In some countries, such an increase in government bond yields could be triggered, for instance, by a disorderly adjustment to global imbalances or by heightened inflationary risk from the recent surge in gasoline and natural gas prices.

While significantly higher bond yields are possible, it is important to consider the financial system implications of long-term yields remaining low. Such an outcome could occur if the current factors driving the strong levels of desired global savings relative to business investment remained in place over the medium term. The implications of this scenario include continued low profitability of carry trades, an ongoing financial burden for pension funds, and possible support for asset prices above sustainable levels, including the price of volatility protection.

The flattening of the yield curve (i.e., long-term yields are only modestly higher than short-term yields) that has accompanied the removal of monetary stimulus in many industrial countries has been accentuated by investors searching for higher financial returns. A flat yield curve diminishes the profitability of the interest rate carry trade, which generally involves borrowing at low short-term rates and lending at higher long-term rates.² A decline in the profitability of the carry trade is likely to be felt most acutely by banks and by certain hedge funds. The impact on U.S. banks may be as much as 15 to 25 per

cent of earnings per share (Hendler 2005). There is a risk that those banks may compensate for a decline in carry-trade profitability by taking on risks in other areas, which could have implications for their financial strength. For instance, many U.S. banks have significantly increased their capital allocation to financial market trading activities, including developing their energy-trading capabilities.

Pension funds, many of which currently have funding deficits, would continue to be challenged by the increase in the discounted value of their liabilities that resulted from the decline in yields on long-term bonds. In response, pension funds may choose to take on more risk in their asset portfolios in order to achieve higher returns to offset increasing liabilities. Alternatively, the higher cost of deferred benefits may weaken the financial position of sponsoring firms.³

The current yield-curve environment also has implications for asset prices more generally. Low, risk-free nominal yields have generally encouraged investors to take on more risk in their asset portfolios. This has supported the prices of risky assets and raises the concern that financial risk may have become underpriced and that large-scale reversals could occur.⁴ Spreads in the corporate bond market are exceptionally low, with little compensation for differences in credit quality. For instance, the current difference between A-rated and BBB-rated bonds in Canada is about 30 basis points, compared with an average differential of about 75 basis points since 1998.

If speculative mispricing exists more generally, prolonged low yields on long-term bonds would likely exacerbate the consequences of a potential future reversal in the prices of risky assets. Indeed, as long as the prices of risky assets remain high, so does the risk of a sudden price decline. Nevertheless, major banks in Canada appear well positioned to manage potential adverse movements in asset prices. Their use of modern

2. See Box 1 on page 20 of the June 2005 *Review* for a backgrounder on carry trades.

3. See the Report "Strengthening Defined-Benefit Pension Plans" on page 29 of this *Review* for more on the challenges facing defined-benefit pension plans in Canada.

4. Current prices for risky assets also reflect the remarkable performance of the world economy in recent years and the better allocation of risks permitted by new financial instruments such as collateralized debt obligations (Armstrong and Kiff 2005) and credit default swaps (Reid 2005).

risk-management practices, such as value at risk and stress testing, should limit the adverse impact of financial market volatility on their trading portfolios.

Many investors are also augmenting their current returns by selling volatility protection through a variety of financial products. Although volatility protection is traded mainly in the options market through products such as swaptions, caps, and floors, or indirectly through assets that contain an option component, such as mortgage-backed securities, it is also increasingly traded as a financial instrument in its own right (e.g., variance swaps). The seller of volatility protection receives a premium, but will suffer a net loss if there is a sharp increase in market volatility. Should such volatility occur, the buyer of protection receives compensation from the seller.

Measurements of interest rate volatility have fallen continuously since their recent peak at the end of 2001 and remain near historical lows (Chart 1). The decline in volatility likely reflects several fundamental factors, such as steady economic growth. Anecdotal evidence gathered from market intelligence suggests that the search for higher financial returns has led an increasing number of investors to sell volatility protection to boost their portfolio returns.⁵ This may, in turn, have caused the price of volatility protection to fall below the level suggested by the fundamentals.

Volatility protection may also be mispriced because new entrants into this market may not fully understand or properly value the risks associated with selling such protection. A significant increase in volatility would likely lead to large losses among some investors, particularly those market participants who sold “uncovered” volatility protection without a clear understanding of the underlying risks related to this strategy.⁶ Large losses could thus lead to an increase in counterparty risk, which, in turn, could negatively affect the financial system. There is, therefore, a risk that the increased use of the strategy of selling volatility protection has increased the

5. Participation in volatility trading had been confined to sophisticated investors, such as hedge funds and the proprietary trading desks of large banks.

6. For example, an uncovered call refers to a short call option position where the call writer does not own the underlying asset.

Chart 1 Volatility of Yields on 2-Year and 10-Year Canadian Bonds*

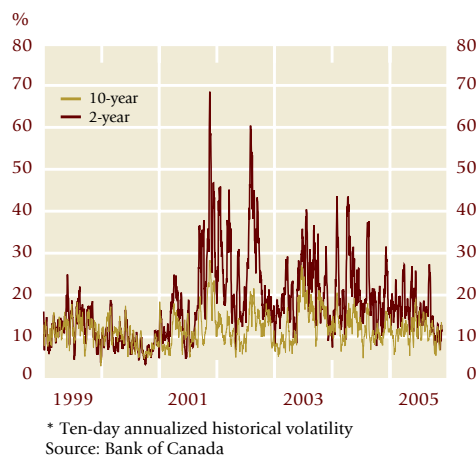


Chart 2 Financial Position of Canadian Households

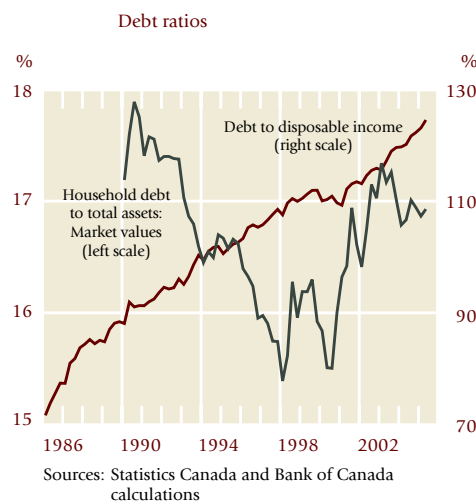


Chart 3 Household Sector Debt



exposure of some financial system participants to a significant financial shock.

Overall, a persistence of low or declining yields on long-term bonds may cause a reallocation of risk in the activities of the banking sector, cause stress on pension fund sponsors, and could contribute to the possible mispricing of risky assets and volatility protection. The implications for the financial system of low yields on long-term bonds thus remain a key concern for medium-term risk.

Financial position of the Canadian household sector: Autumn 2005

Prepared by Virginie Traclet and Dylan Hogg

The financial health of Canadian households is important to the banking sector because of the high exposure of Canadian banks to household credit. The rising indebtedness of households is often cited as a cause for concern. This Highlighted Issue updates the analysis of the financial situation of Canadian households presented in the December 2004 *Review*. Our conclusions remain broadly unchanged: despite a further increase in indebtedness, a return of policy rates to more normal levels should not materially diminish the ability of households to service their debts. Moreover, a significant reversal in house prices in major Canadian markets is unlikely. As a result, financial system risks relating to the Canadian household sector appear to remain low.

Servicing household debt

Total household credit, consisting of mortgage and consumer credit, continued to advance at a rapid pace over the past year. Growth in household debt has outpaced the rate at which household income is rising, with the ratio of household debt to disposable income reaching a new high at 124.5 per cent in the second quarter of 2005 (Chart 2). But since the increase in indebtedness has been accompanied by rising asset values, the ratio of total debt to total assets remained broadly unchanged from a year earlier at about 17 per cent (Chart 2).

A major development in household credit has been a surge in personal lines of credit (PLCs) since 1999, reflecting a substitution away from personal loans and credit card debt, which typically bear higher interest rates and a less flexible payment structure. The growth of PLCs

enhances welfare by allowing households to more effectively smooth their consumption and reduce their debt-servicing costs.⁷

Indeed, despite rising indebtedness, the estimated cost of servicing debt has remained very low: interest payments on existing debt represented 7.6 per cent of household disposable income in the second quarter of 2005, up only slightly from the historical low of 7.3 per cent in the same quarter of 2004 (Chart 3).

The ability of households to service their debt obligations can be further assessed by monitoring a number of indicators of the degree of financial stress affecting households, such as credit card delinquencies, mortgage arrears, or impaired loans (Chart 4). These indicators do not signal concern regarding the ability of households to service their debt. Notably, the rate of impaired consumer loans has decreased sharply over the past three years.

Interest rates are expected to rise as monetary stimulus is reduced. It is, therefore, important to assess households' ability to meet their debt obligations in an environment of higher interest rates. To do this, we simulate the impact of higher interest rates on the household debt-service ratio (Chart 5).⁸ We consider two scenarios: a gradual rise in the overnight interest rate to a range of 4 to 6 per cent (with a midpoint of 5 per cent), and an extreme stress-testing scenario where the overnight rate jumps to 9 per cent, reminiscent of the 1994–95 period, before settling down to 5 per cent. In the scenario where interest rates gradually rise, the debt-service ratio would rise to between 8.5 and 10 per cent by the beginning of 2008, and settle at somewhere between 8.8 and 11.3 per cent by 2011. These levels remain below the peaks reached in 1981 and 1990 and bracket the 1980 to 2004 average for the debt-service ratio. In the stress-testing scenario, the debt-service ratio rises quickly to

7. Growth in PLCs has also been supported by rising house prices, which has led to the greater availability and use of secured credit. Developments in the housing market are discussed in the next section.
8. Box 1 in the December 2004 *Review* describes the methodology involved in this simulation exercise. Key assumptions include holding the debt-to-income ratio constant at its current level over the simulation period. This implies that changes in interest rates over the simulation period do not affect aggregate income relative to indebtedness.

12 per cent before falling to slightly over 10 per cent, still below previous peaks.

These simulations indicate an increase in the debt-service ratio to a rate of about one-half percentage point higher than those reported in the December 2004 *Review*. Increases in the debt-service ratio, such as those seen in the stress-testing scenario and at the upper bound of the other scenario, could adversely affect the quality of household credit. Furthermore, the sensitivity of households to a given level of the debt-service ratio may differ from that in 1980 or 1990. Indeed, the increase in the cost of energy has weighed on consumer confidence this autumn, and may reduce the ability of some households to manage debt-servicing costs for a given level of the debt-service ratio. Nevertheless, a steady flow of income remains the key factor in the ability of households to service their debt. In this respect, current prospects for economic conditions remain supportive.

Overall, our results do not signal any significant concerns as to the ability of households to service their debt. It should be noted, however, that the above assessment is based on the analysis of broad-based indicators of household financial conditions. While this provides useful information, the distribution of levels of household indebtedness and income could have important implications for the financial system that are not captured by aggregate data. Some comfort can be taken from the fact that the Canadian market for mortgage debt comprising elevated credit risk is relatively small, and that lenders in this market appear to focus on borrowers whose credit quality is just below that of prime borrowers.⁹

House prices

Developments in house prices may have a significant impact on the financial health of households and, consequently, on that of lending institutions. Indeed, real estate represents the largest asset of households.¹⁰ The assessment of developments in Canadian house prices is therefore key to determining the ability of households to meet their future debt obligations.

9. See the discussion on page 17 of this *Review* for a discussion of the subprime mortgage market in Canada.

10. Real estate represented about 38 per cent of total households assets in the second quarter of 2005.

Chart 4 Canadian Financial Indicators

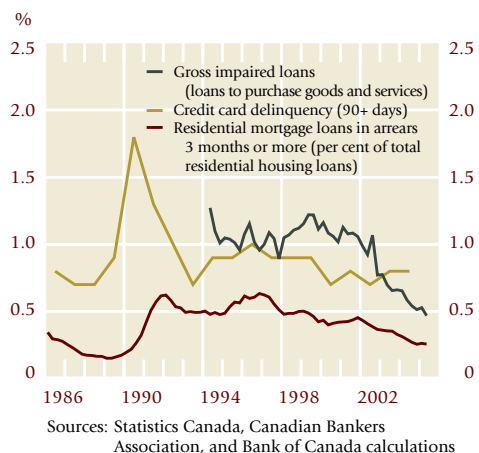


Chart 5 Projections for the Debt-Service Ratio Based on Different Paths for the Overnight Rate

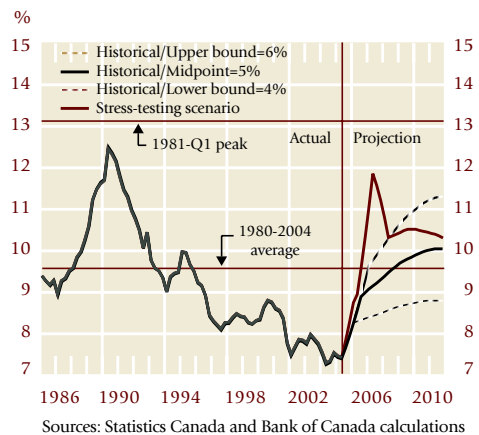


Chart 6 Developments in Real House Prices

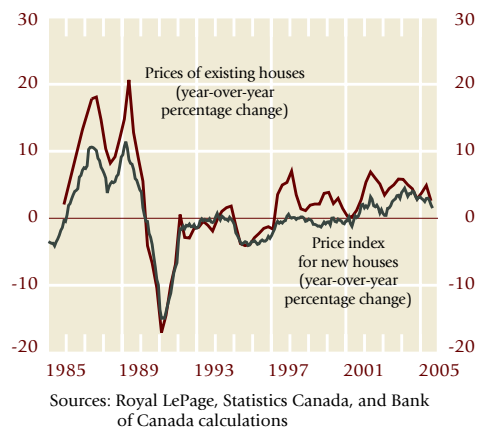
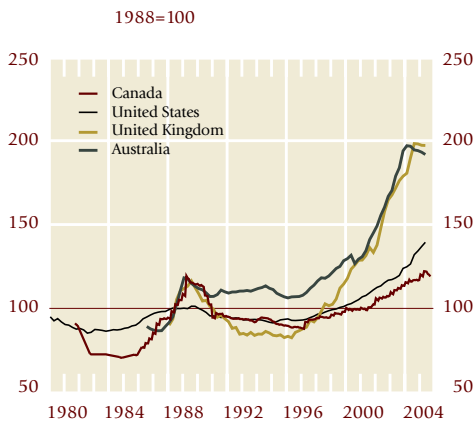
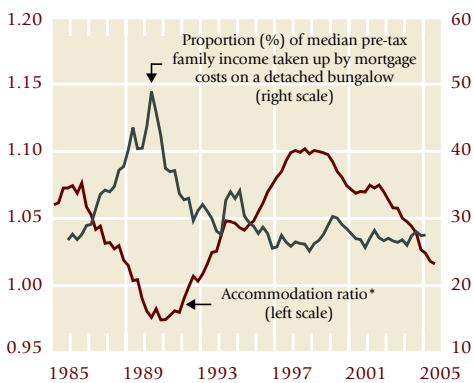


Chart 7 International Prices for Existing Houses – Real*



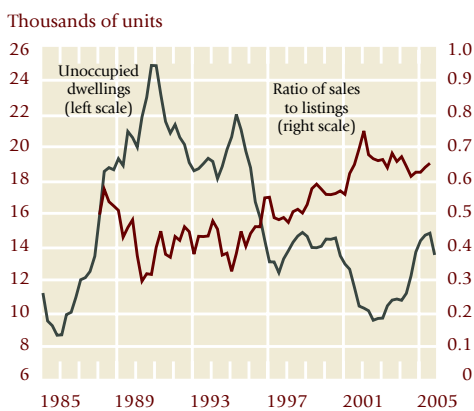
* Deflated using national consumer price indexes
 Sources: Bank of Canada and Royal LePage (Canada), Office of Federal Housing Enterprise Oversight (OFHEO) (U.S.), Australian Bureau of Statistics (Australia), Office of the Deputy Prime Minister (U.K.)

Chart 8 Affordability of Housing and Accommodation



* The accommodation ratio is equal to the rented-accommodation component of the CPI divided by the owned-accommodation component of the CPI.
 Source: Statistics Canada

Chart 9 Housing-Supply Indicators



Sources: Bank of Canada and Multiple Listing Service

After an extended period of flat prices in the 1990s, Canada has experienced increases in house prices in the past few years. These increases, however, have been much more subdued and more gradual than those observed in Canada in the late 1980s (Chart 6), and much more subdued than those in several other countries (Chart 7). In addition, they appear to have been supported by fundamental factors, including rising real disposable income in the second half of the 1990s and low interest rates. And, in contrast to the late 1980s, there are very few signs of speculative activity in the Canadian housing market.¹¹ Houses are apparently being purchased mainly for owner occupancy and because home ownership is currently very affordable by historical standards (note the affordability measure plotted in Chart 8).¹² Finally, it should be noted that the pace of increase in house prices has moderated recently: the inflation-adjusted price of existing houses rose by 4.4 per cent in the second quarter of 2005 from that a year earlier—well below the 6.9 per cent increase in the same quarter in 2002—and the pace of increase in the price index for new housing has been steadily decreasing since June 2004 (Chart 6).

These adjustments in house prices are consistent with improving supply in the market for new homes—illustrated by the gradual increase in the number of recently completed but unoccupied dwellings—as well as in the resale market (Chart 9). They are also consistent with easing conditions in rental markets across Canada, as illustrated by rising national rental vacancy rates (from 1.6 to 2.7 per cent between 2001 and 2004). The combination of rising house prices and easing rental conditions has led to a gradual decrease in the accommodation ratio, which compares the relative cost of renting a dwelling with that of owning a home

- This does not exclude the fact that some purchases are made for investment purposes; i.e., houses turned into rentals after purchase. Indeed, CMHC estimates that condominiums owned by investors for rental account for about 20 per cent of condominiums in Toronto (CMHC 2004).
- Affordability made home ownership feasible for a broader range of potential buyers, including younger and single buyers. This led to a strong demand from first-time home buyers. See Royal LePage 2004 and 2005.

(Chart 8).¹³ This situation should lead prospective buyers to reconsider their home-buying intentions, thereby moderating increases in house prices.

Taken together, these developments support the view that a significant reversal in house prices in Canada is unlikely. The analysis does not, however, exclude the possibility that some imbalances may exist in certain local or specific segments of the Canadian housing market. Based on the overall analysis, risks to the financial system related to the Canadian housing market remain limited.

The Macroeconomic Environment

The global economic expansion has maintained a healthy pace in recent months. Nevertheless, higher world energy prices have led to increased economic and financial uncertainty.

The global environment

Despite increased energy costs, expectations for economic growth in industrialized countries in 2006 have been revised up since the June 2005 *Review* (Chart 10). Activity in many emerging-market economies, especially those in Asia, is also projected to remain robust, and growth prospects in Japan have improved substantially. Expectations for growth in the United States remain solid, despite the impact of three hurricanes. As a result, financial market participants expect the U.S. federal funds rate to rise to about 4.75 per cent by the middle of next year.

Healthy corporate profits and favourable financing conditions continue to moderate the levels of various indicators of financial distress, such as default rates. According to Standard & Poor's, the global corporate default rate for speculative issuers, on a 12-month rolling-average basis, was 1.6 per cent in October, a level similar to the eight-year low recorded in March 2005 (Chart 11). It remains significantly below

the long-term (1981–2004) average of 4.96 per cent.

Emerging markets

Yield spreads on emerging-market bonds, as depicted by the Emerging Market Bond Index (EMBI), reached a historical low of 238 basis points on 25 November and thus remain well below their historical average (from 1998) of 705 basis points (Chart 12). The drop in the EMBI is partly attributable to a general improvement in macroeconomic conditions in emerging markets and also reflects very low bond yields in industrialized countries that provided investors with incentives to move towards high-yielding emerging-market bonds. This search by investors for higher yields led to portfolio reallocations towards riskier assets, including the bonds of emerging markets. This is reflected in sizable new inflows into the secondary market for EMBI bonds. The Institute of International Finance expects net private capital flows to emerging markets to reach a record high US\$345 billion in 2005, surpassing the previous record of US\$323 billion reached in 1996 prior to the Asian crisis.

Although these narrow spreads have been maintained for two years, they may not continue. Indeed, low real interest rates in industrialized countries and abundant liquidity are cyclical. As well, the global appetite for risk is subject to change. As many central banks in the industrialized countries reduce monetary policy stimulus, the economic fundamentals in many emerging-market countries will likely become more important in determining the level of yield spreads. Hence, there are renewed concerns that current valuations have outpaced fundamentals, resulting in a risk of a possible sell-off of emerging-market assets, leading to increased volatility and a sudden decrease in their prices. Should this occur, the direct impact on the Canadian financial system would likely be limited. For instance, the direct exposure of the Canadian banking sector to emerging markets represents only 2.5 per cent of their total assets.

Developments in Asia

The unwinding of global imbalances remains a key issue for the stability of the global financial system. Two elements that would contribute to

13. The accommodation ratio is equal to the rented-accommodation component of the CPI divided by the owned-accommodation component.

Chart 10 Evolution of Consensus Estimates for Annual Growth of Industrialized Economies*



an orderly correction of global imbalances are increased exchange rate flexibility and an increase in the domestic demand (or a reduction in household savings) in Asian countries. China revalued the renminbi by 2.1 per cent on 21 July and announced a mechanism that permits future changes to its exchange rate to be made with reference to a basket of currencies. Additional pressure has been placed on some Asian exchange rates by the budgetary impact of rising energy subsidies. At the same time, strong public support in Japan for the government's privatization of postal savings and insurance has improved the outlook for economic reform and sustained growth in Japan (Chart 13). Nonetheless, the resolution of global imbalances is likely to require a more widespread adjustment in foreign exchange rates and savings across Asia.

The United States

In the United States, attention has recently focused on the economic impact of hurricanes, the sharp increases in U.S. house prices, and rising inflation expectations.

In certain regions of the United States, nominal house price increases appear to have outpaced movements in the underlying fundamentals. The U.S. nationwide house price index rose 75 per cent from 1997 to 2005. A sizable portion can be attributed to the increases in California (160 per cent), in Massachusetts (126 per cent), and in New York (103 per cent) (Chart 14).¹⁴ Excluding these three states, house prices have risen by 53 per cent over the same period.

Increasing policy rates and heightened inflation expectations could lead to higher mortgage rates, thereby curbing future increases in house prices in the United States. However, recent experience in some countries that had had sharp increases in house prices, such as the United Kingdom and Australia, suggests that adjustments in the housing market could be relatively gradual and modest and have only a negligible effect on the overall health of the domestic financial system (Chart 15). It thus appears that

Chart 11 Default Rates on Speculative-Grade Bonds

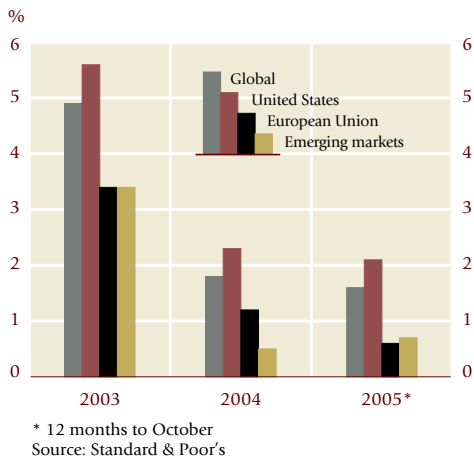
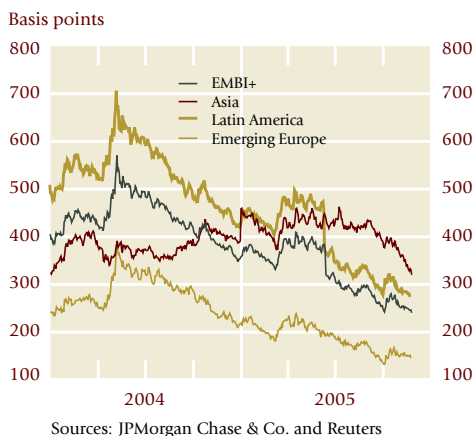


Chart 12 Sovereign Bond Spreads



14. The OFHEO data set includes only mortgage lending below \$360,000. Several metropolitan areas (most notably in California) require homeowners to borrow well in excess of this to finance their purchase, thus the index may understate the true contribution of California to the national housing market.

the potential adjustments to U.S. housing prices would be unlikely to shake the stability of the overall U.S. financial system.¹⁵

The full impact of hurricanes Katrina, Rita, and Wilma on the U.S. financial system is difficult to evaluate at this time. According to the Insurance Information Institute, the number of anticipated claims will easily exceed the previous record of two million claims received from the four Florida storms in 2004. Preliminary estimates suggest that insured losses could exceed US\$50 billion.¹⁶ This is well above the cost of Hurricane Andrew in 1992 that eventually led to some insurance bankruptcies because of concentrated exposure to risk. Since then, however, the insurance industry has adopted risk-management systems to limit risk concentrations to acceptable levels. As a result, Standard & Poor's does not expect any solvency issues for insurance and reinsurance companies involved with the 2005 hurricane season (Standard & Poor's 2005). A more probable channel of stress on the financial system is through personal and business bankruptcies resulting from the hurricanes. The magnitude of these bankruptcies will be known only as the number of uninsured businesses and individuals is revealed.

The Canadian financial system appears to be in a position to easily withstand the impact of a potential adjustment in U.S. house prices or adverse developments related to the recent hurricanes. The direct exposure of Canadian banks to the entire U.S. private sector (households and businesses) represents only about 10 per cent of their total assets, and only a very small fraction of these would be affected.¹⁷

The Canadian economy

Economic growth in Canada picked up in the second quarter of 2005 (Chart 16). Indeed, the Bank now feels that the Canadian economy was operating at its production potential at mid-year.

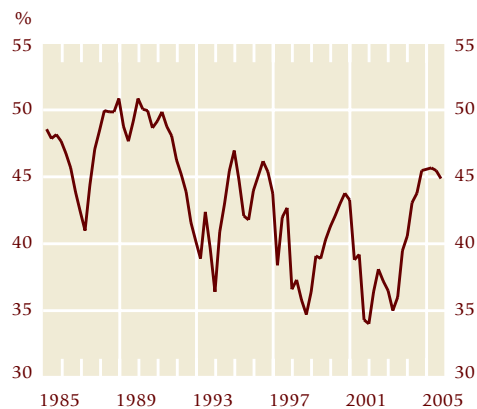
15. Other factors may increase the extent to which a decline in U.S. house prices could affect the U.S. financial system. These include the increasing prevalence of non-traditional mortgage products and the easing of traditional credit underwriting practices. See Schmidt Bies (2005).

16. Insurance Information Institute, October 2005.

17. See the Financial Institutions section on page 15 of this *Review* for more on the impact of recent hurricanes.

**Chart 13 Consumer Confidence Index*:
Japan**

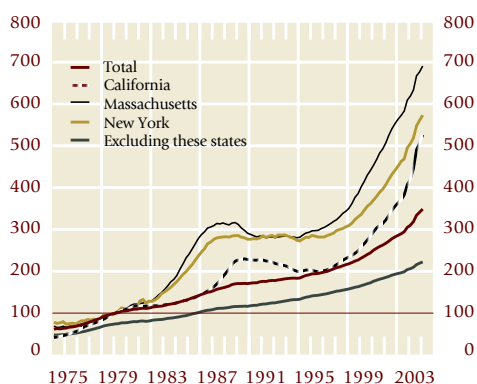
Seasonally adjusted



* Ranges between 0% (all consumers expect conditions to worsen) and 100% (all consumers expect conditions to improve)
Sources: Thomson Financial Datastream and Cabinet Office

Chart 14 House Price Index: United States

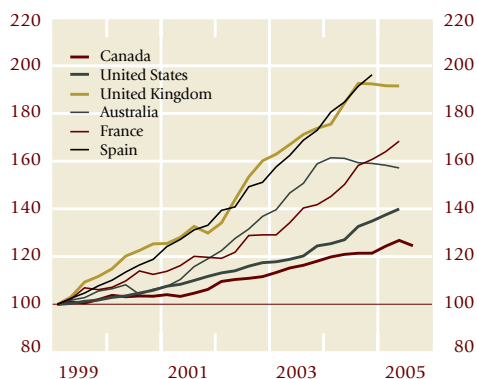
1980Q1=100



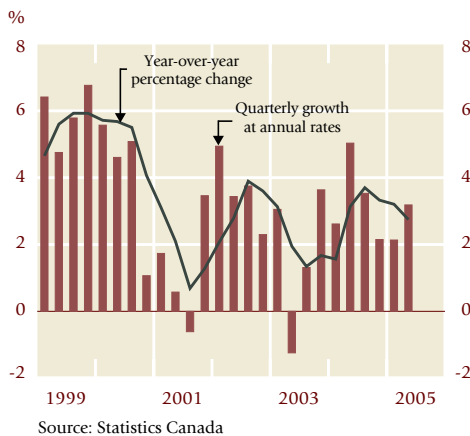
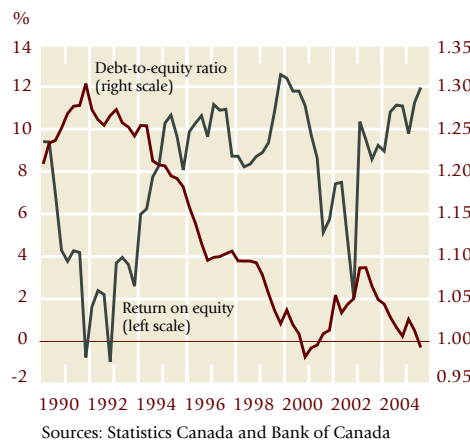
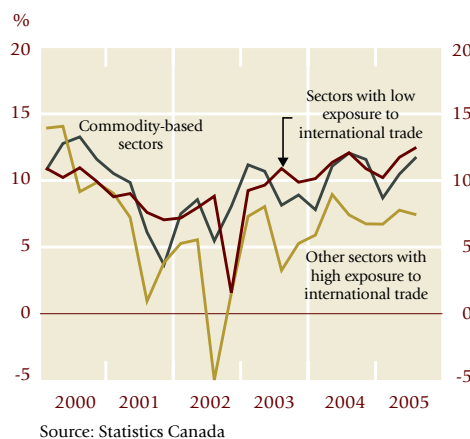
Sources: OFHEO and Bank of Canada calculations

Chart 15 International House Prices – Real*

1999Q1=100



* Deflated using national consumer price indexes
Sources: Bank of Canada and Royal LePage (Canada), OFHEO (U.S.), Australian Bureau of Statistics (Australia), Office of the Deputy Prime Minister (U.K.), INSEE (France), Bank of Spain (Spain)

Chart 16 Real GDP Growth: Canada**Chart 17 Financial Position of the Canadian Non-Financial Corporate Sector****Chart 18 Quarterly Financial Statistics for Enterprises: Rate of Return on Equity for Selected Sectors**

(See the October 2005 *Monetary Policy Report*.) Economic expansion is expected to continue to be supported chiefly by marked gains in final domestic demand. But the drag on real net exports arising from the past appreciation of the Canadian dollar is likely to lessen in 2006 and 2007.

Corporate Sector

The financial position of the non-financial corporate sector remained quite robust in the first three quarters of 2005. Profitability has been at a high level since early 2004, and leverage continued to be very low so far this year (Chart 17).

In the first three quarters of 2005, profitability remained quite strong in most sectors with a low exposure to international trade, as well as in the oil and gas extraction sector (Chart 18). However, the profits of some of the non-energy, commodity-producing sectors did ease from the very high levels reached in the second half of 2004, partly reflecting the impact of both the past rise in the Canadian dollar and sharp increases in the costs of energy and raw materials.

Profitability in most of the other industries with a high exposure to international competition (other than commodity producers) remained comparatively weak. Many firms in these industries continued to adjust to the past appreciation of the Canadian dollar, the high level of energy and raw-materials costs, and increasing competition from emerging markets.

While profitability, overall, remained quite high, the confidence of large firms has decreased since the third quarter of 2004 (Chart 19). The confidence of small firms has also fallen off since early 2005, owing partly to the substantial increase in fuel prices.

Industry

A number of industries, such as auto manufacturing, wood and paper products, and computer and electronics manufacturing, have been subject to considerable financial stress over most of the period since 2001. These industries account for about 12 per cent of the debt of the non-financial business sector. They also represent about 12 per cent of the Canadian banking sector's total loans and overdrafts to non-financial enterprises. Thus, although adjustments may be painful for those directly affected, the risks that these industries pose to the soundness of the financial system are limited.

Nonetheless, the further rise in the Canadian dollar since mid-2004 and substantial increases in the cost of energy and other raw materials exacerbated these industries' difficulties.

The profitability of Canada's auto manufacturing industry, as a whole, has hovered near its 16-year average (Chart 20). However, many auto parts companies in Canada (and in the United States) are continuing to experience serious financial problems. A key issue for most of these firms is that U.S. auto manufacturers, given sharply rising health-care and pension costs, are continuing to press for cost savings from their suppliers.¹⁸

Profitability in the wood and paper products industry has fallen markedly since the third quarter of 2004, reflecting such factors as the appreciation of the Canadian dollar and the surge in energy costs (Chart 21). Indeed, many pulp and paper companies are undertaking a considerable restructuring of their operations.

Rates of return in the electronics and computer manufacturing industry remained much lower than normal in the first three quarters of 2005 (Chart 22). Both the appreciation of the Canadian dollar and ongoing competitive pressures from firms in emerging markets are continuing to exert significant downward pressure on profitability.

The recent sharp rise in fuel costs is also likely to have significant adverse effects on the profitability of the Canadian air transport industry.

Elsewhere, grain producers are being adversely affected by the weakness of global grain prices, the appreciation of the Canadian dollar, sharp increases in energy and freight costs, and the lower-than-normal quality of this year's crop in Western Canada.¹⁹

The Financial System

Financial Markets

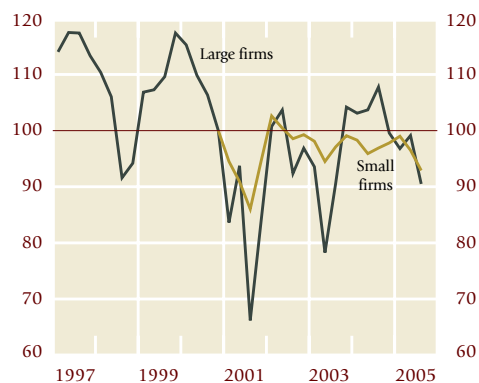
Since the time of the last *Review*, global financial markets have experienced a number of adverse shocks, including sharply higher energy prices and some concerns about a rise in inflation.

18. General Motors has recently announced a number of measures to significantly reduce its costs.

19. The federal government recently announced emergency financial assistance for grain and oilseed producers.

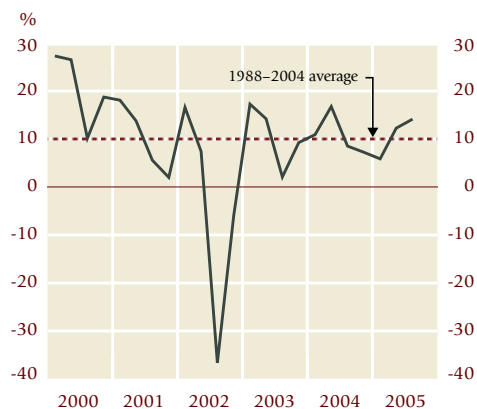
Chart 19 Canadian Business Confidence

2000Q4=100



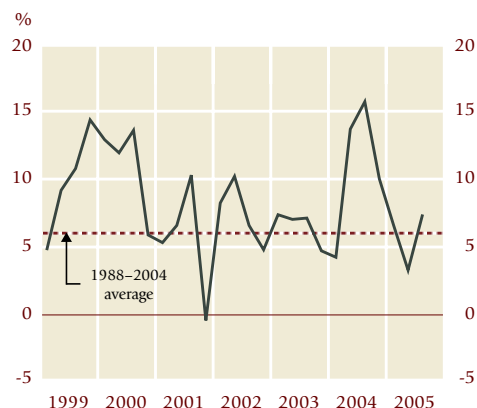
Sources: The Conference Board of Canada and CFIB Research

Chart 20 Return on Equity: Automotive Manufacturing



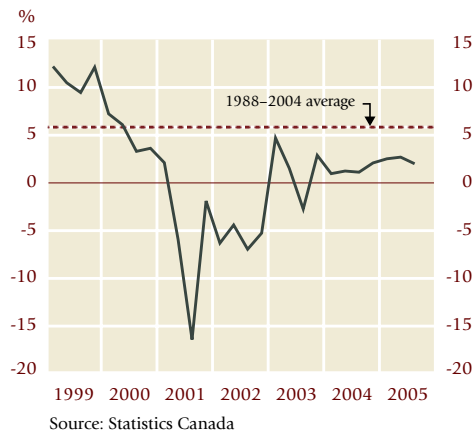
Source: Statistics Canada

Chart 21 Return on Equity: Wood and Paper Manufacturing



Source: Statistics Canada

Chart 22 Return on Equity: Electronics and Computer Manufacturing



In Canada, discussions about the tax treatment of the income trust sector had added some uncertainty to financial markets.

Prices of government bonds have declined, particularly those on long-term U.S. Treasuries whose yields are now well above the levels of June 2005. Global equity prices have continued to move higher, driven partly by strong profits, led by the energy sector. U.S. equity indexes have lagged somewhat, mainly because of rising interest rates and mounting inflation concerns in the United States. Nevertheless, the risk appetite of investors remains relatively strong. For instance, credit spreads (outside of the auto sector) remain near cyclical lows (Chart 23).

To date, financial markets seem to be adjusting to this period of greater uncertainty in an orderly fashion. But additional sources of risk to global financial markets remain, including the possibility of a disorderly adjustment of global imbalances and the adverse implications of investors' continued search for higher financial returns.²⁰

Chart 23 Yields on 10-Year U.S. and Canadian Bonds and Spread on Canadian Corporate High-Yield Bonds

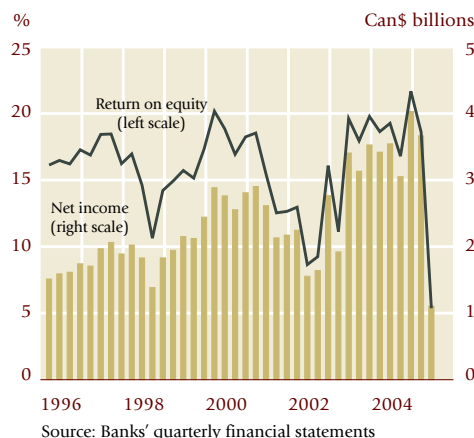


Financial Institutions

The combined financial performance of major banks fell sharply in the third quarter of 2005 (Chart 24). The decline in bank profits was largely attributable to a one-time charge of Can\$2.5 billion on CIBC earnings arising from an agreement in principle to settle the 2003 Enron class action litigation initiated on behalf of investors in Enron securities.²¹ CIBC has stated that, after taking this large charge into account, its Tier 1 capital ratio will remain above the minimum levels set out in OSFI's guideline in its Capital Adequacy Framework (CIBC 2005).

Overall, the implications of the CIBC charge to earnings do not alter the Bank of Canada's assessment of the overall long-term soundness of the banking system. Major Canadian banks reported very strong financial results in the first half of 2005. Average return on equity over that period was about 20 per cent. The diversified

Chart 24 Bank Profits

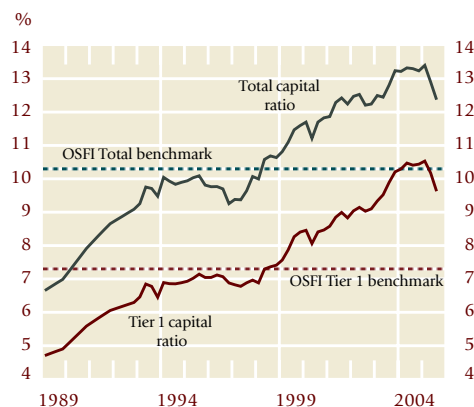


20. Recall the discussion on page 5 of this *Review* on the implications of low long-term bond yields for the financial system.
21. The Royal Bank and the Toronto-Dominion Bank have yet to settle the class action suit initiated by former Enron investors. Private sector analysts expect that any settlement on the behalf of these banks would be substantially less.

business strategy of major banks has supported continued strength in their financial results. The credit quality of their assets also appears to remain high. Furthermore, the very strong capital position of the sector provides institutions with a buffer should adverse economic or financial developments occur (Chart 25).

The property, casualty, and life insurance industries in Canada continued to report robust profitability over the first two quarters of 2005 (Chart 26). It is expected that hurricanes Katrina, Rita, and Wilma will negatively affect those Canadian companies with operations in the United States.²² But the financial consequences of the hurricanes are not expected to have a significant effect on the financial strength of these companies in light of their robust capital position. The securities industry in Canada has also maintained high profitability.

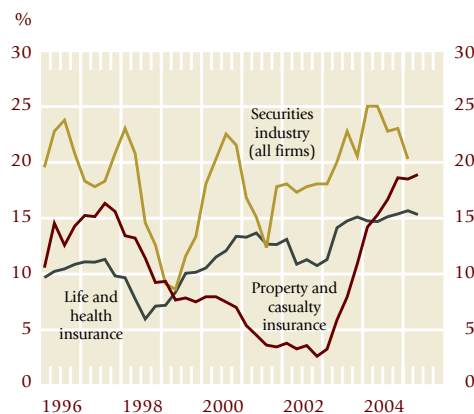
Chart 25 Capital Ratios of All Banks Operating in Canada



Source: Office of the Superintendent of Financial Institutions (OSFI)

Chart 26 Return on Equity

4-quarter moving average



Sources: OSFI, Investment Dealers Association, and Bank of Canada calculations

22. Private sector analysts expect Canadian insurers to report about Can\$550 million in after-tax charges.

Important Financial System Developments

This section of the *Developments and Trends* examines structural developments affecting the Canadian financial system and its safety and efficiency.

Highlighted Issue

The subprime mortgage market in Canada

Prepared by Jim Day

Until very recently, the self-employed, those with a blemished credit history, or those without an established credit history, had difficulty obtaining a mortgage in Canada. This market is now being tapped by a small group of niche lenders. These lenders have experienced strong growth in the past five years by catering to borrowers who do not fit the credit-scoring criteria of major banks. This has increased the efficiency of the financial system by allowing households across a broader range of creditworthiness to obtain mortgage financing and thus become homeowners. But the development of this market in Canada, referred to as the subprime mortgage market, also raises potential risks from a financial stability perspective. This section presents stylized facts about the subprime mortgage market in Canada, together with implications for the financial system.²³

The term “subprime” refers to any lending that has elevated credit risk. Subprime mortgages are rated by their perceived risk: A-, B, C, and even D. Credit scores are used extensively by institutions to determine the appropriate level of risk. Another group of higher-risk mortgage loans are known

as “Alt-A” loans. Borrowers in this group often have good credit scores, but documentation describing their income or employment is limited. Loans that are outside the typical debt-to-income ratios and mortgages with high loan-to-value ratios would also fall into the Alt-A category.

The major players in Canada’s subprime mortgage market are Equitable Trust, Home Trust, Xceed Mortgage, Bridgewater Financial, Wells Fargo Financial Corp., and GMAC Residential Funding (through broker Mortgage Intelligence). The vast majority of subprime mortgage loans are made through mortgage brokerages and their network of agents. One subprime lender estimates the potential size of the subprime mortgage market in Canada to be about \$55 billion (9 per cent of the current total residential mortgage market), suggesting potential growth for this market of \$45 billion. In the United States, subprime mortgage loans make up about 11 per cent of all mortgage loans (up from just 1 per cent to 2 per cent in the early 1990s) and accounted for about 20 per cent of all new mortgage loans in 2004.

Subprime loans have higher risk of default and are more labour-intensive to administer. Lenders are compensated for this by charging higher interest rates and fees than they would for traditional mortgages. How much higher the mortgage rate is depends on factors such as credit score, size of the down payment, and the property type (e.g., single-family home or condominium) and location. Generally, FICO (Fair Isaac and Company) credit scores above 680 are considered prime (scores range from 300 to 900) and would qualify a person for the best, or

23. This analysis is based on the limited statistics that are currently available, as well as on anecdotal sources, including newspaper articles, research reports, and corporate financial statements.

close to the best, mortgage rates. Scores between 600 and 680 are considered near prime.

Canadian subprime lenders indicate that they are primarily targeting borrowers just outside the comfort zone of major banks. As well, they are, for the most part, not offering some of the non-traditional mortgage products including features with elevated risks that have become more common in the United States. For example, only one Canadian subprime lender is offering an interest-only mortgage product. Thus, Canadian subprime loans are less likely to go into default. This is reflected in the fact that one subprime lender posted a 5-year rate only about 150 basis points above the best prime mortgage rates of major banks, while the premium in the United States for the riskiest eligible borrowers can be more than 500 basis points over the best rate.

This level of selectivity by Canadian lenders appears to have contributed to somewhat lower delinquency rates compared with those of their U.S. counterparts: the delinquency rates at Canadian subprime lenders are two to four times the level at the major banks. This is broadly comparable to the delinquency rate on U.S. prime mortgage loans.

To assess the vulnerability of Canadian subprime lenders and the potential implications for the domestic financial system, it is useful to consider the percentage of subprime mortgage loans that are insured. In Canada, federal law requires that mortgages granted by federally regulated financial institutions and having a loan-to-value ratio greater than 75 per cent carry mortgage insurance. This provision protects the lender in the case of borrower default. The two largest subprime lenders in Canada are both federally regulated. In fact, both have a policy of lending only up to a maximum loan-to-value ratio of 75 per cent. Even if it is not required by law, they still choose to insure a significant portion of their mortgages.²⁴

Canadian subprime lenders securitize a greater share of their mortgages than do major banks. Almost all of the insured loans of the top two subprime lenders are securitized and sold under CMHC's NHA mortgage-backed securities program. Since very few insured mortgages are kept

on the balance sheet of the subprime lenders, it is the risk profile of the uninsured portfolio maintained as assets that will determine what effect any change in economic conditions might have on the credit quality of those assets.

As stated above, the two largest subprime lenders in Canada fall under the oversight of OSFI and are subject to its rules and guidelines. While not under OSFI regulation, the other major subprime lenders are publicly traded companies; the public availability of their financial reports aids market discipline.

Over the longer term, potential financial system vulnerabilities could arise from the subprime market. This could occur if economic conditions weaken and/or if interest rates rise. Such developments would likely affect subprime borrowers to a greater degree, since prime borrowers generally have more financial resources available to them. The risk that this market poses to the financial system would be somewhat greater if Canadian lenders started to follow their U.S. counterparts in targeting riskier borrowers and offering riskier mortgage products. However, it does not appear that the developing subprime market in Canada is posing an imminent risk to the soundness of the domestic financial system.

Rather, the development of the subprime market in Canada has increased the efficiency of the financial system by allowing households across a broader range of creditworthiness to obtain mortgage financing and thus become homeowners.

The Financial System

Financial Markets

In October 2005, the board of directors of the Investment Dealers Association of Canada (IDA) approved a proposal to create a trade association to represent the brokerage industry, as well as a separate regulatory body to oversee the activities of brokers and their employees. This decision was taken to address concerns about potential conflicts of interest and, ultimately, to maintain investor confidence in the self-regulatory organization. Member firms will vote on the proposal before year-end.

24. Source: Bank of Canada calculation based on company financial statements

Box 1**The Structure and Evolution of Markets for Energy Derivatives**

Deregulation, together with recent geopolitical events, has spurred a tremendous growth in derivative markets for oil, natural gas, and electricity. The volume of energy contracts traded on the New York Mercantile Exchange (NYMEX) has increased from 41.5 million contracts in 1990 to 118.9 million in 2004 (105.4 million as of September 2005). To put this in context, in April 2005, roughly 5.7 million oil futures contracts traded on the NYMEX, which translated into an underlying (notional) value of approximately US\$286 billion.

Exchange-traded derivatives have been around for some time, with oil futures and options contracts trading since the late 1970s in the United States. More recently, electronic energy-trading systems that specialize in over-the-counter (OTC) energy instruments have emerged, including the Intercontinental Exchange (ICE) in the United States. In Canada, the NGX (owned by the TSX), which began operations in 1994, currently trades roughly \$40 billion annually in notional value of energy derivative contracts. But it trades predominantly physical electricity and natural gas (spot) contracts. The development of these markets is important for the financial system, since they can enhance both its efficiency and its stability.

Like most derivatives, energy derivatives were initially developed to enable energy market participants to hedge against market risk. The new competitive environment that resulted from deregulation amplified the need for energy derivatives, such as exchange-traded futures and options, or off-exchange-traded more-customized instruments, such as forwards and basis swaps, to manage the price risks.¹ These instruments allow firms to better cope with the price uncertainty of a deregulated environment. (See U.S. Department of Energy (2002) for more on risk-management practices in the energy sector.)

Compared with those who invest in equities, bonds, and foreign exchange instruments, energy producers and industrial energy consumers face relatively larger market risks, given the volatility of the underlying energy-commodity prices (Table A). The higher volatility of energy prices relates to the greater sensitivity of wholesale energy markets to non-financial (or non-macroeconomic) events, such as weather. Moreover, natural gas and, more importantly, electricity, face geographic and storage constraints. These imply that local supply shortages or gluts cannot be easily balanced against non-local offsetting imbalances. Without access to financial contracts on energy, producers and

industrial consumers face a relatively higher probability of sharp changes in their financial health.

This brings us to the market-efficiency benefits of energy derivatives. Since energy derivatives allow energy-related firms to better manage their risks, this implicitly lowers their cost of capital (and/or lowers their probability of default). To the extent that firms face costs related to financial distress, the existence of derivatives (by reducing these costs) increases the profitability of any given investment.²

By introducing clearing services for OTC trades, energy exchanges like the NGX, ICE, and NYMEX have also allowed a reduction in the amount of collateral required to back OTC trading and, in the end, the aggregate level of OTC trading counterparty risk. Centralized clearing also makes it easier and less costly for non-traditional participants, such as hedge funds, pensions funds, and investment banks, to enter the energy market and trade with energy producers and industrial consumers, because their counterparty risk concerns are averted.

Table A

Volatility in Energy Prices and Financial Markets*

Electricity	403
Natural gas	78
WTI crude oil	42
S & P 500	13.4
10-year Canadian bonds	9.5
U.S. Dollar/Canadian dollar	4.6

* Average annualized volatility calculated using sample ranges beginning between 1990 and 1995, ending in 2005.

1. Since producers had little incentive to expand supply, the regulation of energy markets led to increasingly acute supply shortages, thus driving the need for deregulation.

2. Allayannis and Weston (2001) show that firms that are more likely to come under duress are likely to use derivatives. Other studies show that increased hedging activity by firms increases firm value (U.S. Department of Energy 2002).

On a different note, a number of developments have spurred a tremendous growth in financial energy-trading markets (oil, natural gas, and electricity). The emergence of these markets has allowed traditional energy market participants (such as utilities, refiners, and oil and gas producers) to hedge their exposures to energy risks more effectively. The implications of these developments for Canada's financial system are assessed in Box 1.

Other recent financial market developments include the issuance by a number of sovereign debt managers of ultra-long bonds. The potential implications of this development for financial system efficiency are discussed in Box 2.

Globally, capital markets are becoming increasingly liberalized and integrated. Within this context, authorities are working to implement a more coherent set of global accounting standards in order to contribute to a more efficient allocation of capital from savers to borrowers. The rationale for these efforts, as well as their prospects for enhancing the efficiency of the domestic financial system, are discussed in Box 3.

Financial Institutions

Over the last several years, numerous factors, including the low returns on traditional financial instruments, have encouraged retail investors to purchase complex financial instruments from securities dealers.²⁵ These include instruments referred to as principal-protected notes, collateralized debt obligations, credit default swaps, and volatility protection. This development raises the need for authorities and securities dealers to promote the financial education of households to help them better understand the financial risks to which they are exposing themselves by investing in such products. Selling financial instruments with complex characteristics to retail investors also exposes securities dealers that market such products to reputational and legal risks. This, in turn, raises the need for Canadian

banks and dealers to maintain appropriate internal controls in order to effectively manage such legal and reputational risk.

Clearing and Settlement Systems

The Automated Clearing Settlement System (ACSS) clears and settles paper-based payments, such as cheques, and electronic items, including direct deposits and pre-authorized withdrawals. In February 2003, the Canadian Payments Association introduced a \$25 million cap on all paper-based payments clearing through the ACSS. This initiative was designed to encourage institutions to send their large-value payments through the Large Value Transfer System (LVTS), which has stronger risk controls and offers immediate finality and irrevocability of payment.²⁶

The \$25 million cap affected one particular payment category in the ACSS: the L-stream, which represents all paper-based payments with values of more than \$50,000. Although total L-stream values had been trending downwards prior to 2003, the cap caused an additional \$4 billion reduction in the L-stream value, to a daily average of \$7.5 billion (Chart 27). This decline has been partially offset by strong growth in the electronic payment categories. As a result, the total value of ACSS payments fell by only about \$3.5 billion when the cap was implemented and has trended upwards since the beginning of 2004 (Chart 28).

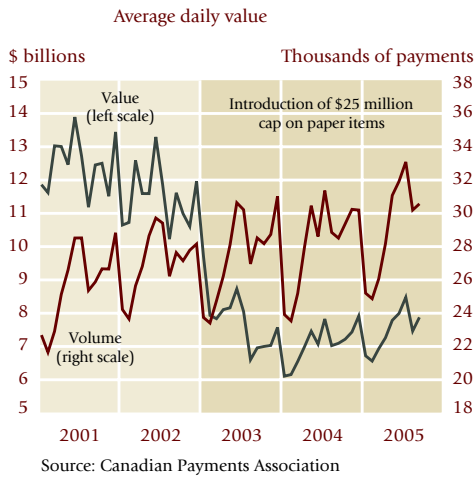
Prior to implementation of the cap, there was concern that large-value payments would not migrate to the LVTS, but would be transferred to other electronic payment categories within the ACSS; namely, Automated Fund Transfer and Electronic Data Interchange (AFT/EDI).²⁷ If such "leakage" occurred, one would expect an accelerated growth in AFT/EDI values after the cap was in place. Although continuing to grow very strongly, there is no evidence of any acceleration since February 2003 (Chart 29).

25. This development is part of the broader trend of households carrying increasing levels of financial risk. See pages 8 to 10 of the June 2005 *Review* for more on this issue.

26. For more information on this initiative see <http://www.cdnpay.ca/publications/news_ceiling.2asp>.

27. AFT contains credits (e.g., direct deposits) and debits (e.g., pre-authorized withdrawals). EDI is often used for payments between corporations.

Chart 27 Paper Items over \$50,000 (L-Stream) in ACSS



Moreover, there is continued effort to examine ways to move more large-value payments to the LVTS.²⁸ For example, efforts have been made to encourage the movement of entitlement payments²⁹ away from paper cheques to more efficient means, such as payment through the LVTS or directly into the securities settlement system.

Chart 28 Total Items Processed by the ACSS

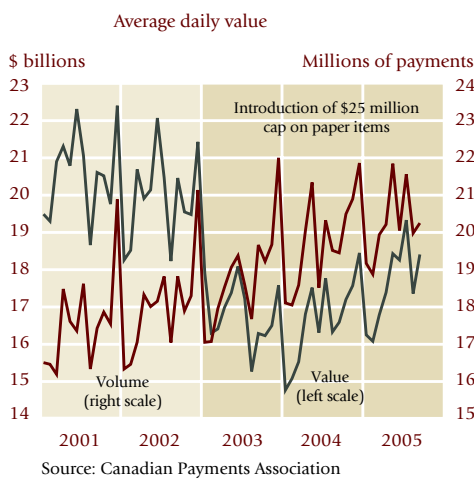
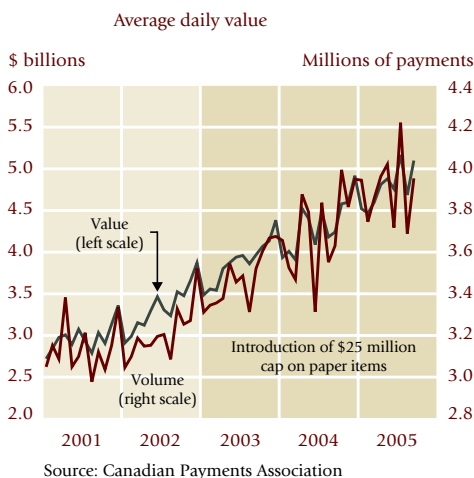


Chart 29 AFT/EDI Items in ACSS



28. A significant portion of the large-value cheques are associated with entitlement payments for the securities business. This inefficient process creates unnecessary cost for CDSX, the Canadian securities clearing and settlement system, and exposes the Canadian Depository for Securities to a small risk.
29. These are payments (e.g., interest and dividend) made to holders of securities by the issuers.

Box 2

Recent Developments in Ultra-Long Sovereign Bonds

Demographic trends, especially the aging of the workforce and the increase in life expectancy at retirement age, in combination with recent changes in accounting standards and pension fund regulations in Europe, have led pension funds to focus on the merits of matching pension fund assets with long-term liabilities. This interest has suited the objectives of a number of sovereign debt managers who see an opportunity to cost-effectively diversify their sources of funding to finance fiscal deficits.

As a result, some sovereign issuers have issued high-quality ultra-long bonds, with a maturity of up to 50 years. The issuance of these fixed-income instruments is in line with the policy conclusions of a recent G-10 report (2005). These bonds may enhance the stability and efficiency of the financial system by enabling pension funds and life insurers to better match their assets with their liabilities.

In February 2005, the French Treasury Agency (AFT) became the first sovereign issuer in recent years to sell ultra-long bonds by issuing €6 billion of 50-year bonds at a yield 3 basis points above that on the French 30-year benchmark bond. The issuance was successful and confirmed the growing interest of institutional investors in ultra-long bonds. Pension funds and asset managers were allotted 53 per cent of the issue. Bonds allocated to insurance companies and banks were worth, respectively, 14 per cent and 13 per cent of the amount issued. The geographic distribution of the issue confirms widespread interest in longer-term bonds. About 45 per cent of the distribution was outside the euro zone, with 7 per cent going to investors in North America. The AFT has indicated that the outstanding amount of the 50-year bond will be increased to €10-€15 billion in the future.

Following the AFT's 50-year issue, the U.K. government issued £2.5 billion of 50-year conventional gilts in an auction at 10 basis points below the yield on 30-year conventional gilts. The U.K. Debt Management Office (DMO) auctioned an additional £2.25 billion on 14 July to promote the liquidity of the original issue and, on 22 September, introduced through syndication the world's first 50-year inflation-linked bond. The nominal amount of this issue was £1.25 billion.

Table A provides details of these new ultra-long bond issues.

Current sovereign issuers of ultra-long bonds have indicated that their initiative was consistent with their funding strategies and not opportunistic. The issuance of ultra-long bonds may not be appropriate for sovereigns with limited borrowing requirements. However, it may enhance the efficiency of the financial system by providing benchmarks for non-sovereign issues, such as the 50-year euro-denominated bond issued by Telecom Italia in March 2005. The duration and the convexity of ultra-long bonds make them attractive fixed-income instruments for the hedging and arbitrage activity of other financial market participants.

Table A

Details of New Ultra-Long Bond Issues

	France (AFT)	U.K. (DMO)
Issuance mechanism	Syndication	Auction
Security type	OAT	Conventional gilt
Announcement date	23 February 2005	26 May 2005
Maturity date	25 April 2055	7 December 2055
Coupon	4%	4.25%
Amount issued	€6.00 billion	£2.50 billion
Total demand	€10.5 billion	£3.99 billion
Yield	4.21%	4.22%

Sources: Agence France Trésor and U.K. Debt Management Office

Box 3**The International Convergence of Accounting Standards**

As capital markets become increasingly liberalized and integrated globally, accounting standard-setters are working towards greater consistency in standards across jurisdictions. This should ultimately lead to a more efficient allocation of capital globally across companies and projects.

The use of a more coherent set of global standards would enhance the comparability of firms and industries across borders. The scope for markets to receive false signals about a foreign company's prospects because of a lack of familiarity with the standards used for its accounts should also be reduced. Investors should be able to make better-informed decisions about foreign investment opportunities and diversify their portfolios globally at a lesser cost.

The global convergence of accounting conventions would also lower the cost of financial reporting—and thus the cost of raising capital—for firms accessing capital markets in multiple countries by eliminating the need for duplication of financial statements. This would create greater competition for listings among marketplaces, potentially enhancing the efficiency of the financial system as a whole. For these benefits to materialize, however, standards for financial disclosure need to be sound, complete, and applied consistently across companies and jurisdictions.

International financial reporting standards (IFRS), the set of global norms developed by the International Accounting Standards Board (IASB), are already in use in over 90 countries, and standard-setters in a number of others are making progress towards harmonization.¹ The path towards national acceptance of global standards varies from one country to the next.² Many countries support the goal of global standards but find some aspects of IFRS too challenging to implement or incompatible with national values. Local standards might thus broadly—but not necessarily completely—converge with global conventions.

IFRS introduce the broad use of fair value accounting for financial instruments. This approach requires financial assets and liabilities to be valued according to current market conditions instead of historical costs. Market value may not be readily observable in some cases, which could open the door for manipulation of financial statements and introduce artificial volatility

in accounting data. Standard-setters are currently developing better guidance on how to apply fair value accounting objectively.

Work is under way to reconcile differences in the approaches underlying IFRS with those of U.S. standards. Indeed, given the importance of U.S. markets in the global financial system, removing existing gaps between IFRS and U.S. standards is crucial for achieving true global convergence. Differences can be attributed partly to the general preference of IFRS for broad principles, while U.S. standards are closer to prescriptive rules. There is wide support for convergence in the United States, and the U.S. Financial Accounting Standards Board (FASB) is collaborating with the IASB to minimize the gaps between their respective standards. But many doubt that full harmonization will be achieved, with U.S. standards likely to remain more prescriptive than IFRS. Benefits may, nevertheless, partly materialize. For instance, the Securities and Exchange Commission has indicated that it may reduce the burden on foreign firms accessing U.S. markets by allowing them to file statements prepared according to IFRS, providing sufficient progress is made in terms of convergence between IFRS and U.S. standards.

The Canadian Accounting Standards Board (AcSB) is proposing gradual convergence with IFRS by 2011 for public companies. The AcSB would participate in the ongoing development and refinement of global standards. Consultations were held on this issue earlier this year, and the AcSB is planning to finalize an action plan by March 2006. Both the AcSB and the Committee of European Securities Regulators (CESR) consider Canadian standards to be broadly equivalent to IFRS.

1. Source: Deloitte-Touche-Tohmatsu International Accounting Standards (www.iasplus.com)
2. The European Union adopted IFRS for publicly listed companies in January 2005. But implementation is deferred to 2007 for companies with securities listed in a country outside the EU, where another set of internationally accepted standards is used. Firms with only debt securities listed in public markets can also wait until 2007 to adopt IFRS.

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Reports

Introduction

Reports address specific issues of relevance to the financial system (whether institutions, markets, or clearing and settlement systems) in greater depth.

Defined-benefit plans are by far the most important part of "pillar three" of Canada's retirement system, which includes employer-sponsored pension plans.¹ However, the future of defined-benefit pension plans is being increasingly jeopardized. Sponsors are worried about the mounting costs of maintaining these plans. Pension regulators are concerned about the large deficits being run by many of these plans and, consequently, about the exposure of plan participants to the potential insolvency of the sponsor. And many active and retired employees are wondering about the security of their promised benefits. In this context, government initiatives are currently under way to review the legislative and regulatory framework for pension plans to ensure that it remains effective and responsive to market conditions. In "Strengthening Defined-Benefit Pension Plans," Jim Armstrong and Jack Selody highlight the major impediments to viable employer-sponsored defined-benefit plans and propose possible options for strengthening these plans. The authors conclude that changes must be made if employer-sponsored pension plans are to remain a viable option for Canadian savers.

The financial health of Canadian public non-financial companies is important to the stability of the financial system. Corporate bonds and equities make up a large part of the asset holdings of banks, insurance companies, and households (through pension plans and mutual

funds). Hence, a rash of corporate failures could have a widespread economic impact by eroding the capital of financial institutions and the wealth of households. When aggregated data are used to assess corporate financial health, important information about the underlying distributions is overlooked. Microdata can provide information about the "vulnerable tails" that are thought to be more relevant for analyzing financial stability. In "The Use of Microdata to Assess Risks in the Non-Financial Corporate Sector," Meyer Aaron and Dylan Hogg focus on company-level accounting measures to assess the financial health of the corporate sector. In particular, they construct a vulnerability indicator using the "vulnerable tails" of the distributions for certain financial ratios. Preliminary analysis shows that the vulnerability indicator can be a useful tool for assessing risks to financial stability in the non-financial corporate sector. The authors also apply their methodology at the sectoral level.

1. It is generally understood that the Canadian retirement system is supported by three pillars. The first pillar consists of the Old Age Security and Guaranteed Income Supplement programs. The second pillar comprises the Canada and Quebec Pension Plans.

Strengthening Defined-Benefit Pension Plans

Jim Armstrong and Jack Selody

The purpose of this report is to provide a framework for discussing ways of strengthening the viability of defined-benefit pension plans.

Responsibility for pension regulation and supervision in Canada is shared between federal and provincial governments. The largest regulator is the Financial Services Commission of Ontario, which supervises almost 40 per cent of all plan assets. About 10 per cent of plan assets fall under federal jurisdiction and are supervised by the Office of the Superintendent of Financial Institutions. The federal government and the province of Quebec have each initiated public consultation processes aimed at strengthening their respective legislation and regulations.¹

Introduction

The future of defined-benefit pension plans is increasingly being questioned. Sponsors are worried about the growing difficulty of maintaining these plans. Pension regulators are concerned about the large deficits that many of these plans are running and, consequently, about the exposure of these plans to the insolvency of the sponsor. As a result, many active and retired employees are unsure about the security of their promised benefits.

Employer-sponsored defined-benefit pension plans are a very important part of the third pillar of Canada's retirement system, which comprises tax-deferred private retirement savings.² Defined-benefit pension plans provide features not provided by other types of plans. They provide a guarantee of retirement income that

ultimately helps risk-averse savers to efficiently achieve their optimal savings rate. The associated pension funds represent large pools of capital with a very long-run investment perspective that contribute importantly to the efficiency of the financial system.

The potential for continued erosion of the viability of defined-benefit plans raises concerns with respect to the financial system, particularly in the area of efficiency. Without the option of defined-benefit pensions, risk-averse savers are likely to pursue less-efficient allocations of capital. And without the presence of such plans, the financial system is less likely to experience the efficiency gains provided by active market investors with a long-term perspective. Inefficiencies from either of these sources could result in significant costs to the Canadian economy.

This report first provides background on the difficulties currently facing defined-benefit plans. A key current impediment is the asymmetry faced by sponsors, whereby pension fund surpluses are increasingly seen as the property of plan members, while deficits remain the sole responsibility of the sponsor. An associated problem is the high opportunity cost of pension fund surpluses for sponsors, which significantly reduces their incentive to maintain surpluses.³

This is followed by an examination of the conceptual underpinnings of defined-benefit plans. The basic elements that the regulatory and legal environment should support to maintain the viability of defined-benefit pension plans are then highlighted.

1. See Department of Finance (2005) and Régie des rentes (2005).

2. The first pillar consists of government income security programs (OAS/GIS), and the second pillar is made up of government pension programs (CPP/QPP).

3. Armstrong (2004) discusses the financial stability implications of the current funding problems facing defined-benefit pension plans.

Defined-Benefit Plans: Their Position in the Canadian Retirement System

The Canadian retirement system consists of three pillars, the first of which comprises government income support, the second public pensions, and third private pension arrangements (Department of Finance 2005).

Government-sponsored minimum income programs—*Old Age Security* and *Guaranteed Income Supplement*—are intended to ensure a minimum level of retirement income for Canadian seniors. The Old Age Security (OAS) program provides a flat monthly pension for Canadians aged 65 and over, who meet certain residency requirements. The Guaranteed Income Supplement (GIS) is an income-based program that provides an additional pension over and above the OAS benefit.

In the second pillar, the Canada and Quebec Pension Plans are compulsory earnings-based plans that are financed solely through employee and employer contributions, with benefits partially pre-funded and backed by a portfolio of assets held at arms length from government. The aim of the CPP/QPP retirement benefit is to ensure that all Canadians have a basic level of earnings-related, defined-benefit, price-indexed pension income. The maximum pension is equal to about 25 per cent of the average industrial wage in Canada over the last five years.

The private plans that make up the third pillar provide opportunities for tax-efficient retirement savings. These are intended to fill the gap between the government income support and pension programs and the desired post-retirement income objectives of individual Canadians. Included in this pillar are tax-deferred private retirement savings consisting of registered employer-sponsored pension plans and registered retirement savings plans (RRSPs), which are individual tax-deferred savings accounts. While employer-sponsored pension plans are voluntary in Canada, they must be registered federally for tax purposes in order to operate as a registered pension plan that can provide tax-deferred pension benefits.⁴ They

must also be registered either federally or with the appropriate provincial authority for the purpose of complying with pension benefits standards.

Registered pension plans are broadly classified as *defined benefit* (DB) or *defined contribution* (DC).⁵ Defined-benefit plans provide members with benefits related to their earnings and years of service. They are designed to provide predictable retirement income for plan members. To achieve this predictability, the employer commits to delivering a certain level of benefits and incurs the risk associated with delivering on that promise.⁶

Under DC plans, employers and/or employees make contributions to an individual account for each member, and retirement benefits are based on the amount contributed to the account plus investment income, gains and losses, less expenses. Benefits paid depend upon the return on investment. Under these arrangements, plan members essentially assume all the risks of providing an adequate income at retirement.

Recent Trends: DB Plans in Decline

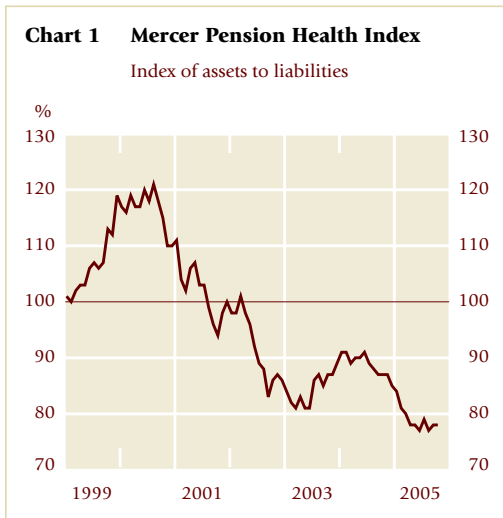
Developments in recent years have led many commentators to suggest that the future of corporate defined-benefit pension plans in Canada is in doubt if reforms are not forthcoming. While defined-benefit plans still account for almost 80 per cent of members covered by registered plans in Canada, this ratio is declining. Very few new defined-benefit plans are being created, and some existing plans have been closed to new members and, in some cases, are being replaced by defined-contribution plans.

Indeed, the proportion of Canadian workers covered by any type of registered pension plan in Canada (DB, DC, and other) has been falling. While over 40 per cent of workers were in employer-sponsored pension plans in 1992 (either DB or DC), this fell to 35 per cent by 2004. Over this same period, the proportion of workers covered by DB plans fell from about 38 per cent to 29 per cent. This drop was concentrated in private sector DB plans.

4. To be registered, plans must adhere to the pension tax rules, which place limits on benefits and transfers. The rules also control the tax-deferral costs associated with amounts over and above those required to fund the promised pension benefits.

5. A small proportion of plans in Canada—often referred to as *hybrid plans*—have characteristics of both DB and DC plans.

6. One risk that sponsors cannot assume is the risk of their own insolvency, the implications of which are discussed later in this article.



Although the decline in DB plans in Canada has not been as fast as that in the United States, the United Kingdom, or Australia, the expectation is that the process will accelerate. For example, a survey by Hewitt Associates (2004) of a diverse group of 174 plan sponsors found that 49 per cent of respondents provided a DB plan for newly hired employees in 2000, but only 39 per cent were expecting to offer one by the end of 2006.

Recent adverse developments

An unfavourable conjunction of events in recent years has caused corporate sponsors in Canada to reconsider sponsoring a DB plan because of the significant risk that these plans pose for the corporate balance sheet. The evolving interpretation of pension law and pension regulation has helped to increase this risk.

In general, the size of pension obligations relative to the size of corporate balance sheets has been rising, as demographic and workforce trends pushed such plans into their mature phase. Furthermore, movements in equity markets and interest rates have caused a sharp deterioration in the funding position of many DB plans since 2000 (Chart 1). Projected movements in market prices seem unlikely to help plans that are in severe deficit positions to recover any time soon (Armstrong 2004). Pension-funding regulations are requiring the sponsors of plans that are in deficit to make additional payments, thus increasing the costs of funding these plans.⁷

At the same time, many argue that legal and regulatory developments have eroded the incentive to sponsor DB plans because of the basic asymmetry mentioned earlier, and some argue that this erosion is significant enough to make DB plans non-viable.⁸

In this context, court rulings have tended to increasingly restrict a sponsor's access to any pension fund surplus. In an important ruling in 1994, the Supreme Court of Canada in *Schmidt v. Air Products* held that pension funds set up as pension trusts are subject to classic trust

7. The deficits of DB plans can also create pressure to increase employee contributions or to reduce future benefits.
8. Regulations pertaining to defined-benefit pension plans are also more complex, and likely more costly, than those governing other types of plans and effectively pose another disincentive to sponsoring these plans.

principles. As a consequence, if a defined-benefit pension plan is funded through a trust, then, practically speaking, the only way a firm could gain exclusive access to a surplus on plan wind-up was if it expressly reserved that right at the time the trust was set up.⁹ If the pension plan was not a trust, however, the Court ruled that ownership of a surplus could be determined according to the principles of contract law.¹⁰

Another landmark ruling occurred in 2004, when the Supreme Court held in *Monsanto* that at the time of a partial windup of the plan Ontario pension legislation requires that a surplus must be partially distributed to the owners of the surplus.¹¹ Many believe that this decision exacerbated the above-noted asymmetry for sponsors (Watson Wyatt Worldwide 2004). The decision allows for the possibility that a proportion of a surplus may have to be paid out to plan members and is therefore unavailable to the sponsor to reduce the chance that it may need to make additional contributions to the fund in the future. Furthermore, since most firms will have to reorganize their business operations at some future time, they would then face the prospect of a partial windup of their pension plans and a partial distribution of any surplus.¹²

Accounting rules for DB plans also tend to be much more complex than those for DC plans. While pension arrangements are typically “off-balance-sheet,” developments in pension funds can impart volatility to reported

corporate earnings and increase the perceived riskiness of the firm to financial market participants, who then may discount the value of the firm. The larger the size of the pension plan relative to the sponsoring firm, the greater this effect tends to be. Companies must deal with ongoing changes to these rules, as well as a likely shift towards “fair value” accounting in coming years, which has the potential to amplify such effects.

These developments have all reduced the incentives for many plan sponsors to make more than the minimum required contributions to their pension funds. The asymmetry of risks and rewards in the “pension deal” in Canada is increasingly seen as unacceptable from the viewpoint of sponsors. For an example, see the arguments put forth by the Certified General Accountants Association (2004).

Factors influencing trends

Concerns about the “DB pension deal” have been underlined in a recent survey of chief financial officers (CFOs) conducted by the Conference Board of Canada and Watson Wyatt Worldwide in early 2005 (Conference Board 2005). The survey found considerable pessimism about the ultimate fate of DB plans, and this pessimism has actually increased since the first survey conducted a year earlier. For example, the proportion of CFOs who believe that there is a widespread problem that will persist for the next few years increased from 20 per cent in 2004 to 43 per cent in 2005. This survey reflects the fact that employers have serious reservations about sponsoring DB plans. The trend in DB plans in Canada appears to be influenced mainly by the concerns of the sponsors.¹³

Benefits of DB Plans

The establishment of a pension plan is not mandatory for Canadian employers. But most large employers consider some form of pension or retirement plan to be a valuable feature of a

9. The *Schmidt* ruling held that sponsors could not unilaterally revoke the trust in order to access a surplus unless the power to do so was expressly reserved from the start. In some cases, a sponsor could still potentially access a surplus by obtaining a sufficient level of member consent. *Schmidt* does not preclude a sponsor from taking a contribution holiday when the plan is in surplus. See Gillese (1996) for additional background information.

10. It should be noted, however, that there is nothing to prevent any new DB plan from defining, in the trust agreement, who owns the surplus under what conditions.

11. This ruling applies only to pension plans under Ontario’s jurisdiction, but a number of other provinces and the federal government have similar wording in their legislation. Note that the *Monsanto* decision does not address the issue of who is entitled to a surplus. It simply requires a partial distribution of the surplus upon partial windup. This would, of course, be contingent on there being a surplus at the time of the partial termination.

12. It should be noted, however, that not every corporate reorganization would lead to a partial windup. This typically depends on a determination by the pension regulator.

13. It is important to note, however, that other forces can affect the mix of pension plans. These include a shift in workforce characteristics (Aaronson and Coronado 2005) and changes in regulatory and accounting standards. In the United Kingdom for example, it appears that a shift to “fair value accounting”—which has amplified the effect of volatility in the pension funding position on corporate balance sheets—has been a major contributing factor to the recent shift away from DB plans.

competitive compensation package. As a result, there are over 14,000 employer-sponsored pension plans in Canada, covering just under 5.5 million employees or 35 per cent of the total Canadian workforce.

As mentioned, the largest proportion of plan members in Canada are currently covered by DB plans. To assess the types of reforms that will enhance financial system efficiency, it is useful to consider the unique characteristics that DB plans offer to employers, employees, and to financial markets.

Employer perspective

In a recent Canadian survey, sponsors were asked for their rationale in providing pension/capital accumulation programs to their employees (Hewitt Associates 2004). The number one answer, by a wide margin, was “to provide a competitive total compensation package.” Other responses included “to attract and retain employees” and to “enable employees to achieve an adequate retirement income so that they transition out of the workplace.”

DB plans have traditionally been viewed as a way to attract and keep high-quality employees because they provide certainty about retirement income. In essence, the employer is offering to insulate the retirement income of employees against the volatility of financial markets and “longevity risk.” It is important to note that the longevity risk assumed by the employer is less than the sum of the individual risks to the employees, because the employer is in a position to effectively “pool” this risk in the DB plan.

On the other hand, DB plans can add to workforce inflexibility by making it more difficult or costly to lay off older or long-standing employees who have become redundant.¹⁴

Employee perspective

The pension literature has generally shown that, from an employee’s perspective, attitude to risk is an important dimension in assessing the intrinsic value of various types of pension plans. Risk-averse workers will typically prefer DB plans because they offer a stream of retirement

income guaranteed by the sponsor. Thus, employees do not have to face the investment risk of managing their own retirement account, and their retirement income is secure even if they live beyond a normal life expectancy.

That said, workers who plan to change jobs tend to prefer DC plans, which are more portable because benefits accrue more evenly over a career than is the case for DB plans.

Investor role

The pension funds associated with DB plans play an important role in the financial system: that of institutional investor. Because DB plans in Canada tend to be sponsored by large organizations—corporations and public sector entities—they result in large pools of capital to invest in stocks, bonds, and short-term instruments. These pension funds provide a stable source of long-term capital for the economy and contribute to financial market liquidity. Furthermore, they have the sophistication and long-term perspective to invest in “alternative asset classes,” such as infrastructure projects (Tuer and Woodman 2005), involving complex analysis and very long time horizons.¹⁵

A Conceptual Framework

Before discussing possible solutions to the problems facing DB plans, it is useful to consider the conceptual underpinnings of these plans.

In principle, any sponsored pension plan is a contract between a firm and its workers. Conceptually, the sponsor is the residual risk-taker for the pension plan. Residual risk is the risk that ex post outcomes differ from those assumed ex ante.

The benefits purchased with the pension contributions, whether paid by the firm or by workers, represent future income earned by the workers as part of a competitive total compensation package. Total compensation includes current wages and benefits in addition to deferred benefits provided by the pension plan, and is

14. Because the benefit accruals in many DB plans (for example, career-average plans) are concentrated in the last few years of employment, when mid-career employees are laid off, the “optics” can be difficult.

15. Large pools of defined-contribution funds, as exemplified by the Teachers Insurance and Annuity-College Retirement Equities Fund (TIAA-CREF) in the United States, can provide some of the financial efficiency gains currently provided by DB funds in Canada. But, ultimately, the investment mix of pooled DC plans reflects the preferences of individual investors, who tend to be relatively risk averse.

set competitively by market forces beyond the control of the individual firm. The sponsor accumulates and invests contributions and promises a future benefit to workers, as plan members, such that the ex ante final expected value of the pension benefits is equal to the final expected value of the assets bought with contributions.

Defined-benefit pension plans are unique in that their sponsors guarantee that ex ante expected benefits will, in fact, be paid ex post. This means that sponsors assume residual pension risk; namely, the risk that the assets accumulated with pension contributions will not match promised benefits. Examples of such outcomes include economic and financial developments that preclude the delivery of the asset returns expected in the ex ante calculation, or plan members, in aggregate, living longer than was anticipated at the time contributions were set. By taking on residual pension risk, the sponsor is assuming responsibility for the difference between the promised benefits and the ex post value of the pension fund. In effect, the sponsor owns both residual pension risk and the outcomes of that risk, which materialize in the form of a deficit or a surplus.

The sponsor's role in a defined-benefit pension plan is particularly demanding, since such plans tend to be dynamically unstable. This is because the funding shortfalls that result from a period of low returns accumulate at a compounded rate over time. Similarly, an extended period of high returns can lead to runaway surpluses.¹⁶

Thus, to maintain stability between pension fund liabilities and assets, the sponsor must actively manage the funding situation of the DB plan by repeatedly injecting funds should there be a deficit, or withdrawing funds (or stopping contributions) should there be a surplus. The more frequently such injections and withdrawals

are allowed to happen, the closer the value of fund assets will be to those of fund liabilities. The sponsor must actively manage the pension fund to keep it dynamically stable, because, ex post, assets and liabilities will differ from those assumed ex ante, and these deviations will grow at a compound rate if not counteracted continually.

This analysis highlights some implications for the regulation of defined-benefit pension plans.

First, sponsors must be able to continually make injections to and withdrawals from the pension fund so that it remains in balance with promised pension liabilities. Impediments that reduce the incentive to inject funds—such as ambiguous ownership of the pension fund surplus—effectively reduce this flexibility.¹⁷

Second, negotiations concerning pension benefits and contributions are economically feasible only in a forward-looking context where property rights have not yet been implicitly assigned. In particular, once the ownership of residual risk has been determined, it is not appropriate to reassign the outcomes of that risk through negotiation. For example, if the sponsor tries to make workers pay for past outcomes that have resulted in a current deficit (for example, by reducing current salaries), workers will tend to leave the firm to work for a competitor that offers the market-determined competitive compensation package. If workers try to capture the value of a current surplus when it is not clear that they own it, the sponsor could be motivated to underfund the pension fund, potentially putting the workers' benefits at risk.

The Focus of Reform

The conceptual framework presented above highlights two fundamental problems with defined-benefit plans as they now exist.

First is ambiguity about who owns a pension fund surplus. This ambiguity reduces the

16. The runaway nature of deficits and surpluses results from two fundamental characteristics of financial-asset accumulation. First, the future expected return on an asset is independent of past returns. For example, observing 20 consecutive heads in a series of coin flips does not increase the probability that the next flip will be tails. Second, an event today will have a greater impact on the final value of an investment than will an equivalently sized event in the future, because of compounding. There will inevitably be a "string" of positive or negative returns that will lead to instability in the funding position.

17. It should be noted that pension regulators have rules that contribute to keeping pension plans stable. They require plans reporting solvency deficits to make contributions to eliminate them over five years. In addition, under the Income Tax Act, sponsors cannot make contributions when plans report a surplus in excess of 10 per cent. Although helpful from a stability perspective, these rules reduce the flexibility that sponsors have to optimally manage pension funding.

incentive for sponsors to fully fund defined-benefit pension plans. Second is the heightened risk of insolvency that plan members face when defined-benefit pension plans are chronically underfunded, which is amplified by the first problem.¹⁸

Pension reform would be most effective if it focused on providing sponsors with the flexibility they need to actively maintain a balance between the final value of the pension fund and the final value of promised benefits. One way of achieving the needed flexibility would be to clarify the sponsors' ownership rights to the pension fund surplus. Some have suggested that this might require changes in the legal framework.¹⁹

Giving the sponsor unambiguous ownership of the surplus would encourage sponsors to maintain surpluses in their pension funds, which would help eliminate the risk of sponsor insolvency. In addition, tax distortions that discourage the maintenance of a reasonable surplus in the pension fund could be removed, and other existing disincentives to maintaining significant surpluses could be eliminated. These surpluses would then act as a buffer against unanticipated negative shocks to pension assets (or positive shocks to liabilities) at a time when it was not convenient for the sponsor to make an immediate injection into the pension fund to offset the shock.²⁰

In such a system, it would be important to protect workers from very big shocks by insisting that a sponsor make an immediate injection of funds if the value of pension assets relative to the value of pension liabilities fell below some critical value—for example, a pension fund with

a value less than 95 per cent of pension liabilities.

It would also be important to eliminate all significant disincentives for the sponsor to maintain a surplus. One large disincentive is the opportunity cost borne by the sponsor when putting its scarce capital in the pension fund in the form of a surplus. One solution might be for the sponsor to be paid an annual return on surplus pension funds, most simply set to equal the average return on the pension fund itself.

Conclusion

The future of defined-benefit pension plans in Canada is an important public policy issue. The choices that savers make should ultimately determine the appropriate mix of pension plan types in the economy. But governments should review current pension legislation and regulations to ensure that they remain appropriate and do not create disincentives to the provision of one particular type of plan. Such initiatives are now under way.

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18. The risk is that the sponsor will become insolvent at a time when there is a pension fund deficit, leaving plan members with less-than-promised benefits.
19. For example, the Association of Canadian Pension Managers in a recent study (ACPM 2005), suggested that the ambiguity regarding surplus ownership that stems from current pension trust law could be resolved by the passage of legislation that would bring pension plans out from under trust law, making contract law supreme. The study also explores a number of other reform options.
20. Other possible ways of mitigating insolvency risk are pension insurance funds and pension collectives. Both approaches suffer from the presence of moral hazard, where it is in the interest of the sponsor to inappropriately transfer pension liabilities to either the insurance fund or the collective.

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The Use of Microdata to Assess Risks in the Non-Financial Corporate Sector

Meyer Aaron and Dylan Hogg

The objective of this report is to assess the use of individual-firm data (henceforth microdata) for the surveillance of risks in the non-financial corporate sector. The financial health of Canadian public non-financial companies (PNFCs) is important for financial system stability. Corporate loans, bonds, and equities make up a large part of the asset holdings of banks, insurance companies, and households (through pension plans and mutual funds). Hence, a rash of corporate failures could have widespread effects on the economy by eroding the capital of financial institutions and the wealth of households.

The analysis of financial accounts data is one way to assess corporate financial health. There is a large body of literature linking corporate financial health to three broad categories of financial ratios: profitability, liquidity, and leverage (Altman 1983; Scott 1981; Ohlson 1980; Bunn and Redwood 2003; and Vlieghe 2001). The following ratios from the above categories of financial ratios are selected to assess financial health: *leverage*, which is the ratio of total assets to total equity; *current ratio*, a measure of liquidity, is the ratio of current assets to current liabilities; and *net profit margin*, a measure of profitability, is the ratio of net income to total revenue.¹

This analysis of the financial health of PNFCs can be conducted with either aggregated data or microdata.² To date, aggregated data have been used most often because these data are easier to obtain. There are, however, a number of reasons to use microdata. Aggregated measures mask information about the underlying distributions,

whereas microdata can provide information about the “vulnerable tails” that are thought to be relevant for the analysis of financial stability (Benito and Vlieghe 2000). This masking is illustrated using the three ratios studied here.

Chart 1 shows part of the histogram for the inverse of the leverage ratio, the current ratio, and the net profit margin for the corporate sample used in this report.³ Vertical lines showing the ratio values calculated from the aggregated data for the same dataset are also included for comparison.⁴

The histograms reveal that the distributions for all three ratios are highly skewed (asymmetrical) and exhibit a large degree of kurtosis (fat tails). Note that the single value calculated for each ratio from the aggregated data masks the distributional information provided by the microdata.

Another reason to use microdata is the flexibility in the way that results can be combined to investigate a point of economic significance. In this case, microdata allow the calculation of the leverage ratio at the level of the individual company. Then, if company size is thought to be relevant for financial stability, the individual leverage values can be combined using asset weights. On the other hand, if debt or employment is of interest, then this analysis could be done using weights that emphasize the amount of debt or number of employees associated with each company in the sample. Hence, microdata allow the construction of various financial

1. These ratios are commonly used in accounting-based models of corporate financial health.
2. The December 2004 *Financial System Review* (pp. 5–7) highlighted an analysis of corporate financial structure using aggregated data.

3. The inverse of the leverage ratio is used here to provide a continuous ordering of companies, given that some of them have negative equity.
4. The ratios for the aggregated data are calculated by summing the numerator and denominator for all companies in the sample prior to calculation of the ratio.

health measures, depending upon the issue under consideration.

This report focuses on using financial accounting microdata at the company level to assess corporate financial health. In particular, we construct a microdata indicator using the “vulnerable tails” of the distributions for certain financial ratios. A preliminary comparison of this microdata indicator with other commonly used measures of financial vulnerability (bond spreads, ratings action, and leverage calculated from aggregated national accounts) shows that it is a good tool for assessing risks to financial stability in the non-financial corporate sector.

Using Microdata

The corporate data are from the *Financial Post's* database on public companies. It contains about 1,200 Canadian public companies from which a sample ranging from 106 to 1,191 companies was compiled annually for the period from 1994 to 2004.⁵ Companies indexed as financial companies were deleted from the sample. The assets covered in our sample represent, on average, 54 per cent of the total assets of non-financial corporations as reported in Statistics Canada’s National Balance Sheet releases (ranging from 6 per cent to 68 per cent over the sample period).

The microdata indicator

Generally, increasing leverage, decreasing liquidity, and decreasing profitability are thought to increase corporate vulnerability. However, the interaction among these measures is also important.⁶ Hence, an indicator based on the microdata is constructed using the “vulnerable tails” of the distributions for each of the three financial ratios.

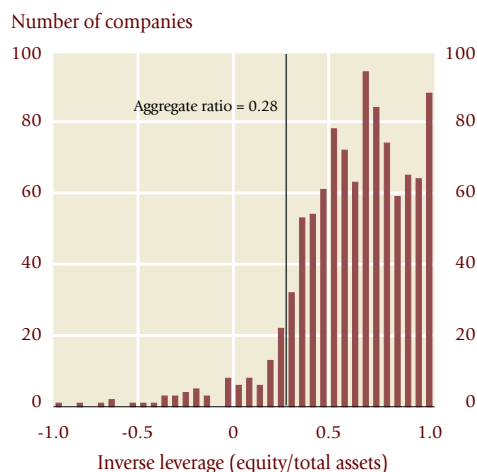
The construction of the indicator is straightforward. A threshold is chosen for each of the leverage ratio, the current ratio, and the net profit margin to define the “vulnerable tail” of the distribution for that ratio. In this case, the thresholds

5. The sample size of 106 companies was for 1994. The other years ranged between 675 and 1,191 companies. Excluding 1994 from the study did not change the conclusions reported here.
6. For example, high leverage by itself may not be a cause for concern if liquidity and profitability are high.

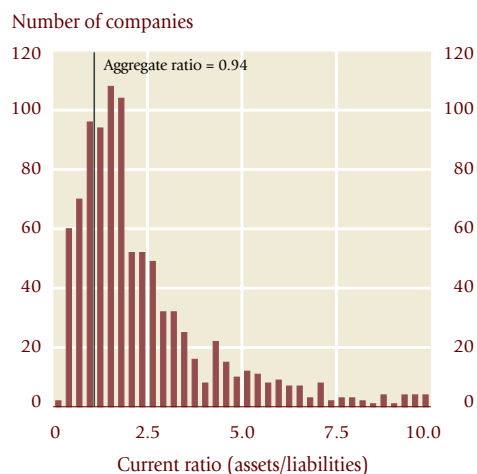
Chart 1 Distribution of Ratios (2004)

Sample size equals 1,049 companies

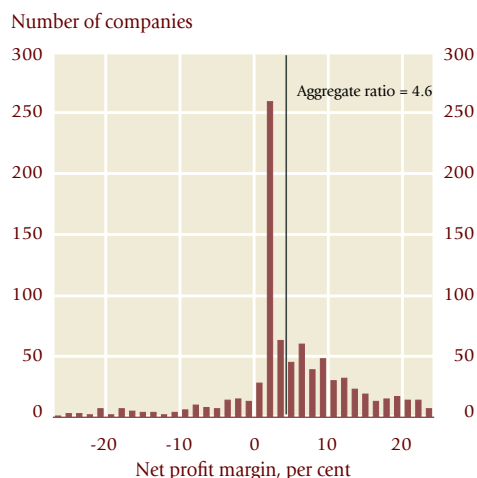
Inverse Leverage



Current Ratio



Net Profit Margin



are set at the average level of the 50th percentile over the entire sample period.⁷ A company is considered to be in the vulnerable tail of the distribution for a ratio if the value for that ratio for that company is “worse” than the value for the 50th-percentile threshold chosen here. Companies that appear in the vulnerable tails of all three ratios are identified, and the indicator is calculated as a percentage of the total sample assets held by these companies.⁸ A higher value indicates higher vulnerability for the sample as a whole.

The choice of the thresholds used to define the vulnerable tails is arbitrary, since there is no theoretical framework to determine these a priori. Sensitivity analysis showed that the indicator was relatively robust to the choice of thresholds ranging from the 25th to the 75th percentile for each ratio.⁹

For the purpose of financial system surveillance, it is useful to have an indicator with leading properties: the signal from the indicator anticipates vulnerability concerns. Here, the leading-indicator properties of this microdata indicator are evaluated using its correlation, one year ahead, with two financial-stress indicators of interest: bank gross impaired business loans and corporate bond defaults.¹⁰ It is also compared with other commonly used measures of corporate health: bond spreads (BBB over AA), ratings action (downgrades as a percentage of ratings actions), and the leverage ratio calculated from the *Quarterly Financial Statistics* for non-financial companies published by Statistics Canada (QFS leverage). Bond spreads reflect the additional return required by investors to compensate for the increased default risk of BBB-rated bonds

compared with the less-risky AA-rated bonds. Therefore, widening bond spreads reflect a higher risk of default and corporate vulnerability. Similarly, a rise in downgrades (changing the rating of a bond to a lower quality) as a percentage of ratings actions, is also taken as an indicator of increasing corporate vulnerability.

A comparison of these indicators is shown in Chart 2. The associated correlations are presented in Table 1. This preliminary analysis shows that the microdata indicator appears to lead banks’ gross impaired business loans and corporate bond defaults by one year. Over the sample period, increases in the indicator in one period are generally followed by increases in impaired business loans and corporate bond defaults in the following period. The microdata indicator performed better than bond spreads in anticipating gross impaired business loans one period ahead. It appears to outperform the indicator from ratings actions, and the indicator using QFS leverage in anticipating both bank gross impaired loans and bond defaults one period ahead.¹¹ Note, however, that this is largely a qualitative assessment, since the limited number of yearly observations in this data set does not permit a more rigorous test.

Sector analysis

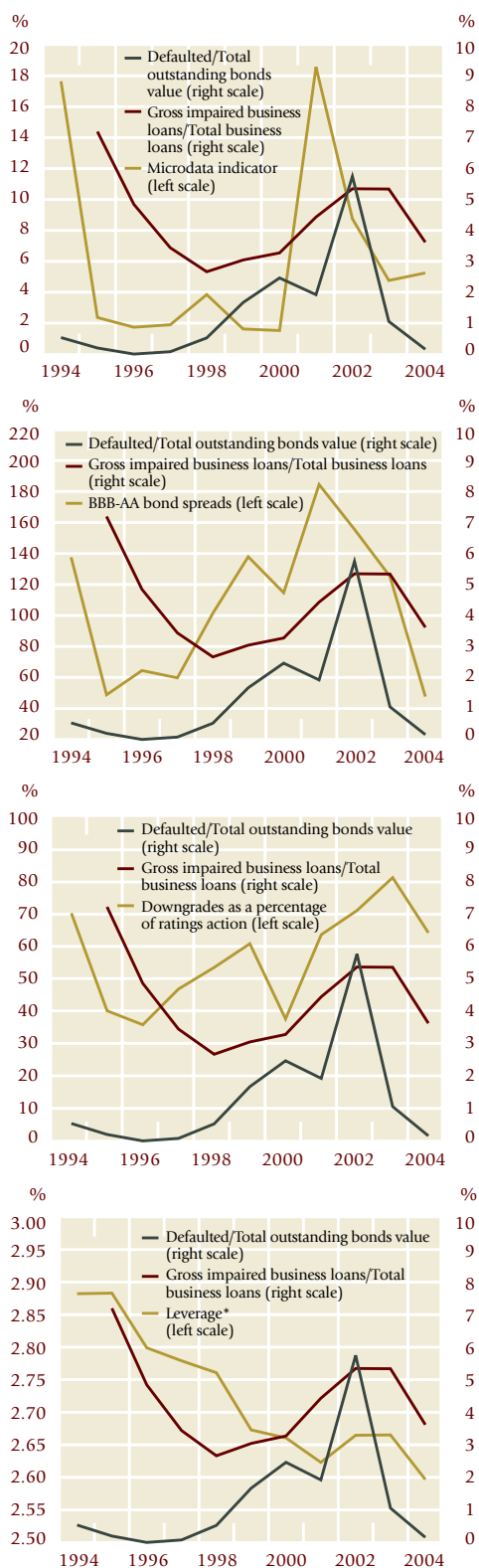
A further refinement is to extend the analysis to the sector level for PNFCs.

For this purpose, the companies identified as being in the vulnerable tails of all three financial ratios (as above) are categorized into eight sectors: consumer, energy, health care, industrials, information technology, materials, telecom, and utilities. The microdata indicator for a sector is calculated as the percentage of that sector’s assets held by the companies from that sector that are found in the vulnerable tails of all three ratios.

7. The 50th-percentile thresholds were: inverse leverage less than 0.606; current ratio less than 1.6; net profit margin less than 0.1 per cent.
8. Although only the asset-based indicator is discussed here, indicators were constructed for each ratio and combinations of ratios on the basis of the percentage of debt and the percentage of companies in the tails, with similar conclusions.
9. The choice of thresholds did affect the level of the indicator and the width of the peaks.
10. Correlation is a measure of the similarity in how two series move together. Here, we mean the correlation between the value of the microdata indicator in one period with the financial-stress indicator in the next period. A high degree of correlation is evidence that the microdata indicator has some leading information about financial stress.

11. There is some overlap of the information contained in these indicators. The microdata indicator has a correlation of 0.65 and 0.54 with the bond spreads and ratings actions, respectively. Note also that the microdata indicator is using information from three financial ratios, whereas the QFS leverage uses information from only a single ratio. Ideally, a proper comparison would require an aggregate index that uses information from aggregated QFS data for the other ratios as well.

Chart 2 Indicators of Financial Health



* Statistics Canada, *Quarterly Financial Statistics*
Sources: Moody's, OSFI, Bank of Canada, Statistics Canada, *Financial Post*, and authors' calculations

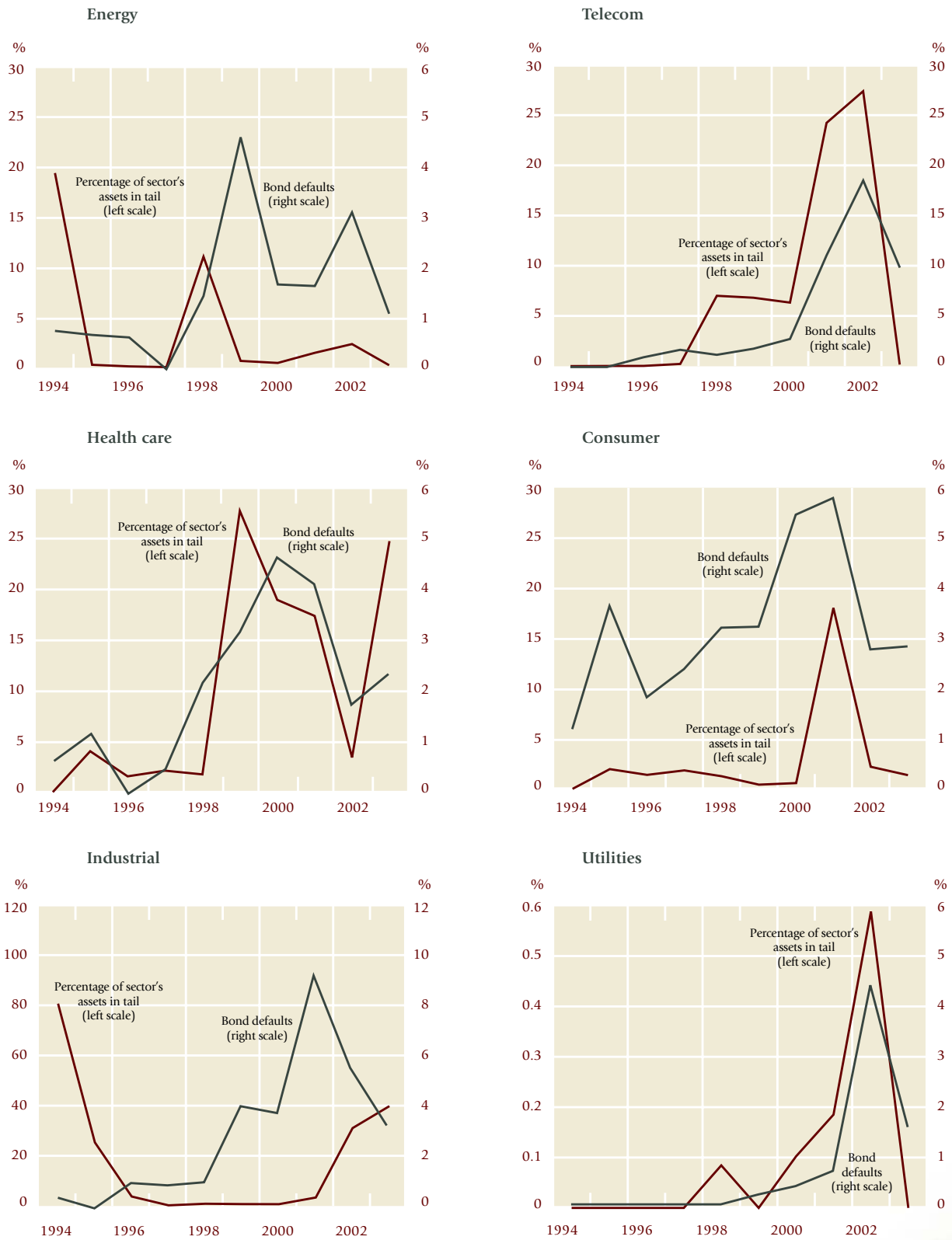
Table 1

Correlation Coefficients for Indicators*

	Microdata indicator	Bond spreads (BBB-AA)	Downgrades as a percentage of ratings actions	QFS leverage
	T-1	T-1	T-1	T-1
Gross impaired business loans	0.79	0.48	0.34	0.21
Corporate bond defaults as a percentage of bonds outstanding	0.46	0.68	0.13	-0.65

* T-1 refers to the indicator one year in the past.
Sources: Moody's, OSFI, Bank of Canada, *Financial Post*, Statistics Canada, and authors' calculations

Chart 3 Sector Analysis



Sources: Standard & Poor's, *Financial Post*, and authors' calculations

Chart 3 shows the relationship between the percentage of a sector's assets represented in the vulnerable tails and bond defaults for that sector.¹² For the telecom, energy, health care, and utilities sectors, the representation of the sector in the tails increases prior to a rise in bond defaults in these sectors. The results were less promising for the consumer and industrial sectors.

Nevertheless, this type of analysis has the potential to be of use to regulators of financial institutions who monitor sectoral exposures for these intermediaries.

Conclusion

This report has focused on the ways that microdata can be used for the surveillance of potential risks to the financial system originating from PNFCs.

Microdata analysis can augment analysis based on aggregated data by utilizing the information about the underlying distributions of vulnerability measures. Microdata also allow flexibility in the way that information can be combined to emphasize a point of economic significance. As such, this type of analysis could prove to be a useful addition to the other tools currently available for assessing financial stability.


The type of analyses presented here can be used for the surveillance of financial stability on a regular basis. At the moment, this is being done annually. However, given that public companies report quarterly, the analysis could be updated more frequently. One concern with financial data is the three- to six-month delay between a company's year-end and the availability of the data for analysis. This delay may largely mitigate the value of the leading-indicator properties described above.

Further work is required to refine the microdata indicators. For instance, a data set for a longer time period is being constructed to allow a more rigorous investigation of the statistical properties of the microdata indicator. A company-level study using panel data will also be conducted to extend this line of research by investigating the relationship between corporate financial health and macroeconomic factors such as output growth.

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Policy and
Infrastructure
Developments

Introduction

The financial system and all of its various components (institutions, markets, and clearing and settlement systems) are supported by a set of arrangements, including government policies, that influence its structure and facilitate its operation. Taken together, these arrangements form the financial system's infrastructure. Experience has demonstrated that a key determinant of a robust financial system is the extent to which it is underpinned by a solid, well-developed infrastructure. This section of the Review highlights work in this area, including that related to relevant policy developments.

The stability of the financial system has traditionally been a vital concern of central banks. In fact, some were created for the express purpose of maintaining financial stability. The Bank of Canada has a long history of promoting financial stability and, in recent years, has joined the ranks of central banks that have intensified their efforts in this area. Assessing the evolution of the risks associated with financial instability is no simple matter, since the financial system has become much more complex and integrated, both nationally and internationally, in the wake of the policy liberalization and financial innovations that have marked recent decades. This challenge is magnified by the fact that no well-tested theory or empirical models currently exist to guide central banks when they are making decisions on issues related to financial stability. Given this context, researchers and analysts have advanced the so-called macroprudential approach. In "Analyzing the Evolution of Financial Instability Risk," Céline Gauthier and Pierre St-Amant briefly describe this approach and explain to what extent it provides a useful analytical framework for assessing the evolution of the risks associated with financial instability. The authors conclude that this methodology must be supplemented by theoretical and empirical models that allow systemic risk to be identified and its evolution to be better

understood. They also review several studies that may provide paths for future research.

A well-functioning large-value payment system is an integral component of any advanced financial system. It provides the necessary electronic infrastructure to facilitate transfers of funds among participating financial institutions to discharge large-value payment obligations. Safety and efficiency are the primary public policy objectives in the design and implementation of these systems. But, given the different types of inherent risks and costs involved, multiple trade-offs between safety and efficiency can be identified within each system. In "Simulation Analysis: A Tool for Examining the Balance between Safety and Efficiency in Canada's Large Value Transfer System," Neville Arjani focuses on one such fundamental trade-off—that between settlement delay and intraday liquidity—with specific application to Canada's Large Value Transfer System (LVTS). In particular, the article illustrates how simulation techniques developed at the Bank of Finland can be used to evaluate this trade-off. The author concludes that a trade-off does exist in the LVTS between settlement delay and intraday liquidity and that this trade-off could potentially be improved with the introduction of a complex queue-release algorithm in the central queue. The author also highlights the caveats of this analysis and offers some ideas for future research.

Analyzing the Evolution of Financial Instability Risk

Céline Gauthier and Pierre St-Amant

The stability of the financial system¹ has always been important to central banks. Indeed, some central banks were created for the express purpose of preserving financial system stability.² Interest in this area was heightened by several episodes of pronounced stress on financial systems between 1990 and 2000 (the Asian crisis, the Long-Term Capital Management affair, the boom and bust in technology stocks, etc.). These events revealed that the inflation-control policies adopted by many central banks were not sufficient to guarantee the stability of the financial system, even though they did contribute to it.

In addition to having an inflation-control policy, the Bank of Canada contributes to financial stability in several ways. It provides liquidity to financial institutions under normal and exceptional circumstances. It advises the federal government on policies related to the financial system. It oversees Canada's major clearing and settlement systems. It offers banking services to those who operate and use these systems. It collaborates with other national and international bodies that promote financial stability. Finally, it analyzes the evolution of risks likely to undermine this stability (systemic risk). This paper examines this final contribution.

The analysis of systemic risk yields valuable information for all activities aimed at promoting financial stability. For example, the Bank must

have a thorough understanding of the state of the financial system if it is called upon to inject liquidity into this system in the event of an exceptionally serious problem. The results are shared with other organizations involved in promoting stability in the financial system (prudential authorities) and with the general public, primarily through the *Financial System Review*.³ The Bank's intent is for this information to contribute to both the better functioning of financial markets and to improved policy design. Finally, the Bank's analysis of systemic risk provides invaluable information for the conduct of monetary policy, given that financial instability tends to depress global demand and make a monetary policy response necessary.⁴

Assessing the evolution of risks that undercut financial stability is no simple matter, since the financial system has become much more complex and integrated, both nationally and internationally, in the wake of the policy liberalization and financial innovations that marked recent decades (Freedman and Goodlet 2002; Freedman and Engert 2003; Houben, Kakes, and Schinasi 2004). The challenge is magnified by the fact that there is currently no acknowledged theory or empirical model to guide central

1. The financial system consists of financial institutions, financial markets, and clearing and settlement systems. This system is unstable if impediments to its good functioning are likely to result in a significant decline in real GDP. Otherwise, it is considered to be stable.
2. The U.S. Federal Reserve System was created in 1913 in response to the panic selling that shook the U.S. financial system in 1907 (Ferguson 2002).

3. The Bank of Canada's principal partners in promoting financial stability in Canada are the federal Department of Finance, the Office of the Superintendent of Financial Institutions, and the Canada Deposit Insurance Corporation. The mandates of central banks in this matter vary from one country to another. Healey (2001) and Oosterloo and de Haan (2004) describe these differences.
4. Some authors (Borio and White 2004) contend that monetary authorities should tighten monetary policy when a speculative bubble develops that could cause financial instability. Laidler (2004) offers a different point of view on the subject. Selody and Wilkins (2004) address this debate in the Canadian context.

banks in the matter. It is in this context that researchers and analysts, especially those at the Bank for International Settlements (BIS) (Crockett 2000; Borio 2003), have proposed the macroprudential approach.

In this article, we briefly describe this approach and evaluate to what extent it can guide the analysis of risk. We conclude that the macroprudential approach provides a useful analytical framework, but that it needs to be supplemented by theoretical and empirical models that allow systemic risk to be identified and better understood. We also review work that we believe may be able to furnish such models. Much remains to be done in this field, and research needs to be ongoing. We conclude by proposing several avenues of future research.

The Macroprudential Approach

The term “macroprudential approach” was initially used to describe analysis that encompasses the entire financial system, rather than focusing on a particular element. In the early 2000s, economists at the BIS proposed this approach as a policy guide for authorities promoting financial stability (Crockett 2000; Borio 2003). The concept was taken up by many central banks, as well as by economists at international financial institutions (Tumpel Gugerell 2002; Selialia 2003; Hoenig 2004; Houben, Kakes, and Schinasi 2004; Gjedrem 2005).

Economists who advocate the macroprudential approach contrast it with the microprudential approach, which concentrates on individual contracts and organizations and, ultimately, strives to protect investors and depositors. The microprudential approach attempts to accomplish this by limiting the individual risks to which certain specific agents are exposed. It treats systemic risk as exogenous, in the sense that it does not depend on the reactions of financial agents. In this framework, the correlation in the activities of individual agents is not considered, and systemic risk is simply the sum of individual risks. Consequently, in its most extreme form, the microprudential approach considers the soundness of institutions taken individually to be both necessary and sufficient for the stability of the system.

The macroprudential approach treats the financial system as a whole, and its ultimate goal is to limit systemic risk. It recognizes the endogenous nature of systemic risk, which may be caused by the actions of financial-system stakeholders. For example, strategic decisions made by banks, including the decision to increase the share of an asset in their portfolios, can contribute to systemic risk. The correlation between decisions made by individual agents thus plays a key role in the evolution of risks. Decisions that appear innocuous when taken individually may, in fact, represent a threat to the financial system if they are taken by many agents. Thus, the fact that a single, medium-sized bank decides to increase the proportion of mortgage loans in overall loans may not increase systemic risk. But, if all banks simultaneously do the same, systemic risk may be exacerbated. The entire financial system is now exposed to a less-diversified risk. Moreover, the greater supply of mortgage credit implied by such a shift could trigger a real estate bubble. The eventual bursting of this bubble could cause hardship to economic agents through an erosion in the value of their real-estate holdings, as well as to those who provide the mortgage credit. We have chosen to illustrate this principle with mortgage credit, but systemic risk can also result from decisions taken in other areas of the financial system. Authorities who focus on the decisions of individual financial agents without accounting for the correlations between these decisions may be ignoring a very important source of systemic risk. The macroprudential approach to risk assessment imposes this accounting.

In practice, policy-makers often draw on both the micro- and macroprudential approaches. Consequently, in its role as lender of last resort, the Bank of Canada can provide liquidity to a bank that it deems healthy, but that is experiencing temporary liquidity problems. The goal is to protect economic agents from the consequences of market failure arising from a lack of information. Under the same policy, however, the Bank may inject liquidity into the entire financial system if it considers that such a measure might avert a significant systemic risk. In this case, the stability of the financial system is the primary concern.⁵

5. Daniel, Engert, and Maclean (2004–05) describe the Bank of Canada’s lender-of-last-resort policy.

According to Borio (2003), the macroprudential approach implies that supervision and prudential standards are tailored to account for the marginal contribution of an institution to system-wide risk. This may have significant implications for prudential authorities; for example, in relaxing the surveillance of agents that are deemed to pose little, if any, risk to the stability of the financial system and in intensifying the scrutiny of those more likely to have a systemic impact. In practice, the breadth and complexity of the financial system means that it would not be feasible to expect the authorities to be able to analyze each of its elements in detail. Given this constraint, it seems more appropriate that they focus their efforts on those parts of the system considered to represent a heightened threat. Consequently, the macroprudential approach results in a more efficient use of resources for authorities seeking to limit systemic risk.

Nevertheless, it is important to bear in mind that there is currently no theoretical model or proven empirical model that establishes clear cause-and-effect relationships between the actions of participants in the financial system and any impact on its stability.⁶ For the time being, the macroprudential approach is, instead, a collection of concepts that can point researchers towards the elements of a sound theory, which should both embrace and inform the intuition of decision makers as to which variables are key to defending financial stability.

Current Avenues of Research for Improving Analysis

In this section, we present several lines of current research at the Bank involving potentially useful models for overseeing and analyzing risk in the financial system.

The first is the contingent-claims approach (CCA), which proposes a method of measuring the evolution of risk in various sectors of the

economy, as well as the transmission of risk between sectors. Next, are some approaches to the structural modelling of links between the real economy and the financial system.

The contingent-claims approach

The macroprudential approach recognizes the importance of shared exposure to certain shocks in the determination of systemic risk. The contingent-claims approach is a promising technique for accounting for these common exposures.

The CCA uses options-price valuation techniques to estimate a firm's risk of default based on the value and volatility of its capital stock and on the evolution of the book value of its debt.⁷ The greater the volatility of its stock, the greater is the probability that the value of the firm's assets will fall below the value of its debt, and thus the greater is the probability that the firm will fail.⁸

Recently, Gray, Merton, and Bodie (2003) proposed a generalization of the CCA for the assessment of risk in different sectors of the economy (non-financial firms, banks, etc.).⁹ They apply the CCA to a sector, rather than to an individual firm, by summing the market capitalization and debt load of each firm in the sector. The correlation between the yields on individual securities, which arises largely from the exposures shared by the issuers, is thus accounted for in the

6. Data problems are often an obstacle to the elaboration of solid empirical models. For example, owing to the absence of adequate data for some countries, Borio and Lowe (2002) were unable to integrate the price of real estate assets into their multi-country empirical models.

7. An option is a derivative whose value depends on the evolution of the price of the underlying asset. Merton (1973) was the first to conceptualize a firm's stock as analogous to a call option on its assets, with the value of the firm's debt being equivalent to the option's strike price. Thus, a stock is worth nothing if the value of the firm's assets is below the value of its debt (the option is "out of the money"). Otherwise, the value of the option is equal to the difference between the value of the assets and the value of the debt (it is, thus, "in the money").

8. Tudela and Young (2003) demonstrate that the CCA possesses the properties of an advanced indicator of the financial health of firms, beyond the information contained in their financial balance sheets.

9. See van den End and Tabbae (2005) and Gapen et al. (2004) for recent applications of this approach.

calculation of the volatility of the sectoral aggregate.¹⁰ All other things being equal, the greater the shared exposure of firms, the greater is the volatility (approximated by the variance) of the sector's market capitalization, and thus the greater the sectoral risk identified by the CCA.

This framework also allows at least a partial evaluation of the transmission of risk from one sector to another via the links between the various sectors' financial balances. Researchers at the Bank of Canada currently apply this method to various subsectors of the non-financial sector and to banking. Our goal is to generate a useful measure of the evolution of risk in particular business sectors over time. Furthermore, sectoral analysis allows us to examine the share of the risk confronting banks that stems from their exposure to these various subsectors. The CCA is open to a wide variety of applications. For example, van den End and Tabbae (2005) apply this methodology to the household and pension fund sectors.

Modelling the links between the real economy and the financial system

Since risk is usually deemed systemic if it has potentially serious consequences for the real economy, and since the financial cycle and the business cycle are intimately linked, the macroprudential approach implies that it is necessary to better understand the links between the financial system and the real economy.

In light of the partial endogeneity of systemic risk, one approach currently being explored at the Bank and elsewhere consists of using various specifications and econometric models to estimate dynamic linkages between certain measures of the health of banks (e.g., yields, or provisions for loan losses) and various indicators of the macroeconomic and financial situation in Canada (GDP growth, interest rate

levels, stock prices, etc.).¹¹ Since Canada is a small, open economy, the incorporation of factors such as commodity prices, U.S. interest rates, and U.S. growth rates as exogenous variables in models of the Canadian economy improves their specification. Such an approach allows the responses of the economy and of Canadian banks to exogenous shocks to be simulated. For example, the impact on Canadian banks of a significant slowdown in the U.S. economy and/or a sharp drop in commodity prices can be estimated. This approach is severely limited by the high degree of imprecision of econometric estimates as soon as the number of endogenous variables exceeds four or five.

Another econometric approach consists of estimating long-term relationships between real variables and certain key financial variables. Estimates of these relationships, provided they are stable, allow the identification of adjustments that could bring the economy into equilibrium.¹²

Considerable effort is also devoted to building dynamic general-equilibrium models that incorporate financial frictions. Specific attention has been paid to linkages between real-estate prices and the business cycle (Iacoviello 2005; Aoki, Proudman, and Vlieghe 2002), the role of bank capital in the propagation of economic shocks (Van den Heuvel 2004; Meh and Moran 2004), and the implications of the rationing of business financing for investment and economic activity in general (Bernanke, Gertler, and Gilchrist 1999; Christensen and Dib 2004).

For example, a model of the Canadian economy based on the work of Iacoviello (2005) incorporates financial frictions by assuming that some households are constrained by a liquidity shortfall. The amount that these households can borrow is limited to a fraction of their real-estate wealth, which introduces a financial-accelerator mechanism to the household sector. Assume that a shock drives up housing prices, all other things being equal. This shock allows constrained households to borrow more. They use

10. Lehar (2005) takes a somewhat different approach. He approximates the risk to a country's entire banking sector using the median of the covariance between the market values of the banks' assets generated by applying the CCA to individual banks. He then employs the idea that, under certain conditions, the total risk of a portfolio converges to the mean covariance (or the mean shared exposures) between the yields of the securities in the portfolio.

11. See Pain (2003); Mawdsley, McGuire, and O'Donnell (2004); Hoggarth and Whitley (2003); and Virolainen (2004).

12. See Pichette and Tremblay (2003), as well as Gauthier and Li (2006) for applications to the Canadian economy. Jacobson et al. (2001) and Cassola and Morana (2002) provide applications to other economies.

their additional funds to consume and invest more, which amplifies the effect of the initial shock on overall demand (this is called a financial accelerator) and may create additional upward pressure on the prices of goods and services, including the price of housing. This type of approach could prove very useful for the analysis of financial stability, at least to the extent that researchers are able to endogenize the other features of the financial system, especially the growth of speculative bubbles. Thus, the ideal model could distinguish between a speculative bubble and a rise in asset prices that is grounded in economic fundamentals.¹³

Moreover, markets appear to be afflicted with what Borio (2003) calls a “risk perception gap.” Indeed, risk-perception indicators suggest that risk is usually perceived as low during the growth phase of the business cycle and high during recessions. In fact, there is ample evidence that risk increases during periods of expansion and is low when weaker agents have already declared bankruptcy. Markets appear to have difficulty integrating the externalities inherent in business cycles.

This phenomenon, which gives rise to a gap between the prices of assets and their fundamental value, could contribute to the development of speculative bubbles in financial markets. Several researchers have attempted to better understand this perception gap in the assessment of effective risk (Froot and O’Connell 2003; Gai and Vause 2004; Kumar and Persaud 2002; Tarashev, Tsatsaronis, and Karampatos 2003; and Misina 2003).

Conclusion

The macroprudential approach provides a useful conceptual framework that central banks and other prudential authorities should not hesitate to employ to guide their efforts in analyzing risk to the financial system. This conceptual framework is not a theoretical or empirical model, however. Construction of such models should be a research priority.

Significant progress has been made in the field. In this article, we have emphasized the promising nature of work that draws on the contingent-

claims approach and on modern econometric methods with little or no theoretical content, and have also pointed to the potential of stochastic dynamic general-equilibrium models with financial frictions.

We believe that additional research into the following areas will be particularly beneficial:

- Application of the CCA to other sectors, such as households and pension funds, and the integration of sectoral risk into a measure of risk in the entire economy.
- Econometric analysis of panel data to examine the linkages between relevant macroeconomic variables and various sectors of the economy.
- Integration of several financial frictions into a single model. To date, most studies have tended to focus on one type of friction at a time. It would be interesting to look at the interaction of several types of friction within a single model.
- Endogenization of speculative bubbles into dynamic general-equilibrium models.

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Simulation Analysis: A Tool for Examining the Balance between Safety and Efficiency in Canada's Large Value Transfer System

Neville Arjani

A well-functioning large-value payment system (LVPS) is an integral component of any advanced financial system. In a market economy such as Canada's, virtually all economic transactions ultimately involve the transfer of funds between a buyer and a seller. An LVPS provides the electronic infrastructure necessary to facilitate exchanges of funds between participating financial institutions to discharge large-value payment obligations on behalf of their own business and that of their customers. The Bank of Canada maintains an active research program in this area, with specific emphasis on Canada's Large Value Transfer System (LVTS).¹ This research contributes to the Bank's broader objective of fostering a safe and efficient financial system in Canada.

Simulation analysis is a recent development in payment systems research. Simulation models are a useful tool since they can often be calibrated to replicate a specific LVPS environment. These models can then be used to assess the impact of changes in the structural arrangements and decision parameters of an LVPS without causing any costly disruption to the operation of the actual system. There is growing interest among central banks in using simulation analysis to conduct research on payment systems. As a contribution to this initiative, the Bank of Finland has developed a general simulation application, called BoF-PSS2, and is offering this

software to other central banks free of charge.² The BoF-PSS2 is currently being used by over 30 central banks. The Bank of Canada has recently adopted the BoF-PSS2 and is calibrating this application to simulate the LVTS environment.

The Bank can use simulation analysis to understand the trade-off between safety and efficiency in the LVTS.³ Improving safety and enhancing efficiency are the primary public policy objectives with respect to the design and implementation of an LVPS. A payment system should be safe in the sense that any disruptions within it do not spread to the broader financial system. At the same time, for its users, the payment system should provide a cost-effective means of sending payments. A system that is too safe (and therefore more costly) may discourage financial institutions from using it, and may instead lead them to resort to less-costly and more risky arrangements for sending payments.

There are different types of risks and costs inherent in an LVPS, and multiple trade-offs between safety and efficiency typically exist within each system.⁴ This article focuses on a fundamental safety-efficiency trade-off—between settlement delay and intraday liquidity—with specific application to Canada's LVTS. Potential

1. The LVTS is owned and operated by the Canadian Payments Association (CPA). On average, approximately Can\$140 billion is transferred through the LVTS each day. The Bank of Canada and 14 deposit-taking institutions participate in the system. The Bank of Canada also supplies the means of settlement and maintains oversight responsibility for the LVTS with a view to controlling systemic risk. For more information on the LVTS, see Dingle (1998) and visit the CPA website at www.cdnpay.ca.

2. The Bank of Canada is grateful to the Bank of Finland for developing the BoF-PSS2 and for allowing other central banks to use it.

3. Simulation techniques have been used by central banks for other types of payment systems research, such as stress-testing. Leinonen (2005) discusses simulation research conducted by central banks worldwide.

4. The risks most often cited in large-value payment systems include credit and liquidity risk, legal risk, operational risk, and systemic risk. See BIS (1997).

improvements to this trade-off will also be discussed. This article shows how simulation analysis can be used to evaluate such a trade-off using actual data on LVTS transactions and credit limits. It also shows how simulation analysis can be used to test hypotheses regarding improvements in the trade-off. In accomplishing this, the usefulness of the BoF-PSS2 as a research tool will be highlighted. The article concludes with some caveats related to the simulation analysis and suggestions for future research.

Settlement Delay and Intraday Liquidity in an LVPS: The Trade-Off

The nature of settlement delay in an LVPS

Participants in a large-value payment system typically maintain a daily schedule of payments that they must send through the system on their own behalf and on behalf of their clients. Payments must be completed by a certain time each day, where the time that a specific payment is due is determined as part of the underlying economic transaction. Most payments must simply be transferred by the end of the day. However, some payments sent through an LVPS are time sensitive. These may include payments related to the settlement of final funds positions in other important clearing and settlement systems, as well as payments associated with the daily implementation of monetary policy. Time-sensitive payments must be sent by a specific time each day.

Payment finality is achieved when an LVPS payment sent from one participant to another cannot be revoked or unwound under any circumstances, as in the case of participant insolvency. A key feature of a modern LVPS is that these systems offer immediate intraday finality—in other words, payments are considered final immediately upon being processed by the system.⁵ As a result, recipients of payments can make prompt use of these funds without any

chance of a payment being subsequently revoked or unwound.

This article defines settlement delay as a potential time lag occurring between a participant's intended submission of a payment to the LVPS (i.e., when the payment is due) and when the payment becomes final (i.e., when it is processed by the LVPS). Settlement delays in an LVPS are often related to the liquidity constraints faced by participants that are associated with the provision of intraday credit. This will be discussed in greater detail below.

The consequences of settlement delay in an LVPS

Given the high speed and high value of daily payments processed through an LVPS, coupled with the fact that many of these payments are time sensitive, the costs associated with settlement delay can be potentially significant.

A participant that is unable to meet its payment obligations when they are due may face certain costs because of the delay, such as reputation damage with its peers and, possibly, a loss of its clients' business. For the intended receiving bank awaiting payment, not obtaining incoming funds when they are expected will result in a shortfall in its intraday funds position. If this participant is planning on using these funds to send its own payments, then those payments may also be delayed. A comparable disruption to the funds position of the receiving bank's client is also likely, resulting in potentially broader consequences for economic activity.

The existence of settlement delay may also intensify the potential losses associated with other risks in the LVPS, such as operational risk. An operational event (such as a computer outage that prevents one or more participants from sending payments) will likely have a larger impact in a case where a number of payments remain unprocessed at the time the incident occurs (Bedford, Millard, and Yang 2005). Also, if faster, more efficient processing of payments helps to encourage greater use of an LVPS versus systems that are not as well risk proofed, it follows that reductions in settlement delay may translate to lower systemic risk in the broader financial system.

5. The discussion here focuses on the "modern LVPS," which refers to real-time gross settlement (RTGS) and RTGS-equivalent LVPS, such as Canada's LVTS. For a complete description of these systems, see BIS (1997, 2005).

Intraday liquidity in an LVPS

Intraday liquidity refers to a participant's ability to meet its outgoing payment obligations in a timely manner. In today's LVPS, participants require intraday funds in order to send payments through the system. Maintaining intraday liquidity, therefore, means having the funds available to complete payments as they become due. This is typically costly for participants. For example, an important source of intraday funding for participants is the provision of intraday credit. If intraday credit was free and unlimited, participants could borrow funds any time they needed to send a payment, and no settlement delay would occur. However, although settlement delay would cease to exist in this case, lenders of intraday credit (typically central banks) would face large risk exposures vis-à-vis borrowers, which is not desirable from a public policy perspective.

Consequently, intraday credit in an LVPS is not free and unlimited, but rather, is typically subject to eligible collateral requirements (which may entail an implicit opportunity cost), explicit interest charges, or caps on credit provision. These intraday credit constraints may limit participants' intraday liquidity in an LVPS, thus increasing the potential for settlement delay in the system.

The trade-off

Consider a hypothetical reduction in the amount of intraday funding maintained by participants in the LVPS. What would be the impact of this reduction? It is anticipated that such a reduction would entail both a "cost" and a "benefit" to system participants. The benefit to participants is clear: a reduction in available intraday funds will directly result in lower funding costs (e.g., reduced collateral requirements). However, participants rely on intraday funds to send payments to each other. Reducing the amount of funds available to a participant increases the likelihood that it may not have sufficient liquidity when its payments become due. Thus, the cost associated with this hypothetical reduction in intraday funding is a potential increase in the level of settlement delay in the system.

Payments that cannot be processed when due because of a participant's lack of intraday

liquidity may be held in that participant's internal queue. Alternatively, these payments could be submitted to the LVPS and held in the system's central queue if one is available. Under standard queuing arrangements, internally and centrally queued payments are released and processed on an individual basis when the sending participant's intraday liquidity improves to the extent that these payments can be processed. This increase in intraday liquidity may be a result of the participant receiving a payment from another participant or acquiring more intraday credit.

It is also expected that the greater the amount of intraday funds removed from the system, the greater will be the magnitude of the accompanying settlement delay. The number of payments becoming queued when due, and also their duration in the queue, will increase as intraday liquidity is further reduced.

A graphical representation of the trade-off

Following a general analytical framework proposed by Berger, Hancock, and Marquardt (1996), the trade-off between settlement delay and intraday liquidity can be characterized as a decreasing convex curve in delay-liquidity space (Chart 1).

Each point in the space represents a possible delay-liquidity combination necessary to produce a given amount of payments. All points along, and above, or to the right of the curve represent feasible delay-liquidity combinations, given the current LVPS technology. Movements along the curve from right to left capture the idea that, as intraday funding is removed from the system, settlement delay is expected to rise at an increasing rate. Points below or to the left of the curve, although preferred, are currently unattainable and can be achieved only through some form of innovation in the LVPS technology.

Improving the trade-off between settlement delay and intraday liquidity

Given the potential consequences of settlement delay, an improvement in the trade-off is desirable. An improvement is characterized by a reduced level of settlement delay for each amount of intraday liquidity. This can be achieved either

through quicker processing of queued payments or fewer payments having to be queued upon submission. Such an improvement is represented by a downward shift of the trade-off curve closer towards the origin (dotted line in Chart 1).

As mentioned above, an innovation in LVPS technology is needed to improve the trade-off. The addition of a complex queue-release algorithm to the central queue represents one such innovation.⁶ These algorithms are designed to simultaneously search for and offset batches of centrally queued payments.

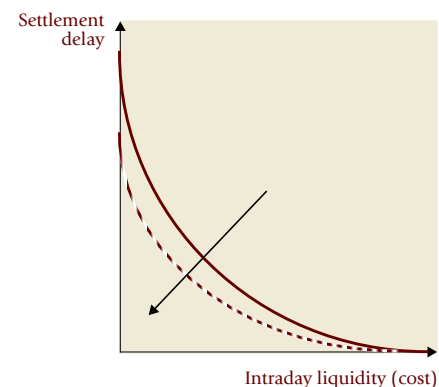
Under standard queuing arrangements, payments are released from the queue *individually* when a participant's intraday liquidity is sufficient for them to be processed. In contrast, under central queuing with a complex queue-release algorithm, the simultaneous processing and release of a batch of queued payments is attempted at regular intraday intervals. In this case, for the entire batch of payments to be released from the queue, participants need access only to sufficient intraday funds to cover any possible net debit (negative) position resulting from the payment offset.

With a complex queue-release algorithm, participants have lower funding requirements for the release of queued payments. Thus, even where intraday liquidity has been hypothetically reduced in the system, the processing time for queued payments can be faster, and average intraday queue length could decrease, compared with a standard queuing arrangement.

Simulation Methodology

It could be interesting to apply this concept to the LVTS environment, and simulation analysis facilitates such an exercise. Specifically, the BoF-PSS2 can be used to assess whether there is a trade-off between settlement delay and intraday liquidity in the LVTS, and whether the introduction of a complex queue-release algorithm could improve this trade-off. This section outlines the simulation methodology involved in this analysis, including a description of the data used, details of the operation of the BoF-PSS2, and how the analysis can be specifically applied

Chart 1 Trade-Off between Settlement Delay and Intraday Liquidity



6. For discussion related to the benefit of these algorithms, see for example BIS (2005) and Leinonen (2005).

in the LVTS environment. Box 1 provides some relevant background on the LVTS. Dingle (1998) contains a more thorough description of the system.

It should be noted that the current version of the BoF-PSS2 does not contain bilateral credit limit (BCL) functionality (Box 1), which is an important component of the LVTS.⁷ The simulation model used in the analysis recognizes only multilateral credit limits, and this is considered further in the concluding section. In addition, the analysis focuses on Tranche 2 (T2), since it is the dominant payment stream in the LVTS.⁸

Description of the data

Three months of data on LVTS T2 transactions and credit limits were collected between July and September 2004. Transaction data include the date and time that each transaction was submitted to the LVTS, as well as the value of the payment and the counterparties involved in the transaction. It is assumed that the time stamp attached to each payment represents the intended submission time of the payment. Data on credit limits include the value of the Tranche 2 net debit cap (T2NDC) available to each participant, as well as the date and time that the value of the T2NDC is effective. The value of a T2NDC may change from day to day and also within each day.

Description of the BoF-PSS2

Although it does not have bilateral credit limit functionality, the BoF-PSS2 operates in a similar fashion to the LVTS. Payments are submitted for processing in order based on a time stamp. A submitted payment is processed by the simulator if the payment does not result in the sending participant incurring a net debit position that exceeds its T2NDC. Payments that cannot be processed upon submission because of a sender's lack of intraday liquidity are stored in the simulator's queue. The BoF-PSS2 offers various

7. A new version of the BoF-PSS2 containing BCL functionality is expected to be available in early 2006. Bank of Canada staff are participating in the development of this new version.
8. On an average day, approximately 86 per cent of daily LVTS payment value and 98 per cent of payment volume is sent through the T2 payment stream.

Box 1

Background on the LVTS

In the LVTS, final settlement is guaranteed under all circumstances, thus virtually eliminating systemic risk. This is facilitated by the system's real-time risk controls (net debit caps), collateral requirements, and a residual guarantee provided by the Bank of Canada.¹ Guaranteed settlement enables immediate intraday finality on all payments processed through the system.

The LVTS consists of two payment streams—Tranche 1 (T1) and Tranche 2 (T2). Each stream has its own risk controls and collateral requirements. Participants may use either stream to send payments. T1 is a defaulter-pays stream, since any T1 net debit position incurred by a participant must be fully secured with eligible collateral pledged by that participant. In T2, a survivors-pay collateral pool is used. At any time, there is sufficient T2 collateral pledged by participants to cover the largest possible T2 net debit position of any participant. The T2 payment stream greatly economizes on participants' collateral requirements relative to T1. As a result, the majority of daily payment activity in the LVTS is conducted in T2.

In T2, participants have the ability to draw on a T2 line of credit. Specifically, LVTS participants grant bilateral credit limits (BCLs) to each other. The value of a BCL represents the maximum bilateral T2 net debit position that the grantee may incur vis-à-vis the grantor at any time during the daily payment cycle. A participant's T2 multilateral intraday credit limit, known as its T2 net debit cap (T2NDC), is calculated as the sum of all BCLs granted to it multiplied by a system-wide parameter (SWP), which is equal to 0.24.² A participant's T2NDC represents the maximum multilateral T2 net debit position that it can incur during the daily payment cycle. A payment submitted to T2 is processed if it does not result in the sending participant incurring a net debit position exceeding either its BCL vis-à-vis the receiver or its T2NDC.³ Participants are required to pledge eligible T2 collateral equal to the value of the largest BCL that they grant to any other participant, multiplied by the SWP.

1. In the unlikely event of multiple participant defaults in the LVTS, the Bank will exercise its residual guarantee to facilitate settlement by realizing on available collateral and absorbing any residual loss.
2. When the LVTS began operations in February 1999, the SWP was equal to 0.30. Since then, it has been gradually reduced and has been equal to 0.24 since March 2000. See LVTS Rule No. 2, available at www.cdnipay.ca.
3. For more on LVTS risk controls, see Engert (1993) and McVanel (2005).

queue-release algorithms for users to choose from, representing alternative queuing arrangements typically available in an LVPS.

The BoF-PSS2 generates a variety of time-series output reports when a simulation is completed. These reports include statistics on the number and value of processed and unprocessed payments. Data on the use of credit limits, as well as the number and value of queued transactions, can also be observed. BoF-PSS2 users can choose the frequency at which these output data are generated. For instance, output statistics can be reported daily, as well as on an intraday basis, in intervals ranging from one to sixty minutes. Moreover, these output data are available at the aggregate system level and also at the individual participant level.

Application to the LVTS

Imposing a hypothetical reduction in participants' intraday liquidity is a key aspect of the analysis. In applying the analysis to the LVTS, this reduction is generated by lowering the intraday credit available to participants. Holding BCL values constant, participants' T2NDC value can be reduced by lowering the value of the system-wide parameter (SWP). Similar to the earlier discussion, reducing the SWP is expected to entail both a cost and a benefit to participants. The former arises because participants will find it more difficult to meet their payment obligations when they are due, since they become constrained by their T2NDC more quickly and frequently during the day. Consequently, the level of settlement delay in the LVTS is expected to rise. However, a reduced SWP will also benefit participants since it lowers the value of T2 collateral required and the related costs.

The simulation analysis involves running two batches of eight simulations. Each of the simulations in a batch is characterized by a reduction of intraday credit available to each participant. To achieve this, additional datasets on credit limits are created over the sample period using lower hypothetical SWP values. Transactions data remain the same in each of the simulations, based on the assumption that participants' payment-sending behaviour remains unchanged during the analysis.

LVTS participants generally utilize internal queues to manage the release of their payments

to the system. Internally queued payments are released whenever a participant's intraday liquidity is sufficient for them to be processed. The first batch of simulations is meant to replicate, as closely as is possible, this internal queuing arrangement. To accomplish this, a standard queue-release algorithm has been specified in the BoF-PSS2.

Three daily measures of settlement delay are calculated and averaged over the sample period for each of the simulations in the batch (i.e., for each level of intraday liquidity). These measures are as follows:

1. Daily Proportion of Unsettled Transactions

Value: This ratio is found by dividing the total value of unprocessed payments remaining in the queue at the end of the day by the total value of payments submitted by participants over the entire day.

2. Daily System-Wide Delay Indicator:

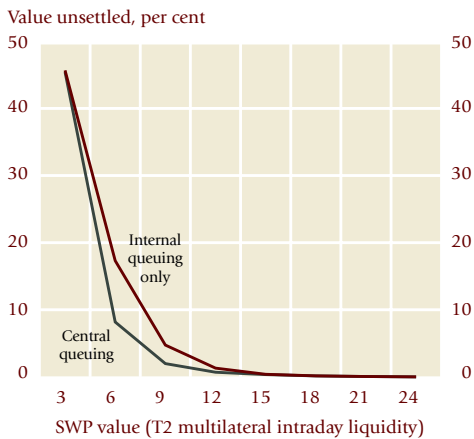
Adopted from Leinonen and Soramäki (1999), this indicator can take on any value between 0 and 1. A value of 0 is attained when all daily payments are immediately processed with finality upon intended submission. A value of 1 is calculated when all payments become queued upon intended submission and remain there until the end of the day.

3. Average Intraday Queue Value: This measure represents the average intraday value of queued T2 payments.

The objective in running the second batch of simulations is to assess whether the introduction of a complex queue-release algorithm can improve the trade-off; i.e., reduce settlement delay associated with each amount of intraday liquidity. The LVTS currently employs a central queue complete with a complex queue-release algorithm. With this algorithm, queued payments are offset at regular intervals (every 20 minutes) throughout the day. Under current LVTS rules, participants are not encouraged to use the central queue.⁹

The second batch of simulations is therefore an experiment to assess whether increased use of

9. LVTS Rule No. 7 states that participants can manage their T1 and T2 positions in real time, and should therefore attempt to submit only those payments that will pass the respective risk-control test. Visit www.cdnpay.ca for more information.

Chart 2 Average Daily Proportion of Unsettled Transactions Value

the LVTS central queue could potentially improve the trade-off. It is assumed that, under this alternative central queuing arrangement, participants no longer hold payments internally until they can be processed. Rather, all payments are submitted to the LVTS when they are due. Any payments not processed immediately enter the central queue.

For purposes of comparison, the same transaction and credit limits data are used in the second batch, and the same measures of settlement delay are calculated. The fundamental difference between the first and second batches is that a complex queue-release algorithm similar to that in the LVTS is specified to run in the latter batch every 20 minutes.

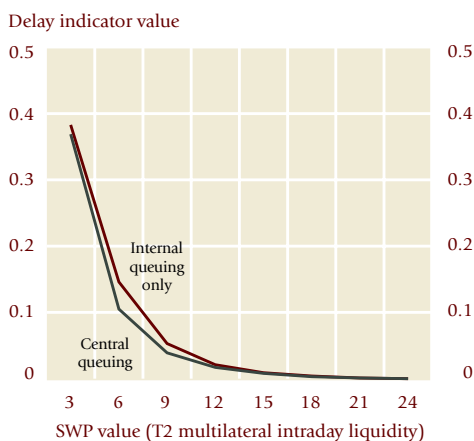
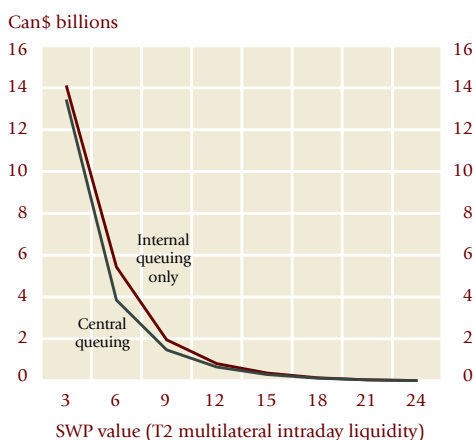
Simulation Results

Simulation results are provided in Charts 2 to 4. Each chart shows two curves corresponding to the two batches of simulations. The curve denoted "Internal queuing only" illustrates the results of the first batch of simulations. The curve denoted "Central queuing" depicts results estimated under the alternative central queuing environment.

The simulation findings confirm that a trade-off exists between settlement delay and intraday liquidity in the LVTS, and this relationship is consistent with the assumptions of the earlier graphical framework. Moreover, the introduction of a complex queue-release algorithm is shown to improve this trade-off. Settlement delay in the second batch of simulations is reduced for each amount of intraday liquidity according to all three measures.

The results indicate that the relative benefit of a complex queue-release algorithm (in terms of reduced settlement delay) increases as intraday credit availability is constrained further, reaching a peak when the SWP is equal to 0.06. In this case, the average proportion of unsettled T2 transactions value is reduced by 9 percentage points or about \$10 billion (Chart 2), the average system-wide delay indicator is reduced by 28 per cent (Chart 3), and average intraday queue value is reduced by 29 per cent or about \$1.6 billion (Chart 4) relative to the first batch of simulations.

The relative gains from the alternative central queuing arrangement begin to decline when the

Chart 3 Average Daily System-Wide Payments Delay**Chart 4 Average Intraday Queue Value**

SWP is reduced beyond 0.06. Close to half of the total value of daily submitted transactions remains unprocessed under both batches when the SWP is equal to 0.03 (Chart 2). At this SWP value, it is believed that participants' intraday liquidity is so constrained that only very small groups of queued payments can be processed each time the offsetting algorithm runs.

A further result of this analysis is that the level of settlement delay increases only marginally as the SWP is initially reduced from its current value of 0.24. This is an interesting finding, since maintaining participants' intraday liquidity (and the avoidance of settlement delay) is perhaps the primary objective in determining the value of the SWP. A reduction in the SWP from 0.24 to 0.18 is estimated to increase the average proportion of daily unsettled transactions value by only 0.15 percentage points under current internal queuing arrangements and 0.14 percentage points under the alternative central queuing arrangement (see Chart 2). Similar results are observed with the other two delay measures. As has been mentioned, reducing the SWP also produces a benefit for LVTS participants in the form of lower collateral requirements. Specifically, a reduction in the SWP to 0.18 reduces the total value of participants' T2 collateral required by about \$750 million per day, on average, over the sample period, holding current BCL values constant.

Summary and Future Research

This research uses simulation analysis to examine the trade-off between safety and efficiency in an LVPS. This article describes a fundamental safety-efficiency trade-off—between settlement delay and intraday liquidity—and illustrates how simulation techniques can be used to evaluate this trade-off in Canada's LVTS. Simulation results indicate that a trade-off does exist between settlement delay and intraday liquidity in this system, and that this trade-off could be improved with greater use of the central queue and its complex queue-release algorithm. Moreover, the article shows that the SWP value could be reduced to as low as 0.18 at little cost in terms of delayed settlement, regardless of whether use of the central queue is increased.

It must be emphasized that these conclusions are preliminary, and the existence of certain

caveats indicates that further work is necessary. Perhaps most importantly, the current analysis assumes that participants' payment-sending and bilateral credit-granting behaviour remains unchanged despite reductions in the SWP and changes in queuing arrangements. This assumption must be challenged. Further research on the factors underlying participants' behaviour, and anticipated developments in the BoF-PSS2, are necessary to conduct more robust simulation analyses in future.

Secondly, the article highlights the benefit of using a central queue equipped with a complex queue-release algorithm. However, it is also necessary to identify and assess the potential implications of such a development, which may not be captured by the current simulation results. For example, BIS (1997) argues that the availability of a central queue may motivate LVPS participants to take on increased credit risk. This could occur where participants have the ability to view information on expected incoming payments in the central queue. A participant, observing that incoming funds intended for one of its clients are waiting in the queue, may choose to credit the client's account with the value of these funds before they are received in the system. Thus, the participant would be exposing itself to credit risk until the payment is processed by the LVPS with finality.

Finally, further research is required to assess whether the benefit of a reduced SWP (in terms of lower collateral requirements) is greater than the associated cost in terms of a marginal increase in settlement delay. This entails attempting to quantify the (social) cost of settlement delay, and will likely depend on a number of factors including how time sensitive the delayed payments are.

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Research

Summaries

Introduction

Bank of Canada staff undertake research designed to improve overall knowledge and understanding of the Canadian and international financial systems. This work is often pursued from a broad, system-wide perspective that emphasizes linkages across the different parts of the financial system (institutions, markets, and clearing and settlement systems), linkages between the Canadian financial system and the rest of the economy, and linkages to the international environment, including the international financial system. This section summarizes some of the Bank's recent work.

In "Endogenous Market Incompleteness with Investment Risks," Césaire Meh and Vincenzo Quadrini use models of theoretical economies to study the macroeconomic and welfare implications of institutional reforms that make available financial contracts which provide the best insurance possible against idiosyncratic investment risks. Indeed, investment activities are subject to important uninsurable idiosyncratic risks, which are pervasive in the macroeconomy. The results confirm that the presence of these types of risks may lead to an under-accumulation of capital relative to that in an economy where such idiosyncratic risks can be fully insured. These findings imply that institutional reforms in Canada that make the use of state-contingent contracts (with payoffs conditional on the state of the world) more enforceable can have important positive consequences for the overall welfare of Canadians. This paper thus supports the Bank's efforts to promote the efficiency of the Canadian financial system.

In many countries, including Canada, multiple regulatory agencies oversee the activities of deposit-taking institutions. Multiple agencies are by no means the rule, however, and many countries have chosen to consolidate their bank regulatory regime. In "An Analysis of Bank Closure Policy under Alternative Regulatory

Structures," Greg Caldwell develops a theoretical model of banking under alternative regulatory regimes. The aim of the paper is to determine which delegation of responsibilities between supervisory authorities facilitates an efficient allocation of credit and proper risk management among banks. The author shows that although regulatory structure is important, effectiveness requires the presence of market discipline.

Over the last few years, the U.S. ability to finance its current account deficit has been facilitated by massive purchases of U.S. Treasury Bonds and agency securities by Asian central banks. In this process, Asian central banks have accumulated large stockpiles of U.S.-dollar foreign exchange reserves. In determining the optimal level of reserves, the monetary authority will seek to balance the macroeconomic adjustment costs incurred if reserves are exhausted with the opportunity cost of holding the reserves. In "An Empirical Analysis of Foreign Exchange Reserves in Emerging Asia," Marc-André Gosselin and Nicolas Parent assess a panel of eight Asian emerging-market economies to see how much their current level of reserves differs from that predicted by the standard macroeconomic determinants. The authors use an econometric technique that formally addresses the weaknesses in prior studies on this topic. They observe that their model cannot explain the very strong pace of reserve accumulation in these countries over the last two years. The authors conclude that a slowdown in the pace of reserve accumulation is therefore likely, implying negative risks for the U.S. dollar. However, the substantial capital losses that Asian central banks would incur if they were to drastically change their holding policy mitigate the risks of a rapid depreciation of the U.S. dollar triggered by such a move.

Endogenous Market Incompleteness with Investment Risks

Césaire Meh (Bank of Canada) and Vincenzo Quadrini (University of Southern California)*

In their review of the literature on financial structure and growth published in the first issue of the *Financial System Review*, Dolar and Meh (2002) argue that the legal system, the enforceability of financial contracts, a transparent accounting system, and transparent corporate governance all have a positive impact on macroeconomic performance. Consequently, policy-makers should pursue institutional reforms that deliver growth-enhancing financial services, such as those that lead to better sharing of the idiosyncratic (individual-specific) risks associated with investment activities.

Indeed, investment activities are subject to important, uninsurable idiosyncratic risks, and these risks are pervasive in the macroeconomies of both developing and developed countries. In the United States for instance, entrepreneurs and private investors face highly variable returns (Moskowitz and Vissing-Jørgensen 2002). Moreover, the incomes of entrepreneurs are two to four times more volatile than those of non-entrepreneurs. The survival rate of private firms is only 39 per cent over the first five years, and returns on investment vary widely among surviving firms.

These large idiosyncratic risks are likely to have important consequences for macroeconomic performance and welfare, since privately held companies account for about half of production, employment, and corporate equity, in addition to representing more than half the financial wealth of rich households.

Objective

Meh and Quadrini (2005) examine the macroeconomic and welfare implications of institutional reforms that produce financial

contracts which provide the best possible insurance against idiosyncratic investment risks. More specifically, the authors seek to determine the effect of such institutional reforms on aggregate capital accumulation and welfare.¹

Methodology

To address this objective, general-equilibrium models of three economies are considered²: (i) the complete markets economy, (ii) the optimal contract economy, and (iii) the debt contract economy. In the first two, agents can sign optimal state-contingent contracts; i.e., contracts where the payoffs are conditional on the state of the world—defined according to whether the entrepreneur's investment fails or succeeds (idiosyncratic investment risks). These risks are independently distributed across entrepreneurs. When the project fails, the entrepreneur receives an insurance payment, and when it is successful, the entrepreneur makes a payment to the financial intermediary. By pooling a large number of entrepreneurs, the financial intermediary is able to provide insurance against idiosyncratic investment risks. The provision of full or partial insurance by state-contingent contracts, however, depends on whether there is complete or incomplete information.

In the *complete markets economy*, information is complete, and all actions of the entrepreneurs are observable. Therefore, full insurance against idiosyncratic investment risks is possible. This is the benchmark economy with which the others are compared.

In the *optimal contract economy*, information is incomplete (asymmetric information), and the

* This report draws on a forthcoming journal article (Meh and Quadrini 2005).

1. For further details, see Meh and Quadrini (2005).
2. These general-equilibrium models are theoretical, not empirical, models.

entrepreneur's actions are not publicly observed. As a result, there is a moral-hazard problem in the sense that the entrepreneur has an incentive to invest in riskier projects when insurance is available. Because of this moral-hazard problem, the financial intermediary will structure the contract such that the entrepreneur has an incentive not to undertake projects that are too risky (i.e., the contract is incentive-compatible). Thus, the optimal state-contingent contract provides less than full insurance to the entrepreneur. Examples of such contracts are: options; credit derivatives, such as credit default swaps; and equity contracts.³ Another practical example of a state-contingent contract is one that would share the funding of pension deficits between workers and the firm when a firm encounters financial difficulty.

Unlike the first two economies, the *debt contract economy* does not feature any state-contingent contracts. As a result, agents can sign only non-contingent contracts, where the borrower makes a pre-arranged payment regardless of the success or failure of the investment (that is, regardless of the investment risk).

Results

By comparing these three theoretical model economies, we show that:

(i) In the two model economies with incomplete markets (the debt contract economy and the optimal contract economy) the steady-state equilibrium, risk-free interest rate is lower than that in the complete markets economy. However, the aggregate stock of capital is lower than in the complete markets economy; i.e., there is under-accumulation of capital.

(ii) Even with very large moral-hazard problems, the availability of optimal state-contingent contracts brings the aggregate stock of capital and the equilibrium riskless interest rate very close to the corresponding levels in the complete markets economy. As a result, the availability of optimal state-contingent contracts increases welfare significantly. More specifically, the average welfare gains from the debt contract economy to the optimal contract

economy are more than 2 per cent of aggregate consumption.

The intuition behind the under-accumulation of capital results from the fact that the accumulation of capital is risky, and agents require a risk premium when markets are incomplete. The availability of optimal state-contingent contracts allows better insurance against investment risks and, as a result, the risk premium decreases and the demand for capital increases. Consequently, the use of state-contingent contracts can lead to an aggregate stock of capital that is very close to that in complete markets and substantially higher than the stock of capital that would prevail when only non-contingent debt contracts are feasible. The provision of better risk sharing, coupled with the resulting increase in aggregate capital, leads to a significant increase in welfare.

Discussion

This result illustrates the importance of factors that make state-contingent contracts feasible. Among these factors, formal and informal institutions play a central role. State-contingent contracts may not be extensively used in practice because enforcement may be highly inefficient and costly. For instance, the resolution of contractual disputes might be extremely long and uncertain. Substantial cross-country evidence indicates that the degree of contract enforcement is correlated with the degree of financial development.⁴ In this study, the economy with state-contingent contracts can be interpreted as an economy in which financial markets are more developed, partly because of more efficient institutional enforcement. Thus, we argue that institutional reforms—for example, well-developed legal systems—that lead to greater contract enforceability can importantly improve welfare. Future research should establish which types of institutions facilitate or make possible the use of these contracts.

Policy Implication

Legal and regulatory policy should endeavour to create an environment where a wider variety of enforceable state-contingent contracts become available. This is one way that the Bank of

3. *The Economist* (2005) provides further examples of credit derivatives (contracts that, for a fee, allow lenders to transfer to another party the risk that a firm will default) to share the risk in business activity.

4. See Levine (1997) and Dolar and Meh (2002) for reviews of the empirical literature.

Canada can direct its efforts (through its advisory role) to promote the efficiency of the Canadian financial system (Dodge 2005).

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An Analysis of Bank Closure Policy under Alternative Regulatory Structures

*Greg Caldwell**

Many countries have multiple regulatory agencies that oversee the activities of deposit-taking institutions (DTI). In Canada, for example, the Office of the Superintendent of Financial Institutions (OSFI) is responsible for prudential supervision, while the Canadian Deposit Insurance Corporation (CDIC) is responsible for managing the deposit insurance fund and for the resolution decision for a failed DTI. Multiple agencies are by no means the rule, however, and numerous countries have chosen to consolidate their bank regulatory regime. This raises the question of what trade-offs there might be from maintaining separate agencies versus amalgamation.

This study develops a theoretical model of banking under alternative regulatory regimes. These regimes are defined by their organizational structure, as well as by the closure and resolution policy. Closure policy is a set of rules that describe the conditions under which a regulator or supervisor will intervene in the operations of a bank. Resolution policy describes the way in which a bank will be wound up in the event that it is closed. Various resolution options are described below.

The study's purpose is to determine which delegation of responsibilities between supervisory authorities facilitates an efficient allocation of credit and proper risk management among banks. The effect of separating the closure and resolution decisions between two agencies (a dual regime) instead of keeping both decisions within a single institution (a meta-regulatory regime) is analyzed.

The study incorporates two standard features of banking models: moral hazard and market

discipline. Moral hazard exists because the owners of a bank can be tempted to choose an excessively risky loan portfolio. When the majority of its creditors (i.e., depositors) are insured by a third party (the deposit insurer), then the bank bears little of the downside risk associated with its lending choice and has an incentive to take such risks. If its loans perform badly, the owners of the bank have the option to exit, leaving the deposit insurer to bear the residual costs of the bank's failure.

A supervisor can mitigate these incentives by establishing capital requirements for banks. Binding capital requirements provide the bank with an incentive to more efficiently manage the risk inherent in its assets. In this case, if the loans perform poorly, the owners' capital will be exhausted first, before the deposit insurer incurs any losses. This study finds that higher capital requirements do, indeed, reduce risk shifting. However, the cost of increasing capital requirements is reduced intermediation. Namely, some welfare-enhancing projects will be abandoned by banks that are not willing to set aside the requisite amount of capital.

Market discipline, the second feature modelled in this study, is represented by the amount of uninsured deposits that a bank accepts relative to the amount of its insured deposits. Uninsured depositors bear some of the risk in a bank's lending decision, while insured depositors do not. Consequently, uninsured depositors will demand greater compensation for that risk. Since this increases the bank's cost of funding, it may reduce its incentives towards excessive risk taking.

Combinations of market discipline and capital regulation are interwoven in the various regulatory regimes. This research shows that although regulatory structure is important, effectiveness requires the presence of market discipline.

* This article summarizes a recently published Bank of Canada working paper (Caldwell 2005).

Closure and Resolution Policy

Regardless of the regulatory regime, regulators are modelled in this study as having to choose conditions under which a bank will be closed. The same factors that determine insolvency in a commercial enterprise affect the decision to shut down a bank. But concerns about financial stability, together with the perceived “specialness” of the banking sector further complicate the policy for closing a bank. More recently, a trend in developed countries has been towards early-intervention policies, whereby the bank is shut down by supervisory authorities well before it becomes insolvent.¹ This trend reflects several factors, including historical experience with forbearance, by regulators; excessive gambling by banks that were, in fact, insolvent; and a recognition that accounting measures of bank capital, based on historical costs, may be inaccurate and potentially misleading.

Once a bank is closed, the model enables the regime to choose between two resolution options: *liquidation*, whereby the bank's assets are sold off and funds are retrieved by creditors based on a predetermined ordering; or *purchase and assumption*, where the bank is recapitalized by authorities and then merged with a healthy bank. With the second option, there is a multitude of possible acquirers, but this is left unmodelled.²

Either resolution option has its trade-offs. If a closed bank is liquidated, there is an assumed recovery cost. This could be explained by asymmetric information problems with bank loans. In particular, the purchaser of the failed bank's loans does not know the quality of the borrowers as well as the originating bank. Consequently, liquidation can be costly since assets are sold off. If, instead, the bank is merged with another, there is less need to sell off the entire portfolio of assets. Creditors tend to receive more favourable payoffs under mergers.

1. In an early-intervention regime, a bank is closed if its capital falls below a predetermined threshold or if the supervisor judges that insolvency is a material risk. For a discussion of the evolution of the safety net in Canada including the early-intervention framework, see Engert (2005).
2. The bank could remain separate but with new management; another private bank could acquire it; or it could be nationalized. Each of these options share some notion of recapitalization.

These arguments suggest that merging a failed bank after closure is efficient. But this does not necessarily imply that a merger policy is optimal. If a bank's creditors do not believe that it will be liquidated, if closed, they will not demand as much compensation for risks incurred by the bank. Consequently, the incentives for the bank to take risks are heightened by the implicit guarantee associated with a resolution policy of mergers. This leads to increased risk, since the lending decisions of the banks will not be as prudent as they would if banks faced a greater likelihood of liquidation after closure.

Choice of Regulatory Regime

Given the choices involved in closure and resolution, what is the socially optimal regulatory regime for the various agencies that make these decisions? The academic literature provides some guidance about when to close a bank (Acharya and Dreyfus 1989) and whether a central bank or supervisor should have this responsibility (Repullo 2000; Kahn and Santos 2001). There is little guidance about the optimal resolution regime, however. On the policy side, Garcia (1999) discusses issues concerning coordination between supervisors, central banks, and deposit-insurance agencies. He concludes that there is considerable heterogeneity in regime choice across countries.

This study endogenizes the choice between two regimes: a dual regime and a meta-regulatory regime. In a dual regulatory environment there is a separation of responsibilities between the supervisor and the deposit insurer. The former is responsible for establishing minimum capital requirements and thresholds for intervention (i.e., closure). The latter is responsible for the resolution decision. In a meta-regulatory regime, all these responsibilities lie with a single supervisory agency.

Although regime is important, the objective or mandates of the decision makers also affect the eventual outcome. This study assumes that the supervisor is concerned with choosing the regulatory regime that maximizes the expected overall wealth of all participants. Better regimes have better possibilities for expected wealth, since banks are given incentives to take on efficient levels of risk. Namely, the private gains of bank intermediation are aligned with the public benefits.

Conversely, the deposit insurer's objective is to protect insured depositors but also to resolve closed banks in a manner that is the least costly to the agency. The result of these separate mandates is that when a deposit insurer must determine the resolution decision, it tends to lean more towards liquidation than a bank supervisor would. This tendency reflects the deposit insurer's narrower mandate for protecting insured depositors and itself from losses.

Conclusion

This study found that regimes that separate the supervisor from the deposit insurer always perform at least as well as the amalgamated meta-regulatory regime. The meta-regulator's objectives increase its proclivity towards the choice of merger for a failed bank. This weakens the incentives of uninsured creditors to discipline the bank's risk taking. The consequence is a greater likelihood of bank failure, unless the meta-regulator imposes stronger capital requirements.

The least costly resolution (the resolution objective of an independent deposit insurer) might not be as efficient a choice in a world where a bank has actually failed; however, this study found it to be more efficient prior to indications of a bank failure, since it mitigated excessive risk taking by banks. A further benefit is that the supervisor need not impose strong capital requirements to get the most efficient level of risk taking and credit allocation.

The dominance of the dual regulatory regime over meta-regulation was found to rest on the exercise of market discipline. If the proportion of uninsured to insured deposits reached a critical mass, then the dual regulatory regime outperformed the meta-regulator. Until this threshold was achieved, the greater threat of liquidation under a dual regulatory regime failed to have any impact on the incentives for risk taking by banks.

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An Empirical Analysis of Foreign Exchange Reserves in Emerging Asia

Marc-André Gosselin and Nicolas Parent

Over the last few years, the U.S. ability to finance its current account deficit has been facilitated by massive purchases of U.S. Treasury Bonds and agency securities by Asian central banks. As a result, Asian central banks have accumulated large stockpiles of U.S.-dollar foreign exchange reserves.

In theory, a country holds reserves as a buffer stock to smooth unexpected and temporary imbalances in international payments. In determining the optimal level of reserves, the monetary authority will seek to balance the costs of macroeconomic adjustment incurred if reserves are exhausted with the cost of holding reserves. Reserve hoarding entails sterilization costs stemming from the negative spread between the interest earned on reserves and the interest paid on the country's public debt. Moreover, if capital flows are not sterilized, sustained accumulation of reserves will, at some point, generate inflationary pressures that could threaten domestic financial stability. If Asian central banks decide to stop accumulating U.S.-dollar reserves, they could trigger an abrupt depreciation of the U.S. dollar. Given the potential impact on global interest rates, economic growth, and financial stability, the issue of Asian reserve accumulation is of considerable importance.

Our objective is to assess the degree to which the current level of foreign exchange reserves held by Asian central banks diverges from that predicted by the standard macroeconomic determinants.¹ To do so, we estimate a long-run demand function for reserves in a panel of eight Asian economies: China, India, Indonesia,

South Korea, Malaysia, the Philippines, Singapore, and Thailand.

The International Monetary Fund (IMF 2003) uses a simple empirical model based on various determinants of reserve holdings to study a panel of 122 newly industrialized emerging-market countries. Predicted values from the Fund's model indicate that the acceleration in reserve accumulation in emerging Asia in 2002 was well in excess of expectations based on fundamentals.

The IMF study suffers from a number of shortcomings in our view. First, although the time series used are clearly not stationary, statistical inference is based on the assumption that the data are stationary.² Second, although there is evidence that Asian countries have increased their level of reserves for self-insurance purposes in the aftermath of the Asian financial crisis (Mendoza 2004; Aizenman, Lee, and Rhee 2004; Aizenman and Lee 2005), the IMF model does not allow for a structural break in the estimated demand for reserves. By using the panel cointegration tests of Pedroni (1999) as the basis for the specification and estimation of our long-run demand function for reserves and by allowing for structural breaks, we formally address these issues.

Results

Using data from 1980 to 2003, we find that the level of reserve holdings is a function of GDP, the ratio of imports to GDP, the ratio of broad money to GDP, the volatility of export receipts, as well as a break in the coefficient of imports to GDP, and a break in the coefficient of broad

1. In the literature, reserves are modelled as a function of economic size, current account vulnerability, capital account vulnerability, exchange rate flexibility, and opportunity cost.

2. It is well known in time-series econometrics that t-statistics of spurious regressions are invalid. Statistical inference in the existing literature on foreign exchange reserves ignores this fact.

money to GDP in the post-crisis period. By accounting for a positive structural break in the demand for international reserves by Asian central banks in the aftermath of the financial crisis of 1997–98, our model allows for a higher level of long-run reserves in the post-crisis period. While the Fund concludes that reserves in emerging Asia were in excess of their long-run level by US\$73 billion in 2002, we find that reserves were essentially in line with their determinants that year. Nevertheless, our model cannot explain the large accumulation of international reserves by these countries in 2003 and 2004.

Reserve holdings in emerging Asia as a whole were above the level predicted by their determinants by US\$52 billion in 2003 and by US\$112 billion in 2004. China accounts for most of the increase in the reserves gap from 2003 to 2004. Furthermore, the error-correction equation associated with this cointegrating vector reveals that the reserves gap closes at an average rate of 56 per cent per year over the sample. These results suggest that, everything else remaining the same, a slowdown in the speed of accumulation of reserves is likely.

Implications for the U.S. Dollar

Our findings imply potential downward pressures on the U.S. dollar. But although the error-correction model suggests that adjustment could be relatively quick, changes in holding policies might actually be very gradual in the current context. Indeed, the amount of reserve assets held by Asian central banks is so large that any change in holding policies could have a substantial impact on the U.S. dollar and, consequently, on the balance sheets of Asian central banks. To avoid large capital losses, Asian central banks will be very cautious when slowing the rate of reserve accumulation. The recent announcement by the Bank of China to peg its currency against a basket of currencies reflects this cautious approach. As a result, the chance of a rapid depreciation of the U.S. dollar triggered by Asian central banks is not very high.

The currency composition of reserve stocks may pose an additional risk for the U.S. dollar. Diversifying away from the dollar would reduce capital losses in the event of a reduction in reserve holdings (autonomous or coming from

a currency revaluation). But the currency composition of reserves in developing countries is remarkably stable over time. It is determined by factors that display substantial inertia, such as the choice of currency peg, the identity of the dominant trade partner, and the composition of foreign debt (Eichengreen and Mathieson 2000). A radical currency reallocation of reserves is thereby not very likely to happen within a short time. Hence, although the outlook for the U.S. dollar may not be favourable from the perspective of the currency composition of reserves, risks of an abrupt depreciation in the U.S. dollar coming from this source remain limited.

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