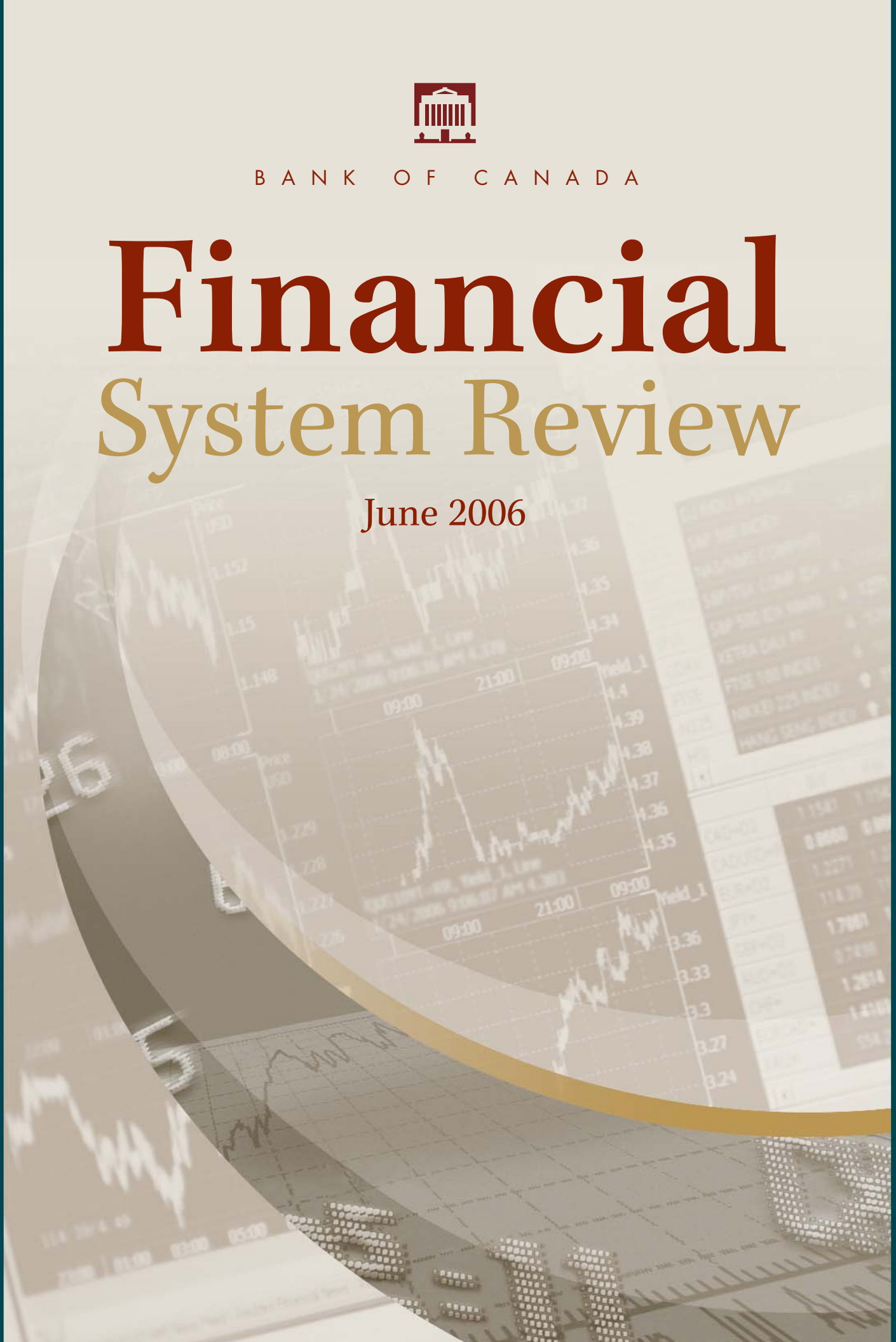
BANK OF CANADA

# Financial System Review

June 2006



## 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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BANK OF CANADA

# Financial System Review

## June 2006

## Members of the Editorial Committee



The significant contribution of individual authors of specific portions of the Developments and Trends section, as well as that of members of the working group mandated with the preparation and organization of the *Review*, is gratefully acknowledged.

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Bank of Canada
June 2006

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# Developments and Trends

Notes

The material in this document is based on information available to **1 June** 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, its safety, and its efficiency, such as developments in legislation, regulation, or financial practices.

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

*This section of the* Review *presents an assessment of the risks arising from both international and domestic sources bearing on the stability of the Canadian financial system. The objective is to highlight key risk factors and vulnerabilities in the financial system and to discuss any potential implications for the system's overall soundness.*

## Key Points

- The likelihood that a shock would have a significant adverse impact on the Canadian financial system remains small.
- The Canadian financial, non-financial corporate, and household sectors are healthy and in a good position to withstand shocks.
- The possibility of a significant price reversal in riskier assets remains, although markets have so far been resilient in the face of negative shocks.
- There continues to be a small risk that the adjustment of global imbalances could slow the growth of the global economy appreciably and increase volatility in financial markets significantly. This risk may, however, be lower than previously thought.
- Issues raised by a possible influenza pandemic have received considerable attention domestically and internationally in recent months.

## Overall Assessment

In general, households, businesses, and financial institutions are in good financial shape. This is partly the result of a very favourable macroeconomic environment. It is also the result of improved risk-management practices at financial institutions and of prudent financial behaviour by non-financial corporations.

The macroeconomic situation has been particularly favourable for the past several years, with robust global growth, high commodity prices, and strong profits. On the whole, the Canadian economy has adjusted remarkably well to large relative price changes, including a significant appreciation of the Canadian dollar, although that appreciation and heightened global competition continue to pose challenges for a number of firms.

Volatility in financial markets has been extraordinarily low in recent years, and this has contributed to a reduction in risk premiums to a very low level. In May, however, volatility suddenly increased in commodity, foreign exchange, and equity markets against a background of increased uncertainty about the strength of the global economy and future inflation in the United States. There was also some limited correction in the prices of riskier assets. Nonetheless, both volatility and spreads remain at historically low levels. There is thus a possibility that a more pronounced increase in market volatility could still trigger a significant repricing of risk. An important question is how resilient world markets would be to such repricing.

One area of concern is growing global current account imbalances. These imbalances primarily reflect mismatches of savings and investment in major regions of the globe, with large precautionary savings in Asia and low savings in the

United States. The base-case scenario presented by the Bank of Canada in its April *Monetary Policy Report* assumes that these imbalances will gradually diminish as public and private savings in the United States rise and domestic demand picks up in the rest of the world.

There is, however, a risk that the adjustment could involve considerable volatility in markets and large movements in exchange rates, which would spill into the real economy, partly through weaker consumer and investor confidence and, perhaps, through protectionist measures. This would result in a pronounced slowdown in global economic growth and lower commodity prices. The larger the global current account imbalances become, the larger the adjustment to reduce them will need to be. And the more impediments there are to a market adjustment of these imbalances, the greater the risk that the adjustment will be disorderly.

Although these imbalances have continued to grow recently, there have been some tentative signs of policy shifts that could contribute to an orderly adjustment. Moreover, global economic growth is becoming more broadly based with the strengthening of Japan's economy and, to a lesser extent, that of Europe. On balance, it appears that the risk of a disorderly adjustment may be lower than was previously judged.

What are the implications of these risks for Canada?

A slowing of the world economy, together with a sharp upward movement in the Canadian dollar, could imply lower export volumes for Canada and weaker commodity prices, which could impair the profits of Canadian companies and strain the ability of households to service their debts. Repricing of risky assets internationally would likely affect the prices of risky assets in Canada, as well as the balance sheets of any Canadian entities holding risky assets abroad.

### *Canadian financial situation*

Canadian financial institutions are currently in a good position to withstand shocks. Major banks have been profitable, are well capitalized, and are using sophisticated risk-management models. Market-based indicators suggest that markets consider the major Canadian banks to be healthy.

**Box 1**

## The Risk of a Pandemic

Issues raised by the risk of an influenza pandemic have been discussed recently at a number of international meetings, including the Joint Forum and the Financial Stability Forum. There is considerable uncertainty about the timing and severity of such a pandemic. From an economic point of view, the key factors would be increased absenteeism related to illness, disruption of the supply chain, and the possible effect on confidence. The extent of any economic disruption would depend partly on how well prepared firms were to continue operations if they were faced with extensive absenteeism.

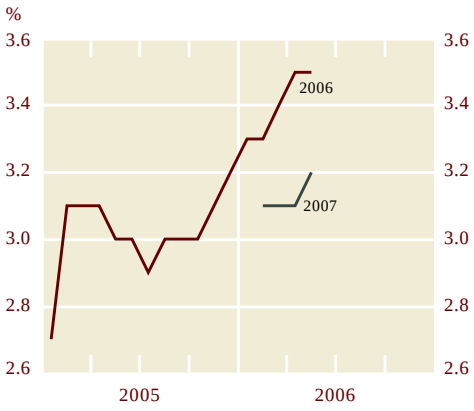
Financial institutions would likely experience an increase in non-performing loans to households and corporations affected by the pandemic, while higher mortality rates would increase payments by life insurance companies.

The International Monetary Fund (IMF) has been active in raising awareness of the possible economic and financial consequences of a pandemic.[1] It has also encouraged co-operation among countries in preparing contingency plans to deal with absenteeism in their financial sectors and in developing best practices.

The Government of Canada has put in place a Canadian Pandemic Influenza Plan, and in the May 2006 budget allocated $1 billion over 5 years to further improve Canada's preparedness to deal with a pandemic. The Office of the Superintendent of Financial Institutions is working with financial institutions to understand the challenges associated with a possible pandemic and best practices to respond to such an occurrence.

1. See <http://www.imf.org>.

**Chart 1 Evolution of Consensus Estimates for Global Economic Growth***




* This estimate covers 46 countries.
Source: Consensus Economics Inc.

The behaviour of non-financial corporations in Canada seems to have been prudent at a point in the cycle when risk taking can often lead to vulnerabilities that can cause problems when the macroeconomic environment becomes less favourable. Many non-financial companies are earning substantial profits and are using these profits to reduce debt-to-equity ratios and to accumulate liquid assets. A number of sectors are, however, suffering from the appreciation of the dollar, high input costs, and increased competition in international markets.

One sector of the economy that has seen a substantial increase in debt is the household sector, as growth in household credit has risen to around 11 per cent. Despite growing debt and recent increases in interest rates, debt-servicing ratios remain low, partly because of a substitution of home-equity lines of credit for other forms of personal credit. Analysis of the market for condominiums supports the assessment in the December 2005 *Financial System Review* (FSR) that the risk of a marked reversal in housing prices in major Canadian markets appears limited. Since December 2005, there has been a significant escalation in the prices of houses, but the movement was largely limited to cities in Western Canada. Our assessment continues to be that the household sector poses a low risk to the financial system. If economic prospects were less positive, however, or if interest rates were to rise significantly, the finances of some households would, undoubtedly, be heavily strained.

## The Macrofinancial Environment

The global economy has continued to expand at a solid pace in recent months. Indicators of real activity and financial health remain strong, and the global economic outlook is somewhat better than expected in the last FSR. However, it appears that inflation pressures may be building in the United States. As a result, there has been some net increase in bond yields and increased volatility in commodity, exchange rate, and equity markets.

### The international environment

Despite higher oil prices, expectations for global economic growth in 2006 have generally been revised upwards since the December 2005 FSR

(Chart 1), owing mainly to a stronger outlook for Asia, including Japan, and, to a lesser extent, for Europe. Expectations for 2007 point to a slight moderation in global economic activity, partly reflecting some monetary tightening undertaken to balance aggregate supply and demand.

Healthy corporate profits and favourable financing conditions continue to be reflected in various indicators of financial distress, such as default rates. According to Standard & Poor's, the global corporate default rate for speculative-grade bonds fell to 1.1 per cent in the 12 months ending in April 2006, the lowest level in more than two decades (Chart 2).

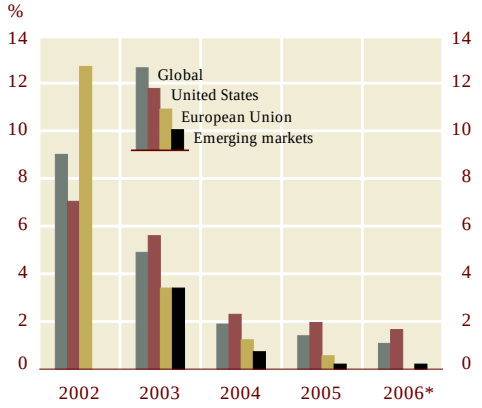
## United States

Attention in the United States continues to focus on the housing market, which has been slowing since mid-2005. Price declines have been modest and orderly so far, with the median prices of new and existing homes falling by less than 5 per cent from their recent highs (Chart 3). Since their peak last summer, sales of existing homes have declined by 5 per cent and sales of new homes have fallen by 12 per cent, although the latter are a much smaller segment of the market. The average inventory of unsold new homes available so far in 2006 exceeds five months' worth of sales—much higher than the previous five-year average of 4.1 months. Applications for conventional mortgages have fallen by about 40 per cent since the middle of 2005.

The current housing boom has featured significant increases in lending to "subprime" borrowers. Non-traditional mortgages, such as adjustable-rate mortgages, hybrids, and simultaneous second mortgages and home-equity credit lines, are now commonly offered along with interest-only introductory periods and no requirements for documentation. These practices raise home ownership rates and lower consumer debt payments, but they also increase default risks and expose more homeowners to rising interest rates. Subprime mortgages, second mortgages, and equity-based lines of credit have higher delinquency rates than conventional fixed-rate mortgages and appear more sensitive to economic conditions (Chart 4). These developments need not pose difficulties for banks as long as these new types of mortgages are correctly priced.

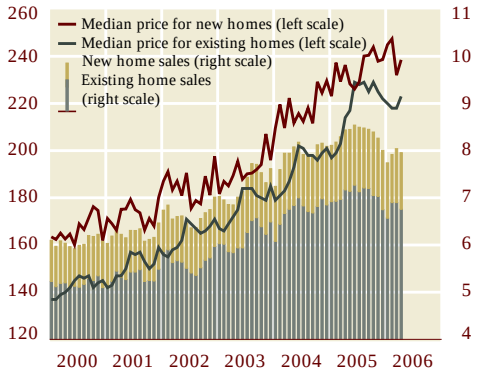
To ensure adequate management of potential risks, the Federal Reserve tightened regulations on home-equity loans and non-traditional

**Chart 2 Default Rates on Speculative-Grade Bonds**




* 12 months ending April 2006
Source: Standard & Poor's

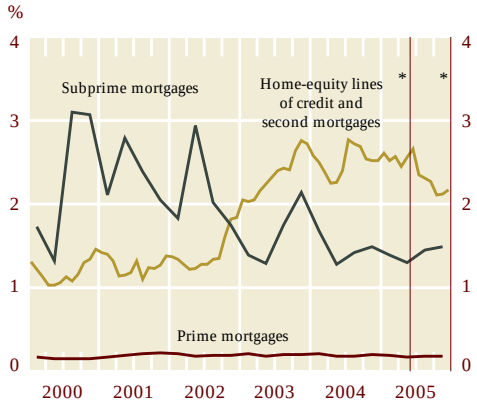
**Chart 3 United States: Market Selling Price and Units Sold, New and Existing Homes**




Note: Data for existing homes include condos as well as single-family homes.
Source: U.S. National Association of Realtors and U.S. Census Bureau

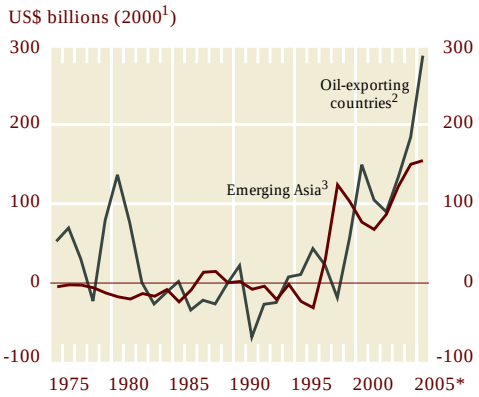
**Chart 4 United States: Delinquency Rates**

Not seasonally adjusted




* Vertical lines indicate regulation dates.
Source: American Bankers' Association

**Chart 5 Current Account Surpluses**

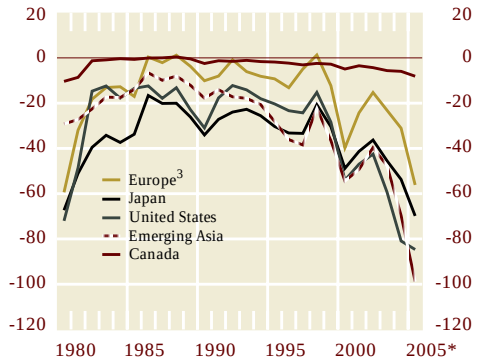



1. Deflated using U.S. GDP deflator
2. Includes OPEC, Norway, and Russia
3. Includes China (Mainland + Hong Kong), Indonesia, South Korea, Malaysia, Singapore, and Thailand

* 2005 is an estimate

Source: IMF

**Chart 6 Trade Balances with Oil-Exporting Countries[1]**

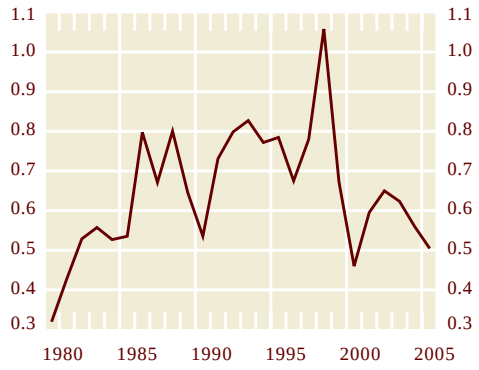



1. Includes OPEC, Norway, and Russia
2. Deflated using U.S. GDP deflator
3. Includes France, Germany, Italy, and United Kingdom

* 2005 is an estimate.

Source: IMF

**Chart 7 Ratio of Imports to Oil Exports: Oil-Exporting Countries**




Source: OPEC and IMF

mortgages in 2005. Most lenders have also recognized the potential risks posed by non-traditional mortgages. In the January Senior Loan Officer Opinion Survey, 40 per cent of respondents expected the quality of their non-traditional mortgages to decline in 2006. Accordingly, banks have increased loan-loss reserves.

Developments in the U.S. housing market to date appear to be broadly in line with consensus forecasts calling for a moderation in house prices over 2006, but a large price reversal remains a concern. Since Canadian financial institutions have very little direct exposure to the U.S. housing market, they are unlikely to be seriously affected by further adjustments to U.S. house prices. Canada would be affected indirectly, however, by the broader consequences of such adjustments on U.S. household spending and on U.S. economic activity.

# Highlighted Issue

## Petrodollar recycling and Canadian financial stability

*Prepared by Robert Lavigne*

The rise in oil prices since 2002 has produced significant windfall revenues for fuel-exporting countries. According to IMF estimates, revenues from international oil sales reached US$800 billion in 2005, a figure that has propelled the current account surpluses of major oil-exporting countries past those of Emerging Asia (Chart 5), making them the world's largest surplus-generating region.[1] The sources of this positive trade balance are divided among surpluses with the United States, Europe, and Asia (Chart 6). Canada, a net oil exporter, has only a small deficit with this group of countries.

These export earnings are recycled into the global economy either through imports of goods and services from oil-importing countries or through purchases of their assets. Chart 7 shows import growth in oil-exporting countries lagging the expansion of oil revenues by a considerable margin. There are several reasons for this

1. In this article, "oil exporters" are defined as OPEC, Norway, and Russia (the IMF definition also includes a number of smaller exporters). Emerging Asia comprises China, Hong Kong, Indonesia, South Korea, Malaysia, Singapore, and Thailand.

increased propensity to save, including uncertainty with respect to oil prices, the highly concentrated ownership of oil resources in many countries, limited immediate investment opportunities in local economies, and the constraints imposed by heavily managed exchange rate regimes on the conversion of petrodollars into domestic currencies.

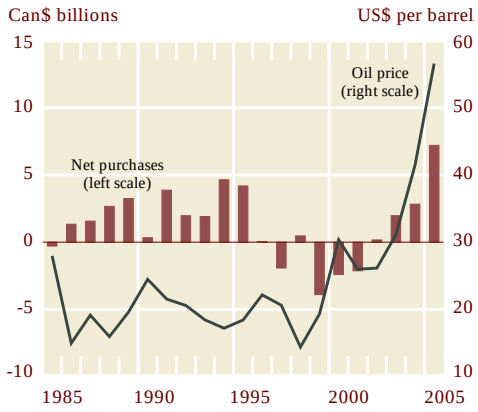
Although some of these savings are being used to pay down external debt, most petrodollars are invested abroad. In contrast to earlier periods of high oil prices, when petrodollars were stored mainly in international reserves or recycled via deposits in a few multinational banks, oil revenues are now allocated in a much more diversified manner, with a focus on portfolio investments.

## Impact on Canada

Recycled petrodollars can enter the Canadian financial system through several channels. The most direct is through the purchase of Canadian securities. The extent of such inflows is difficult to assess, however, because most petrodollars move through international financial centres, which masks their origins in bilateral statistics.[2] Matters are further complicated by a lack of transparency in the investment policies of many oil exporters, an issue that may become a growing source of uncertainty if high oil prices are sustained.

With this in mind, it is interesting to note that net purchases of Canadian equities and long-term bonds by non-OECD and non-EU countries rose markedly in 2005 to an all-time high of over $6 billion (Chart 8).[3] While specific data on oil exporters are not available, the strong positive correlation between the price of oil and the net portfolio purchases from the aforementioned group suggests that petrodollars may be increasingly entering Canada. These inflows accounted for a sizable portion of net foreign

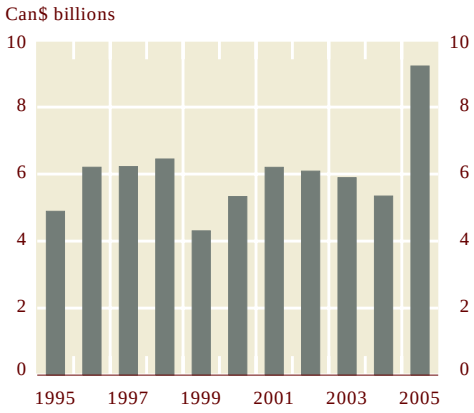
**Chart 8 Net Purchases of Canadian Stocks and Bonds by Developing Countries***




* Defined as non-OECD, non-EU countries
Source: Statistics Canada

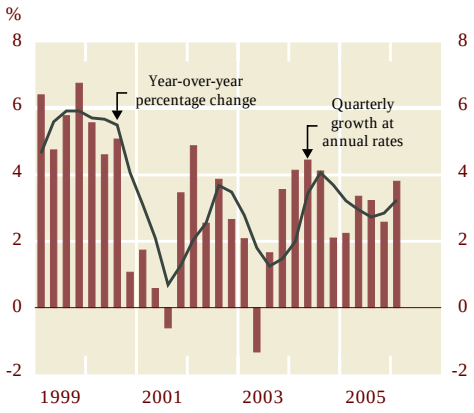
2. An extensive BIS study found that only 30 per cent of petrodollar investments could be tracked to a country destination.
3. The closest proxy for oil exporters in Statistics Canada data on non-resident purchasers of Canadian stocks and bonds (excluding money market instruments) is the category of non-OECD, non-EU countries. Because this data set includes the net purchases of other regions with current account surpluses, such as Emerging Asia, it reflects more than just petrodollar inflows.

**Chart 9 Deposits of Oil-Exporting Countries in Canadian Banks**



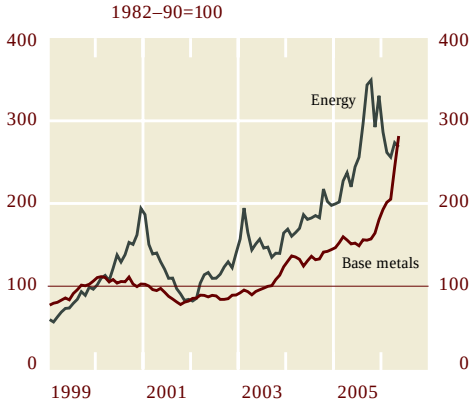

Source: Bank of Canada

**Chart 10 Real GDP Growth: Canada**




Source: Statistics Canada

**Chart 11 Bank of Canada Commodity Price Index**




Source: Bank of Canada

purchases of Canadian securities in 2005. Nevertheless, the magnitude of these flows remains small in relation to the average size of total foreign net purchases in recent years and to the overall stock of foreign-held Canadian securities (about $700 billion).

Petrodollars can also enter the Canadian financial system through deposits in Canadian banks. Indeed, there was a significant increase in deposits from oil-exporting countries in 2005, with the amount outstanding at branches and subsidiaries of Canadian banks worldwide nearly doubling to about $9 billion by the end of 2005 (Chart 9). This still represents only about 2 per cent of the total deposits of foreigners at Canadian banks worldwide.

Foreign direct investment in Canada by oil-exporting countries remains limited.

Overall, the relatively modest (though increasing) petrodollar inflows suggested by the available data are unlikely to significantly affect the Canadian financial system. Of potentially greater consequence for Canada is the impact of petrodollar recycling on global imbalances. Clearly, higher oil prices are serving to widen the U.S. current account deficit (net petroleum imports now account for 25 per cent of the deficit). However, petrodollars are increasingly being invested in a diversified, profit-oriented manner, which encourages a market-led resolution of imbalances.

## Canadian developments

### *Canadian economy*

Canada's real GDP grew at an average annual rate of just over 3 per cent in the second half of 2005 and the first quarter of 2006 (Chart 10). In the April 2006 *Monetary Policy Report*, the Bank judged that the Canadian economy was operating at, or just above, its production capacity in early 2006. Growth in final domestic demand is expected to remain the key driver of economic expansion in Canada through 2008. Net exports will likely exert a small drag on GDP growth for some time.

The Canadian economy is adjusting to the appreciation of the Canadian dollar, higher energy prices, and enhanced competition from Asian countries. Oil and metals prices have recently, been very volatile (Chart 11). Although the high prices for these commodities are largely related to the strong growth of world economic activity,

the current level raises questions about whether these prices will be sustained.

## Corporate sector

The overall financial position of the Canadian non-financial corporate sector remained healthy in early 2006 (Chart 12). Profitability has been very strong in recent years. Many corporations used this opportunity to reduce their debts. As a result, the ratio of debt to equity has declined. The high level of profits has also allowed non-financial corporations to fund their investment spending from internally generated revenues and has made them net suppliers of funds to the rest of the economy. This contrasts with their traditional position as net borrowers (Tomas 2006). Furthermore, as companies endeavoured to find additional opportunities for profitable investment, they increased their holdings of cash and liquid assets, which amounted to 9 per cent of their total assets at the end of March 2006. The improvement in their balance sheets would make it easier for firms to deal with the financial consequences of adverse shocks.

In late 2005 and early 2006, profitability remained buoyant in most sectors with a low exposure to international trade, as well as in oil and gas extraction and mining (Chart 13). On the other hand, overall profitability for other industries with a high exposure to international competition continued to be relatively weak. Many companies in these industries were restructuring their operations because of such factors as the past appreciation of the Canadian dollar, the high level of energy costs, and increasing competition from emerging markets.

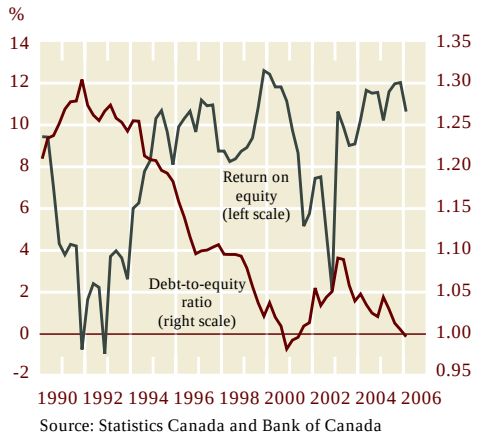
With the favourable macroeconomic environment and prudent behaviour by companies, business bankruptcies, as a per cent of total establishments, have continued to fall, corporate bond defaults have been virtually non-existent, and corporate bond spreads are still at a very low level.

While some indicators suggest that credit quality may start to deteriorate, this deterioration is expected to be confined to a few sectors, and is unlikely to pose a significant risk for the Canadian financial system (Box 2).

## Industry

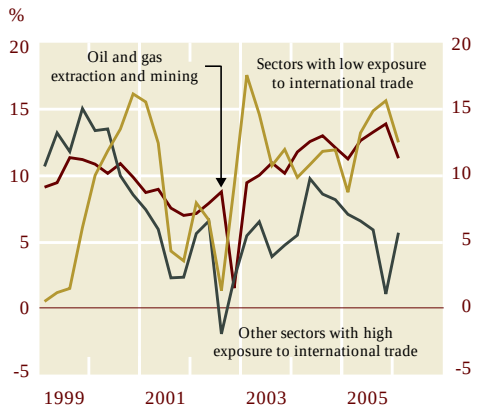
A limited number of industries, such as auto manufacturing, wood and paper products, and computer and electronics manufacturing, have

**Chart 12 Financial Position of the Canadian Non-Financial Corporate Sector**




Source: Statistics Canada and Bank of Canada

**Chart 13 Rate of Return on Equity for Selected Sectors**




Source: Statistics Canada

**Box 2**

## Corporate Credit Quality in Canada: Assessment and Outlook

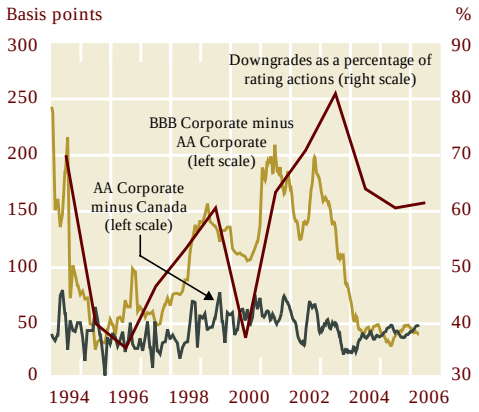
Favourable macroeconomic conditions in recent years have resulted in record profits for the non-financial corporate sector. A number of market-based indicators suggest that corporate credit quality is very high. Corporate bond spreads—for both high-rated bonds compared with government issues, and low-rated bonds compared with high-rated bonds—are at a very low level. The ratio of downgrades to upgrades has flattened after a few years of decreases (Chart 1). The quality of Canadian corporate credit is very strong, and default rates are very low.

However, there are some indications that credit quality might weaken. According to Moody's Investors Service, the corporate default rate in Canada is expected to increase in 2006 in tandem with the global default rate. The main driving factors are rising interest rates and slightly lower average credit ratings among speculative-grade issuers. Two potential leading indicators of credit risk in the aggregate non-financial sector developed at the Bank of Canada also suggest that credit quality may start to deteriorate from its current strong level.

One of these indicators uses the contingent claims approach (CCA), combining information on the market value of equity, debt, and market uncertainty to derive a measure of credit risk in the non-financial corporate sector. The second uses company-level financial accounts ratios (microdata) to make this assessment.[1] Both indicators show a recent increase in risk (Chart 2). The CCA measure of risk in the non-financial corporate sector started to increase in late 2005. The asset-based microdata indicator also increased in 2005.[2]

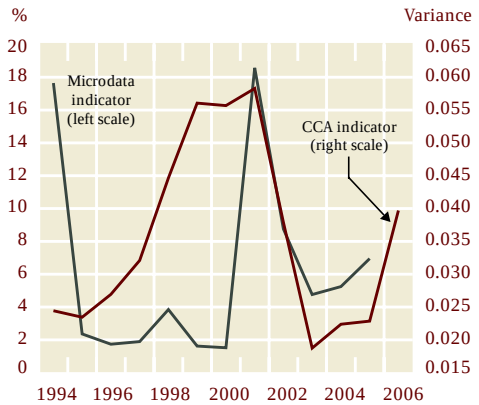
Preliminary work suggests that both measures may have leading-indicator properties, which may hint at deteriorating corporate credit quality in the future. However, the deterioration is expected to be confined to a few industries. Given the current strength of balance sheets in the non-financial corporate sector, this is unlikely to present a significant risk for the Canadian financial system in the near to medium term.

**Chart 1 Bond Yield Spreads* and Ratings Actions**




* 4-week moving average
Source: Scotia Capital and Moody's

**Chart 2 Microdata and CCA Indicators**




Source: Bank of Canada, *Financial Post*, Thomson Financial Datastream, and *The Globe and Mail*

1. The contingent claims approach is explained in this issue of the *Financial System Review* (Kozak, Aaron, and Gauthier 2006). The report on the microdata indicator was published in the December 2005 issue of the FSR (pp. 37–42). Briefly, this indicator is calculated for publicly traded companies as the percentage of assets held by companies that fall in the vulnerable tails of three financial ratios used as measures of financial vulnerability: profitability, liquidity, and leverage.
2. Both the microdata and the CCA indicators are based, at the moment, on the limited sample of balance-sheet data for 2005 available as of 2 May 2006. For the microdata indicator, only 47 per cent of companies had reported 2005 balance-sheet information. For the CCA indicator, all market information as of 2 May is included, and about 50 per cent of companies had reported 2005 balance-sheet information.

experienced particular financial stress since 2001. These sectors represent about 12 per cent of the banking sector's total loans to non-financial enterprises.

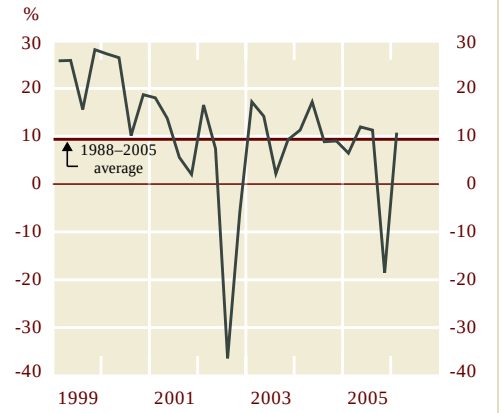
Canada's auto manufacturing industry experienced a substantial loss in the fourth quarter of 2005, partly reflecting writedowns, as a number of firms began major restructuring in response to the loss of market share by General Motors and Ford in recent years (Chart 14). Profitability did, however, recover markedly in the first quarter of 2006. Many auto parts companies in Canada (and the United States) are continuing to make difficult adjustments in an environment of high input costs and intensifying foreign competition.[4]

In addition, the wood and paper products industry experienced a loss in the fourth quarter, partly reflecting writeoffs, as a number of pulp and paper producers announced rationalizations of their operations (Chart 15). Factors such as the high value of the Canadian dollar, high energy costs, and rising wood fibre costs in Eastern Canada have all contributed to downward pressure on profitability. As a result, a number of Canadian companies saw their debt ratings/outlooks reduced towards the end of 2005. In the first quarter of 2006, profitability remained low. On the positive side, the Canada-U.S. Agreement Ending the Softwood Lumber Dispute should lead to an improvement in the financial position of lumber producers, chiefly as a result of the revoking of duties and the return of at least 80 per cent of duties paid since 2002.

Rates of return in the electronics and computer manufacturing industry remained quite low in 2005 and early 2006 (Chart 16). The industry continues to face intense competitive pressures from firms in emerging economies, even though sales volumes have continued to grow strongly. Consolidation is under way in the global telecom equipment industry, which might lead to a further restructuring of operations in the Canadian segment of this industry.

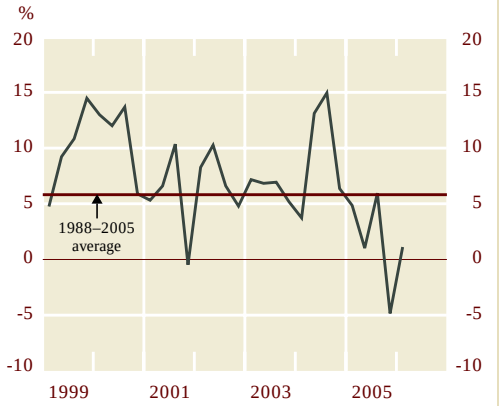
Grains producers have been adversely affected by weakness in world prices until very recently, as well as by the appreciation of the Canadian

**Chart 14 Return on Equity: Automotive Manufacturing**



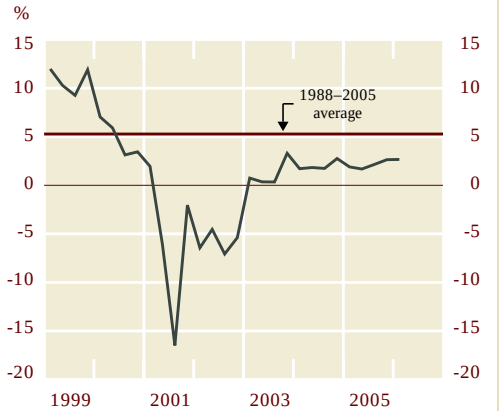

Source: Statistics Canada

**Chart 15 Return on Equity: Wood and Paper Manufacturing**




Source: Statistics Canada

**Chart 16 Return on Equity: Electronics and Computer Manufacturing**

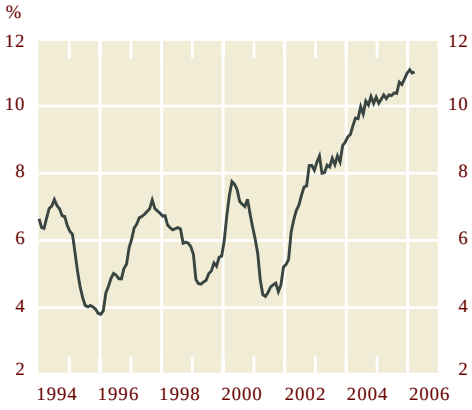



Source: Statistics Canada

4. With a major U.S. auto parts company, Delphi, asking to repeal a number of labour agreements, there is a heightened risk of labour disruptions over the near term. This would contribute to even greater financial stress in the North American auto industry.

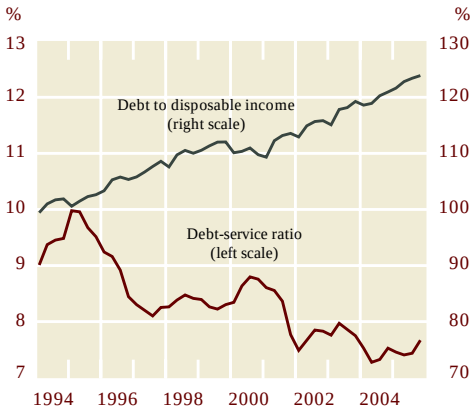
**Chart 17 Household Credit**

Year-over-year rate of growth




Source: Bank of Canada

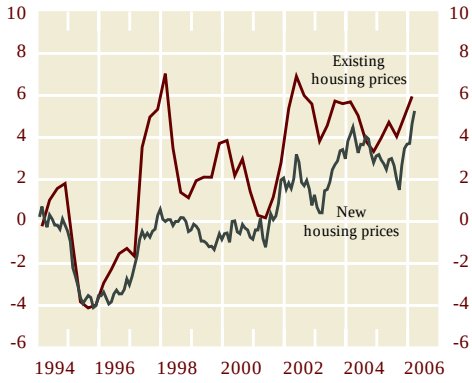
**Chart 18 Financial Situation of Canadian Households**




Source: Statistics Canada and Bank of Canada calculations

**Chart 19 Developments in Real House Prices**

Year-over-year percentage change




Source: Royal LePage, Statistics Canada, and Bank of Canada calculations

dollar and rising input costs. At the same time, despite further improvements in sales volumes, a sharp rise in fuel costs dampened the profitability of the Canadian air transport industry in late 2005 and early 2006.

The problems in all of these sectors could have severe consequences for a number of firms in the affected industries. However, it is unlikely that such problems would severely impair the Canadian financial sector. In addition, many of these firms are currently undertaking significant adjustments in their operations to improve their financial situations over the longer term.

## Households

Expenditures on housing and consumption were strong in 2005 and the first quarter of 2006, partly financed through the continued growth of credit (Chart 17). As a result, there has been a further rise in the ratio of household debt to disposable income. Even with this increase in debt and higher interest rates, the debt-service ratio of households remains at a very low level (Chart 18). The continued solid growth in employment and income currently projected should help households to service their debt. However, as discussed in the December 2005 FSR, if the overnight rate were to rise significantly above the current level, the aggregate debt-service ratio could rise above the average level for the 1980–2004 period. And if economic prospects for employment and income were less favourable than projected, a number of heavily indebted households would undoubtedly be strained financially.

Housing prices increased at a faster rate in late 2005 and the first quarter of 2006 after a period of moderation (Chart 19). This aggregate measure, however, hides significant differences among regions. While the pace of increase in housing prices in Central Canada (e.g., Montréal and Toronto) has been slowing gradually, prices in cities in Western Canada have accelerated significantly, particularly in Alberta (Chart 20), reflecting the economic boom in that region. There are few signs of excess supply at the aggregate level despite strong building activity, as illustrated by the gradual decrease in the number of recently completed but unoccupied dwellings. Taken together, these factors support the view that a significant reversal in housing prices is unlikely. However, there is a possibility of imbalances in certain areas or segments of the housing market.

A more detailed analysis of the condominium market appears below. This analysis suggests that the risk to the Canadian financial sector from this market is relatively small, both because the exposure of financial institutions to the market is limited and because a widespread reduction in condominium prices appears unlikely.

# Highlighted Issue

## An analysis of condominium prices

*Prepared by Virginie Traclet*

In the past few years, condominium prices have increased faster than prices for single homes in a number of cities and as fast as prices for single homes in the Greater Toronto Area and Calgary.

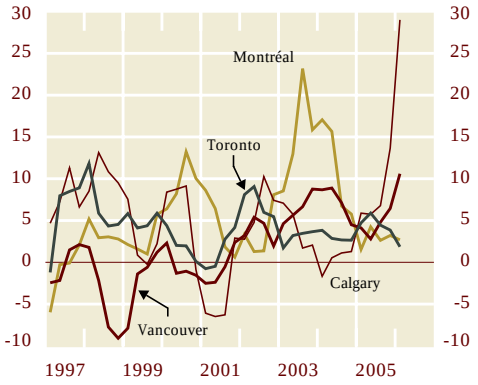
### *Exposure of financial institutions to condominium markets*

Mortgage loans for condominium purchases have increased significantly in the past few years (by 46 per cent between 2000Q1 and 2006Q1). However, the share of mortgage loans for condominiums in total residential mortgage loans outstanding at commercial banks has remained stable, at slightly below 10 per cent. More than 40 per cent of mortgage loans for condominium purchases are currently insured and thus pose little risk for financial institutions.[5] Financial institutions generally require larger down payments for the purchase of rental condominiums than for the purchase of owner-occupied units.[6] Thus, the exposure of financial institutions to condominium markets is rather limited.

Loans from commercial banks to builders and developers for residential purposes have also increased markedly in the past two years (by 45 per cent between 2003Q4 and 2005Q4).[7]

**Chart 20 Real Prices for Existing Houses**

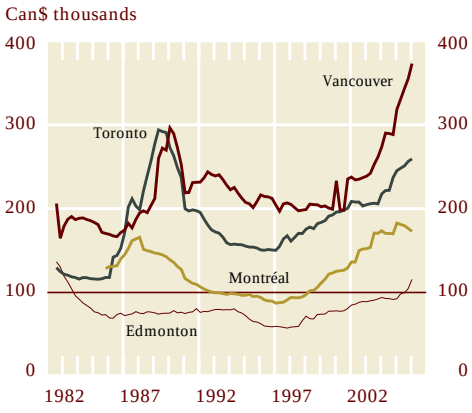
Year-over-year percentage change




Source: Royal LePage, Statistics Canada, and Bank of Canada calculations

5. Mortgage insurance, which is required when the down payment is less than 25 per cent of the value of the property, is provided by either CMHC or Genworth Financial Canada. The obligations of both CMHC and Genworth carry an explicit government guarantee.
6. Mortgage insurance is also available for rental condominiums, e.g., through CMHC multi-unit mortgage loan insurance, although with different eligibility criteria.
7. These loans include both condominium and rental projects.

**Chart 21 Real Condominium Prices in Selected Cities***




* Nominal prices deflated by CPI (1992=100)
Source: Royal LePage and author's calculations

Table 1

**Cycle of Real Condominium Prices in Local Markets**

| | Previous Condo Price "Boom" | | | Current Condo Price "Boom" | | |
|---|---|---|---|---|---|---|
| | Period | Average annual increase % | Total increase % | Period[a] | Average annual increase % | Total increase % |
| Montréal | 85Q4-88Q4 | 13 | 29 | 98Q4-05Q1 | 15 | 95 |
| Greater Toronto Area | 85Q4-89Q2 | 37 | 130 | 97Q3-06Q1 | 5 | 42 |
| City of Toronto | 86Q1-89Q2 | 46 | 151 | 97Q2-06Q1 | 8 | 68 |
| Edmonton | 86Q2-88Q3 | 5 | 11 | 99Q3-06Q1 | 11 | 71 |
| Greater Vancouver | 87Q1-90Q2 | 19 | 60 | 01Q3-06Q1 | 15 | 69 |
| City of Vancouver | 87Q3-90Q1 | 27 | 68 | 01Q3-06Q1 | 20 | 89 |
| Ottawa | n.a. | n.a. | n.a. | 00Q1-06Q1 | 12 | 73 |
| Calgary[b] | n.a. | n.a. | n.a. | 02Q1-06Q1 | 9 | 37 |

a. The starting point of the period is the date at which prices start rising again after having been flat in the 1990s. In Montréal, condominium prices reached their peak in 2005Q1 and have decreased slightly since then.
b. The condominium price measure cannot be calculated for Calgary over the whole period but only over the period starting in 2002Q1, because of changes in neighbourhood boundaries covered in the Royal LePage survey.

At $4.4 billion, however, they still account for a very small fraction of the loan portfolios of commercial banks, although some smaller institutions might be more heavily exposed.

While a correction in condominium prices would pose little risk to the stability of the financial system, it could have a negative impact on the household sector.

## *Developments in condominium prices*

Condominiums accounted for 9 per cent of owner-occupied dwellings in 2001, up from 3 per cent in 1981.[8] They have performed strongly in the current housing cycle, accounting for about one-quarter of new home starts in 2005. Real condominium prices have increased in major Canadian cities in the past few years, after an extended period of flat prices in the 1990s (Chart 21 and Table 1).[9] Prices for condominiums have risen more than those for single houses in Montréal, Ottawa, Edmonton, and Greater Vancouver (Chart 22).[10]

A combination of structural and cyclical factors has contributed to the growing popularity and rising prices of condominiums. A shift towards smaller households and an aging population have increased the demand for condominiums, which require lower maintenance. Rising real disposable incomes since the mid-1990s, low interest rates, and tight rental markets in big cities have all made ownership attractive. At the same time, rising prices have put detached dwellings beyond the reach of many households, particularly first-time homebuyers (Royal LePage 2004, 2005). Finally, condominiums represent an affordable option for small investors who wish to include rental real estate in their portfolios. Tight rental markets in the second half of the 1990s, the poor performance

8. Not surprisingly, condominiums are more popular in big cities, where land is scarce and expensive. For instance, they accounted for 17 per cent of the owner-occupied housing stock in Vancouver, according to the 2001 census.
9. The condominium price measure used here is a quarterly resale price calculated using the Royal LePage *Survey of Canadian House Prices*.
10. This comparison must be used with caution, since it is done using a condominium price measure that is an unweighted average of prices in various neighbourhoods and a housing price measure that is a weighted average of prices in various neighbourhoods.

of equity markets in the early 2000s, and low interest rates in fixed-income markets all contributed to make rental condominiums an attractive investment. These factors suggest that at least some of the recent increases in condominium prices will be sustained.

### Investment activity in condominium markets

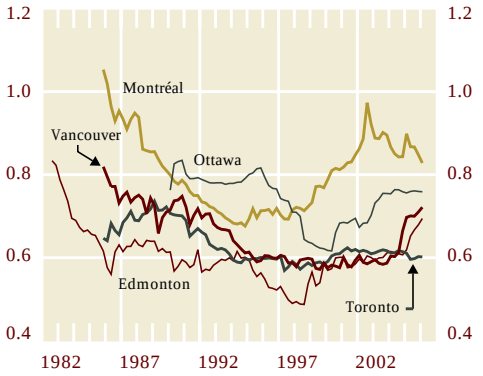
Investment in condominium markets falls into two categories: speculative investments, where the investor's objective is to "flip" the property to make a quick capital gain, and rental investments, where the objective is to rent out the condominium to generate cash flow over time. Contrary to the late 1980s, there are currently few signs of speculative activity in condominium markets in either Toronto or Vancouver.[11] In Vancouver, for example, only 12 per cent of the condominiums sold in the first eight months of 2005 had been purchased within the previous 12 months, compared with close to 30 per cent in 1989 and 50 per cent in 1981 (CMHC 2005a).

On the other hand, investment in rental real estate appears to have attracted a rising number of investors in the past couple of years (RE/MAX 2006). In Central Toronto, the number of rental condominium units rose by 21 per cent from 2001 to 2005; in the Greater Toronto Area as a whole, investor-held rental condominium apartments accounted for 19 per cent of the condominium market in 2005 (CMHC 2005b). Anecdotal evidence also suggests that rental condominiums are attracting an increasing number of small investors in Alberta.

### Are there signs of excess supply?

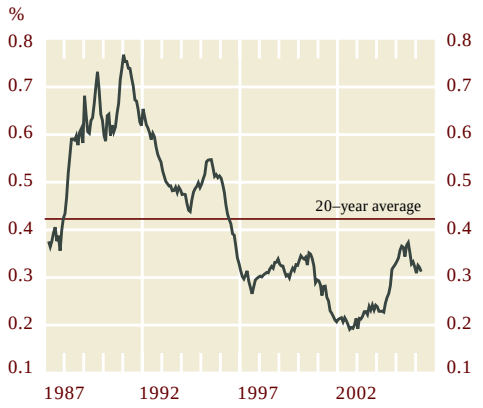
There seem to be few signs of excess supply at the aggregate level: the number of recently completed but unoccupied multiple dwellings relative to population is currently below its 20-year historical average (Chart 23).[12] Moreover, to avoid the buildup of excess supply, lenders typically

**Chart 22 Ratio of Condominium Prices to House Prices**




Source: Royal LePage and author's calculations

**Chart 23 Unoccupied New Multiple Dwellings, as a Percentage of Population**




Source: CMHC and Statistics Canada

11. Information about speculative investment in condominium markets is available only for Toronto and Vancouver.
12. It should be noted that unoccupied multiple dwellings include condominiums as well as apartments. More disaggregated data are not available. Because of data availability, we cannot calculate the ratio of unoccupied multiple dwellings to the stock of multiple dwellings. Instead, we use the population 15 years and older from the *Labour Force Survey*.

Table 2

**Assessment of Excess Supply in Local Markets[a]**

| | Ratio of unoccupied multiple dwellings to population[b] | Relative price of renting versus owning | Rental vacancy rate |
|---|---|---|---|
| Montréal | Strong increase (above average) | Strong decrease | Strong increase |
| Edmonton | Increase[c] (above average) | Strong decrease | Increase |
| Ottawa | Stable (below average) | Decrease | Increase |
| Calgary | Decrease[d] (below average) | Strong decrease | Decrease |
| Toronto | Stable (below average) | Decrease | Stable |
| Vancouver | Strong decrease (below average) | Stable | Decrease |

a. Changes in these indicators over the past three years
b. Comparison of the current value of this ratio to its 20-year average appears in brackets.
c. This ratio has decreased steadily from an historical high in March 2005, but currently remains above its 20-year average.
d. After having increased in the past three years, this ratio abruptly reversed in the autumn of 2005 and is currently below its historical average.

require developers to pre-sell a certain percentage of units—currently 60 to 70 per cent—before granting them the financing required to begin construction.[13] These factors suggest that a widespread reversal in condominium prices driven by excess supply is unlikely. The aggregate picture, however, conceals different situations in local markets.

Our assessment of excess supply in local markets is based on an analysis of the number of unoccupied dwellings (as a ratio of population), the rental vacancy rate, and the relative price of rented versus owned accommodation.[14] When the situation in rental markets improves for renters; i.e., when the rental vacancy rate increases and the relative price of rented accommodation decreases, a rise in the number of unoccupied dwellings is less likely to be absorbed by new first-time condominium buyers coming from the rental market. Thus, the combination of a growing number of unoccupied dwellings, a decreasing accommodation ratio, and a rising rental vacancy rate would point to emerging excess supply.

The results presented in Table 2 indicate that there are some disquieting signs in the Montréal and Edmonton markets. There is, however, no evidence of excess supply in Vancouver, Toronto, or Calgary, which together account for a very large share of the stock of condominiums in Canada. Evidence is mixed for Ottawa.

Thus, while there may be some risk of future downward pressure on prices in some condominium markets, overall, the risk of a broad reversal of condominium prices appears limited. Moreover, the exposure of financial institutions to condominium markets is itself limited. Thus, this presents no major risk for the Canadian financial system.

13. In the 1980s, it was common for projects to start with pre-sales well below 50 per cent.
14. This relative price, also known as the accommodation ratio, is the ratio of the rented-accommodation component of the CPI to the owned-accommodation component. It is not a perfect measure of the relative price of renting versus owning a condominium, since the CPI components include all types of dwellings, but it is the only proxy available.

# The Financial System

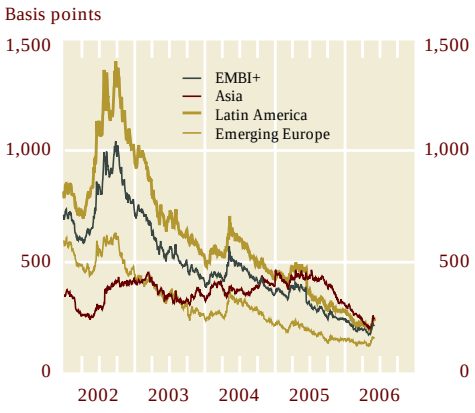
## Financial markets

Prices for risky assets, such as equities and emerging-market bonds, fell over a relatively brief period in May 2006 (Chart 24),[15] retracing most of their appreciation since the December FSR. This correction in the values of risky assets occurred in tandem with a general retrenchment in commodity prices, particularly prices for metals. As a result of these price movements, market volatility rose sharply in May (Chart 25). In addition, yields on bonds from major industrialized countries fell modestly in May, as investors sought to reduce portfolio risk. Nevertheless, these yields remain above those observed at the time of the December FSR by roughly 50 to 70 basis points.

The recent declines in a broad array of asset prices appear to primarily represent a correction of the rapid escalation of asset prices vis-à-vis fundamentals since December, rather than a sharp increase in risk aversion. Since the prices of most risky assets are currently higher than at the time of the last FSR, and volatility, as measured by the VIX, still remains below its 10-year average, the concerns expressed in the December FSR that financial risks may be underpriced and that there is potential for further significant decreases in riskier asset prices remain despite the recent correction.

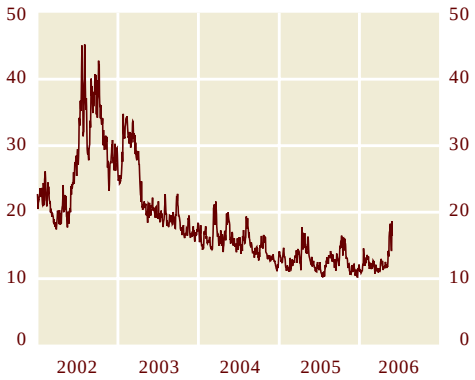
The correction in the prices of risky assets appears to reflect a change in the perception of global growth fundamentals. There are mounting concerns among investors that stronger-than-anticipated global inflation, particularly in the United States, may bring forward and increase the degree of monetary policy tightening required among the G-3 beyond that which has already taken place. The European Central Bank and the U.S. Federal Reserve have raised their policy rates since December, while the Bank of Japan has recently announced the end of its quantitative easing policy. Investors seem to be increasingly concerned that the global reduction in monetary policy stimulus could lead to a

**Chart 24 Yield Spreads on Emerging-Market Sovereign Bonds***




* Yield spreads between sovereign debt of emerging-market countries and U.S. Treasuries
Sources: JPMorgan Chase & Co., U.S. Federal Reserve, and Reuters

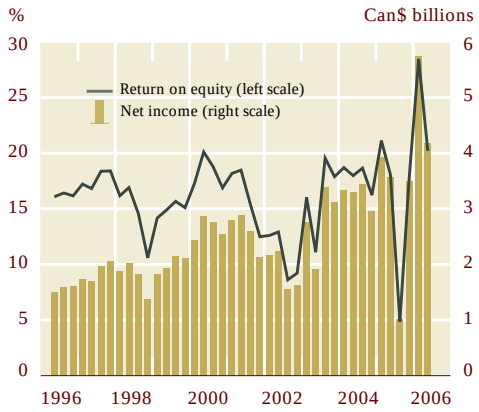
**Chart 25 Implied Equity Volatility***




* VIX: Implied volatility on the S&P 100
Source: Bloomberg

15. For example, the JPMorgan Emerging Market Bond Index (EMBI+), after reaching an all-time low of a 173-basis-point spread over U.S. Treasuries on 1 May, rose about 50 basis points. The TSX climbed by 10 per cent since December only to drop by about 8 per cent in mid-May.

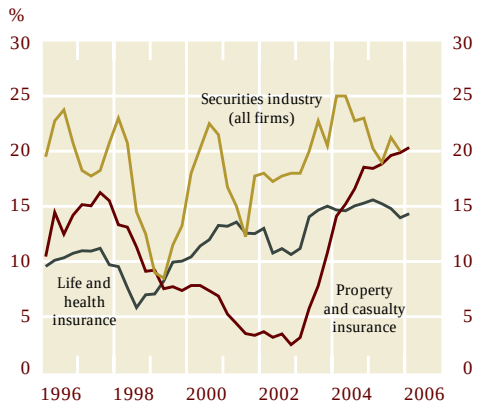
**Chart 26 Bank Profits**




Source: Bank quarterly financial statements

**Chart 27 Return on Equity**

4-quarter moving average




Source: OSFI, IDA, and Bank of Canada calculations

decline in global growth. Accordingly, there has been a relatively large decline in the prices of assets that are particularly sensitive to the pace of global economic activity or to movements in commodity prices, such as emerging-market debt and shares of construction and materials companies. To date, markets have reacted to these changed perceptions of the underlying fundamentals of global growth in a relatively orderly way.

## Financial institutions

The large Canadian banks continue to be very profitable and well capitalized, registering very strong profits through the first half of fiscal 2006 (Chart 26). Even excluding a $1.7 billion one-time gain by TD Bank in the first quarter on the sale of its U.S. brokerage operation, the average return on equity in the first half of 2006 was 20 per cent. Underlying profitability is firm, reflecting strength in personal and commercial sector business, strong revenues from trading and investment banking, and very high credit quality.

Market indicators support the view that Canadian banks are financially healthy. For example, a relatively new technique known as the contingent claims approach (CCA), based on the Merton model, uses both market and balance-sheet information to measure the riskiness of firms. A study applying this approach to the major Canadian banks suggests that their financial soundness has improved steadily in recent years and is currently very strong (Kozak, Aaron, and Gauthier 2006).

Canadian life and health companies have also enjoyed good profitability and strong capital positions through 2005 and early 2006. These companies have benefited from buoyant equity markets, which have boosted sales of segregated funds and other wealth-management products (Chart 27). Furthermore, sales of individual and group insurance products have been firm and credit losses very low. Profits have been strong in spite of the effect of the appreciation of the Canadian dollar on earnings derived from foreign operations and low yields earned on new fixed-income investments.

The Canadian securities industry reported its third straight year of record profits in 2005, boosted by a very robust fourth quarter (Chart 27). The

21 per cent increase in profits for the year reflected strength in all major categories of revenue.

The December 2005 FSR discussed the adverse impact of low global bond yields on the funding status of defined-benefit pension plans in Canada. The fall in yields over the past few years had raised the discounted present value of their pension plan liabilities (Tuer and Woodman 2005). However, the modest increase in yields since December has resulted in a decline in estimated pension obligations. The decrease in estimated pension fund liabilities, along with strong returns on pension fund assets, has generally resulted in an improvement in the funded ratio of pension plans. While the risks to the financial system related to the funding status of pension plans have declined since December, defined-benefit pension plans in Canada remain underfunded on balance. The 2006 federal government budget temporarily extended the period for funding the solvency deficits of federally regulated defined-benefit pension plans from 5 to 10 years, if plan sponsors meet certain conditions.

# Important Financial System Developments

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

## The Financial System

### Financial markets

In January, the Canadian Accounting Standards Board (AcSB) ratified its strategic plan approving convergence with international reporting standards.[16] It has also adopted new accounting standards with regard to financial instruments. The standards, based on existing U.S. and international standards, will come into effect for public companies beginning on 1 October of this year.[17] They specify when a financial instrument should be recognized on a firm's balance sheet and how it should be measured once it is recognized. While the implementation of these standards may result in increased volatility in the value of key financial statement variables for firms whose assets and liabilities are not matched, it will also mean that users of financial statements will have better information on which to base decisions.

In March, the Canadian Securities Administrators (CSA) released a revised proposal on harmonized internal-control reporting requirements.[18] The new rules would require all publicly traded companies to report on the effectiveness of their internal controls on financial reporting but would not, as previously considered, require an external auditor's opinion. The CSA's decision is based on feedback from Canadian stakeholders and is consistent with international developments and experiences regarding financial reporting. In the United States, anecdotal and formal evidence of higher-than-expected compliance costs have led to calls for a similar reduction in the requirements for reporting on internal controls under the Sarbanes-Oxley Act, particularly for smaller public companies.

Another area in which recent U.S. initiatives have been important is the credit derivatives market. The rapid growth of this market over the past several years has not been matched by the growth of the supporting infrastructure for processing and settlement. Box 3 discusses recent industry initiatives to address this issue.

### Canadian mortgage market

Two recent developments in mortgage insurance should provide further support to the Canadian housing market. These are offers to increase the amortization period of insured mortgages and to increase access to mortgage insurance for non-prime customers.

Canada Mortgage and Housing Corporation (CMHC) and Genworth Financial Canada recently announced an increase in the maximum amortization period allowed for insured mortgages, from the traditional 25-year amortization period to 30 years for CMHC and to 30 to 35 years

16. See Box 3 in the December 2005 FSR for a discussion of the international convergence of accounting standards.
17. Three new sections were added to the Canadian Institute of Chartered Accountants Handbook in January 2005: Section 3855—Financial Instruments, Recognition and Measurement; Section 3865—Hedges; and Section 1530—Comprehensive Income.
18. For more discussion on internal controls, see the Highlighted Issue, "Corporate financial reporting: The regulatory response in the United States and Canada," in the June 2005 issue of the FSR.

for Genworth Financial.[19] A premium surcharge will be added to the normal premium for mortgages with these longer amortization periods. Eligibility criteria for mortgage insurance are the same for mortgage loans with longer amortization periods as for traditional (25-year) mortgage loans (Traclet 2005). Since a longer amortization period will translate into lower monthly mortgage payments, a number of additional borrowers will become eligible for mortgage insurance.[20,21]

Genworth Financial has introduced two mortgage insurance products specially designed for non-prime/subprime borrowers. One is designed for customers who have experienced a credit setback and have started to rehabilitate their credit profile. The second is designed for self-employed people, who are traditionally considered low-documentation borrowers.

## Highlighted Issue

### Recent developments in the income trust market

*Prepared by Stacey Anderson*

Over the past few years, the income trust market has grown rapidly. It currently represents about 10 per cent of the total market capitalization of the TSX, up from around 2 per cent in 2002.[22] This rapid growth, which appears to be unique to Canada, has been influenced by the favourable tax treatment of the income trust structure, particularly from the point of view of tax-

19. For CMHC, it is a four-month pilot project conducted with FirstLine Mortgages from 3 March to the end of June 2006. CMHC will then assess the results of the pilot project and determine whether this will become a permanent program.
20. For a mortgage with a 5 per cent down payment and a 6 per cent interest rate, monthly payments would be 7 per cent lower with a 30-year amortization period than with a 25-year amortization, after factoring in a higher insurance premium.
21. Recall that the main eligibility criterion is that mortgage debt payments (and total debt payments) should not exceed a certain percentage of household income.
22. Source: TSX "Income Trusts on Toronto Stock Exchange." Data as of 30 September 2005. For a description of the characteristics of an income trust, see King (2003a,b).

**Box 3**

### Measures to Reduce Operational Risk in the Credit Derivatives Market

Rapid growth in the credit derivatives industry over the past five years, primarily in the United States and the United Kingdom, has overwhelmed the infrastructure for processing and settlement, leading to delays and backlogs in trade confirmations. Deficient operational practices have resulted in uncertainties regarding counterparty risks and credit exposures of the major global bank-dealers that play a leading role in credit derivatives markets. In addition, a high proportion of non-bank involvement in credit derivatives trading, including hedge funds, has meant that the operational capabilities of some players are not supervised to the same degree as those of others.[1]

A private industry group, Counterparty Risk Management Policy Group II, was convened to study the issue, and its July 2005 report outlined recommendations for improving credit risk management, disclosure, and financial infrastructure. Further to that point, the Federal Reserve Bank of New York brought stakeholders together last autumn to discuss the issues and to encourage the industry to create and implement its own solutions.

This resulted in a public commitment last October by 14 major international bank-dealers to improve the infrastructure supporting the credit derivatives market. By February 2006, the number of trade confirmation backlogs had been reduced, a new industry protocol had been adopted (prohibiting the assignment of trades without consent), and the automation of trade processing had increased. In March, the 14 major dealers outlined further targets for action, including

- an additional reduction in confirmation backlogs;
- the creation of a largely electronic marketplace based on an industry-accepted platform;
- the creation of a central trade information database and support infrastructure;
- the development and implementation, by November 2006, of industrywide processing standards for trades, including those that cannot be confirmed electronically; and
- progress on a new framework for settlement of contracts following a credit event.

International supervisors and regulators, including Canadian authorities, have expressed satisfaction with the co-operation to date and are hopeful of continued progress towards an efficient and robust operational infrastructure for credit derivatives.

1. For a discussion of the impact of credit default swaps on financial stability in Canada, as well as internationally, see Reid (2005).

exempt and non-resident investors.[23] Strong demand from retail investors for income-producing investments has also contributed to the growth. A number of recent developments are likely to increase the involvement of institutional investors in the income trust market. First, income trusts have been included in the S&P/TSX Composite and MSCI (Morgan Stanley Capital International) indexes as of 17 March and the end of May, respectively. Second, five provinces (Alberta, British Columbia, Manitoba, Ontario, and Quebec) now offer limited liability protection to income trust investors.[24]

The following discussion examines the development of the income trust market over the past several years, reviews some evidence on the possible implications of the income trust structure for financial market completeness, and looks at some of the risks related to investing in income trusts.[25]

### Changing characteristics of income trusts

The characteristics of firms adopting an income trust structure have broadened since energy and real estate firms first used them as funding vehicles. The past five years have seen a substantial increase in the percentage of trusts that belong to the industrial and consumer sectors and a decline in the proportion but not in the number of energy, real estate, and utility trusts (Chart 28).[26] At the same time, income trusts have emerged in the financial services, telecommunications, and health care sectors.

The growth in the relative number of these non-traditional trusts (henceforth, business trusts) has been accompanied by a decrease in the average size of income trusts. Most business trusts would be classified as mid-cap or small-cap. The average market capitalization of business trusts is $400 million, compared with $1.8 billion for energy, $800 million for utilities, and $650 million for real estate investment trusts (REITs).[27] Newer trusts also tend to be smaller than more established trusts. An examination of the initial public offerings (IPOs) of income trusts between 2001 and 2005 shows a steady decrease in median IPO size from $155 million in 2001 to $75 million in 2005 (Chart 29).[28]

Payout ratios, broadly defined as the amount of funds distributed to unitholders as a proportion of distributable cash, vary substantially by firm and by industry (Chart 30).[29] Firms with more variable cash flows and those with large capital expenditure requirements, such as energy trusts, tend to have lower payout ratios. Firms with the opposite characteristics, such as utilities, can support higher payout ratios. In some instances, however, cash flows can be too volatile to allow for sustainable distributions. Indeed, over the past few years, a number of income trusts have had to suspend or cut distributions. As of the end of 2005, 26 business trusts (or about 20 per cent of all business trusts) had cut or suspended distributions at least once since their creation. The reason most often cited was a decrease in demand for the trust's products, followed closely by the impact of the value of the Canadian

23. An income trust is a "flow-through" vehicle that allows income to flow through it and be taxed only at the investor level. For tax purposes, distributions are considered to be a combination of interest, dividends, and a return of capital. In its 2006 budget, the federal government increased the gross-up and dividend tax credit to eliminate the double taxation of dividends from large corporations at the federal level. This change in tax policy does not affect tax-exempt or non-resident investors, however. Since they do not pay taxes, they are not eligible for the gross-up and dividend tax credit and thus cannot recover taxes paid at the corporate level. They would thus have a preference for the income trust structure.
24. This legislation, which brings the treatment of trust unitholders in line with that of corporate shareholders, protects investors from being held personally liable for losses of the trust beyond their initial investment.
25. While this article presents some evidence on the impact of the income trust structure on market completeness, it makes no attempt to draw conclusions regarding the overall impact of income trusts on market or economic efficiency.
26. Sectors are defined according to Standard & Poor's Global Industry Classification Standard (GICS) methodology; the Consumer Discretionary and Consumer Staples sectors have been combined.
27. As of 7 February 2006.
28. This discussion is based on an analysis of data from the FPinfomart.ca New Issues database.
29. The definition of payout ratio used here is based on funds from operations (FFOs), which does not take capital spending into account. This would tend to bias the ratios downwards. The calculation of distributable cash, and thus the payout ratio, is subject to debate. (See the discussion on accounting later in this Highlighted Issue.)

dollar. Also frequently cited were risks related to the prices of raw materials and commodities (Blackmont Capital 2005, 2006). The incidence of cuts in business trust distributions over the period 2002 to the present has been broadly similar to that of dividend-paying stocks (Scotia Capital 2006).

### *Do income trusts enhance market completeness?*

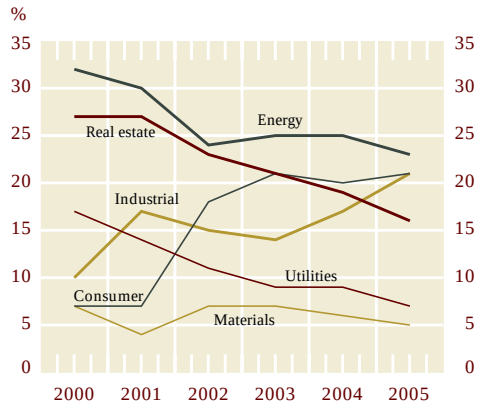
Income trusts exhibit characteristics different from those of common stocks. Limited evidence suggests that income trusts may enhance market completeness by providing diversification benefits to investors and a source of financing to firms that might not otherwise have had access to markets.

One reason for their recent popularity is that income trusts provide retail investors with a higher level of current income than dividend-paying stocks. Cleary and MacKinnon (2006) analyze the returns of an equally weighted portfolio of 59 trusts over the period 1995 to 2004. Their decomposition of trust returns into independent stock and bond return factors reveals that trusts are more similar to stocks than to bonds, but that income trusts have risk-return characteristics sufficiently different from either public equities or bonds to allow investors to achieve portfolio risk-return combinations not otherwise available.

The income trust structure may also have improved the access of certain firms to market financing. Carpentier, Kooli, and Suret (2003) note that primary equity issuance has been far less in Canada than in the United States and that capital raised is appreciably less after standardization by GDP. This trend in equity issuance may have shifted in recent years with the large number of income trust IPOs (Chart 31). Over two-thirds of business trust listings have been the result of either private firms going public or large public firms spinning off non-core parts of their operations through IPOs. These IPOs have been considerably larger than the average Canadian equity IPO, with average gross proceeds of $129 million, compared with $31 million for traditional equities.[30]

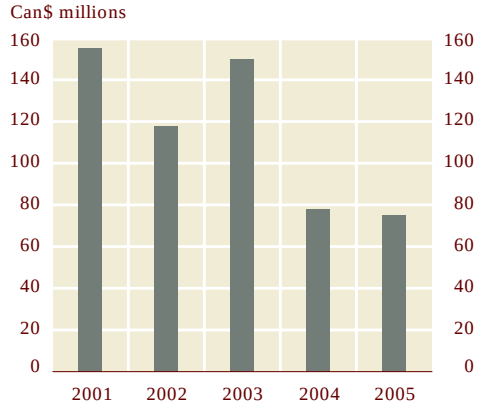
30. These averages are for different time periods. The income trust average is for 2001–2005. The traditional equity average is for the 1991–2000 period (source: Carpentier, Kooli, and Suret 2003).

**Chart 28 Distribution of Income Trusts by Sector**



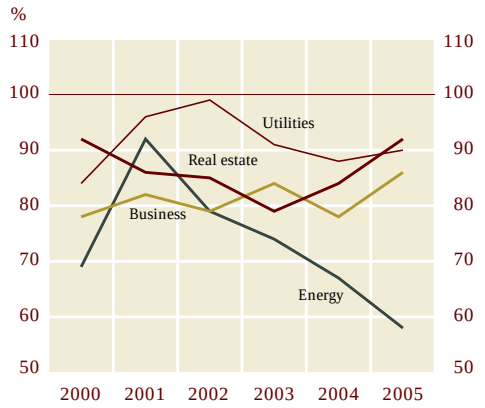

Source: FPinfomart.ca and author's calculations

**Chart 29 Median Size of Income Trust IPOs**



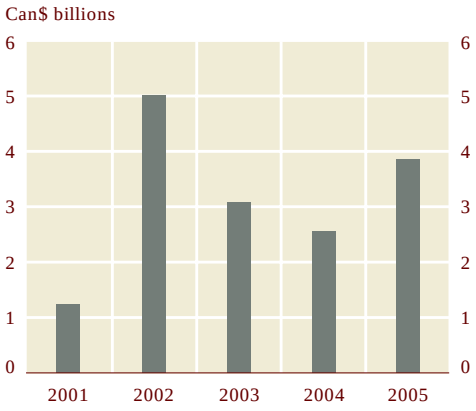

Source: FPinfomart.ca and author's calculations

**Chart 30 Average Payout Ratio**




Source: BMO Nesbitt Burns and author's calculations

**Chart 31 Total Gross Proceeds of Income Trust IPOs**




Source: FPinfomart.ca and author's calculations

## *Issues related to investing in income trusts*

While the income trust market has matured over the past several years, there are still some areas where standards for trusts are not equivalent to those for corporations; in particular, two areas related to accounting and corporate governance.

The quality of income trust accounting has been questioned recently. In particular, distributable cash, a measure that is crucial to the financial analysis of income trusts, is not defined under Generally Accepted Accounting Principles (GAAP) but is left to the discretion of trust managers. This means that reported cash available for distribution is often overestimated, which may cause investors to make incorrect conclusions about the sustainability of distributions (Charbon and Hibbert 2006). A lack of transparency may obscure the fact that a firm is not reinvesting enough to remain a going concern. Various entities, acknowledging the need for improvement, have provided guidelines regarding the calculation of distributable cash.[31]

Because they are not corporations, income trusts are not covered under the Canada Business Corporations Act (CBCA) or equivalent provincial legislation. As a result, unitholder rights, which are defined in the declaration of trust, are somewhat different for each trust. While unitholders have most of the protection afforded to shareholders of a corporation, all of the same legal remedies are not available to them.[32] The Uniform Law Conference of Canada

31. These entities include the Accounting Standards Board (AcSB), the Canadian Securities Administrators (CSA), Standard & Poor's, and the Canadian Association of Income Funds (CAIF). In the case of REITs, the Real Property Association of Canada (REALpac) has published standards for calculating funds from operations.
32. For example, income trust investors cannot table shareholder proposals for a vote at annual meetings. For a fuller discussion of corporate governance issues related to income trusts, see King (2003a).

is currently working on a project to develop new harmonized provincial legislation that will address these issues.[33]

## Conclusion

The continued growth and maturation of income trusts as an asset class has resulted in a market that is increasingly diverse in terms of sector, size, and risk characteristics. While there are areas where improvements can be made—in particular, increased clarity with respect to the calculation of distributable cash and corporate governance—available evidence suggests that income trusts may enhance financial market completeness.

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33. The Uniform Law Conference of Canada is an independent organization comprising two sections: Criminal and Civil. The Civil section considers areas in which provincial and territorial laws would benefit from harmonization. Delegates from each province and territory (as well as representatives from the federal government, private sector lawyers, academics, and law reformers) meet annually to develop non-binding recommendations for the various levels of government.

# Reports

# Introduction

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

For the first time, the *Financial System Review* (FSR) includes the annual report on the Bank of Canada's oversight activities under the Payment Clearing and Settlement Act. This report covers the Bank's role with respect to the three designated systems (the Large Value Transfer System, CDSX, and CLS Bank) in 2005, as well as other Bank activities that support this role. This article by Clyde Goodlet is an elaboration of the discussion that appears in the *Bank of Canada Annual Report* and will be an annual feature of the FSR. For more information on the Bank's oversight role, see the article by Walter Engert and Dinah Maclean in the Policy and Infrastructure Developments section of this FSR.

In Canada, as in other G-10 countries, there is a growing need for investment capital to upgrade aging public infrastructure. At the same time, investment in infrastructure is gaining acceptance among institutional investors, particularly defined-benefit pension funds and life insurers. Globally, public-private partnerships (PPPs) are gaining more acceptance as a model for the alternative delivery of public infrastructure and services. Although there have been a number of PPPs in Canada, the market is still considered to be in its infancy. To take advantage of the availability of capital and to draw on the private sector's skills and expertise, some Canadian provinces now plan to increase the use of PPPs, suggesting that the market could grow significantly over the next decade or more. In the report, "The Market for Financing of Infrastructure Projects through Public-Private Partnerships: Canadian Developments," Elizabeth Woodman examines market developments in Canada, including a brief discussion of how the need for increased investment in infrastructure is prompting a greater role for PPPs. She also looks at the characteristics of a typical PPP; the international experience with PPPs; the structuring and financing of a PPP, using examples of projects recently launched in Canada; PPP as an investment; and what is required to support the development of a viable, efficient PPP financing market in Canada.

Monitoring risks to the stability of financial and non-financial public corporations is important for central banks, owing to the systemic importance of these sectors. Previous issues of the *Financial System Review* have explored the use of corporate financial information to monitor the health of public corporations in Canada. Information from financial markets can also be used in this analysis. Central banks use market-based indicators because they are forward looking and are available more frequently than accounting information. In "Using the Contingent Claims Approach to Assess Credit Risk in the Canadian Business Sector," Michal Kozak, Meyer Aaron, and Céline Gauthier explore one such method, the contingent claims approach (CCA), which uses Merton's extension of the option-pricing model to assess credit risk. The authors apply the CCA to non-financial public corporations and the six largest Canadian banks.

# Bank of Canada Oversight Activities during 2005 under the Payment Clearing and Settlement Act

*Clyde Goodlet*

Since 1996, under the Payment Clearing and Settlement Act (PCSA), the Bank of Canada has had formal responsibility for the oversight of clearing and settlement systems that could be operated in a manner that would pose systemic risk. Systemic risk is defined in the PCSA as the risk that the default of one participant in a clearing and settlement system could, through the operation of the system, lead to the default of other participants in the system or in other systems. A clearing and settlement system is the set of instruments, procedures, and rules for the transfer of funds or other assets among system participants. Typically, there is agreement among the system participants on the technical infrastructure to be used.

This report summarizes the Bank of Canada's oversight activities under the PCSA during 2005. An article on the general oversight strategy and processes used by the Bank is presented on page 57 of this issue (Engert and Maclean 2006).

Under the PCSA, the Bank identifies clearing and settlement systems in Canada that could be operated in a manner that could pose systemic risk. Once identified, and provided the Minister of Finance agrees that it is in the public interest to do so, these systems are designated for oversight by the Bank of Canada and must satisfy the Bank that they have appropriate risk controls in place to deal with concerns related to systemic risk. Three systems have been designated by the Bank: the Large Value Transfer System (LVTS), CDSX, and CLS Bank.

## The Large Value Transfer System

The LVTS is owned and operated by the Canadian Payments Association (CPA). It began operations in February 1999. During 2005, it processed about 18,000 transactions per day, worth approximately $145 billion. There have been few changes to the LVTS design or rules during its years of operation that could raise concerns about systemic risk, and 2005 was no exception. One important change was made to the system in 2005, however, to permit participants that might be experiencing problems with normal communication mechanisms to send each other payment messages using another route. This alternative mechanism, called the Direct Network, is normally used to send information about LVTS operations. After extensive discussion with the Bank, the CPA developed an arrangement that would permit participants to use the Direct Network to send a limited number of their most important payment messages to other participants should they have difficulties using their customary arrangements. Use of the Direct Network in these circumstances should significantly reduce the possibility of payments gridlock arising from a lack of liquidity in the system and would permit important time-sensitive payments to be made.

A rule change was made to the LVTS to permit the Direct Network to be part of the system. Payment messages sent using the Direct Network will be subject to LVTS risk controls and will benefit from the legal protection afforded such messages under the PCSA. The Bank was satisfied with this rule change, and the rule became operational in November 2005.

An important part of the Bank's oversight process is the use of Memoranda of Understanding (MOUs) with operators of designated systems. MOUs elaborate on the Bank's powers and its exercise of oversight responsibilities as laid out in the PCSA. They also address such questions as confidentiality of information, time frames for review of significant system changes, and the use of minimum standards. Having put such an arrangement in place with the operator of the CDSX, the Bank continued to work with the

CPA during 2005 to develop an MOU applicable to the oversight of the LVTS. The Bank expects that an MOU will be in place before the end of 2006.

## CDSX

CDSX is a system for the clearing and settlement of securities transactions in Canada. The system is owned and operated by The Canadian Depository for Securities Limited (CDS) and processed about 300,000 trades daily, worth $200 billion, in 2005.

During 2005, the most important issue dealt with by the Bank and CDS involved potential systemic risk arising from the provision of cross-border services. Early in the year, CDS examined the possibility of consolidating three existing cross-border services into a single service. Under this arrangement, CDS would act on behalf of its participants in the clearing and settlement of equity trades in the U.S. market. Analysis by CDS and the Bank highlighted a number of areas in the structure of the proposed service where the potential to create financial losses for CDS could, in turn, impair its ability to operate CDSX. Of particular concern was the possibility that in the U.S. arrangement for clearing and settlement, transactions that had previously been accepted by the system could be unwound in the event of a participant failure. Further analysis by CDS indicated that it would be difficult to deal with these concerns in an acceptable manner. Consequently, CDS decided not to pursue this initiative and began to determine how they might address risks present in their current cross-border services.

The analysis and discussion regarding the risks posed by cross-border services are a prime example of the Bank's desire to foster effective and co-operative relations with the operators of designated systems. The timely and co-operative interaction between CDS and the Bank served to identify key issues early in the discussions, led to an examination of possible ways to address these concerns and, ultimately, resulted in a decision not to proceed with the original proposal before any significant development resources had been spent.

As part of the analysis of cross-border services, the Bank is also working with CDS to examine how U.S.-dollar liquidity could be accessed in the event of contingency situations to support continuing the operations of CDS and its participants.

Other issues examined by CDS and the Bank during 2005 included the reconstitution of collateral pools and participant funds following a participant's suspension (these pools and funds are an integral part of the arrangements to control systemic risk), methods used by CDS to calculate replacement-cost risk, and other arrangements used by CDS to protect itself as the central counterparty in its Continuous Net Settlement and DetNet services. A number of changes to the CDSX rules followed these examinations and were part of the fourteen rule changes approved by the Bank in 2005.

Bilateral meetings between the Bank and CDS that examine a range of topics related to the operation of CDSX are an extremely valuable part of the Bank's oversight of the system. These meetings provide the Bank and CDS with an opportunity to explore any concerns or questions related to proposed changes to the CDSX on a timely and efficient basis. The Bank can be alerted to possible changes very early in the process and can inform CDS of concerns that it may have, so that they can be dealt with efficiently by CDS as it develops changes to the system. During 2005, the Bank held three such meetings with CDS.

## CLS Bank

Introduced in 2002, the CLS Bank now clears and settles foreign exchange transactions in fifteen currencies, including the Canadian dollar. Since CLS Bank operates transnationally, the Bank of Canada, as well as a number of other central banks, has oversight responsibilities or interests in the operation of the system. Most of the developments with regard to CLS Bank in 2005 involved its overall operations, and there were no specific changes to the arrangements used to settle the Canadian-dollar portion of foreign exchange transactions.

Four new currencies were smoothly incorporated into the system in December 2004. The U.S. Federal Reserve, which is the lead regulator of CLS Bank, reviewed CLS liquidity and capital policies relative to the standards set for CLS Bank. The results of this review, as well as additional information, were developed in consultation with other central banks that have their currencies settled in CLS Bank. This is part of the

co-operative oversight arrangement for CLS Bank that facilitates the sharing of information among central banks (subject, of course, to confidentiality requirements), the discussion of common oversight policies and approaches, and the coordination of oversight activities.

The G-10 central bank Committee on Payment and Settlement Systems announced that it will carry out a survey on the management of foreign exchange settlement risk at major banks. The survey will be conducted during the first part of 2006, and more than 100 institutions have been invited to participate.

The Bank of Canada continued to work with the Office of the Superintendent of Financial Institutions to encourage Canadian banks to make greater use of CLS Bank for the settlement of foreign exchange transactions. The CLS arrangement is now considered the most effective means through which to mitigate foreign exchange settlement risk. While some Canadian banks initially were very slow to settle their eligible foreign exchange transactions in CLS Bank, most are now doing so.

## Other Oversight Activities

To date, most of the Bank of Canada's oversight activities have involved reviewing and analyzing new design proposals for systemically important systems or major innovations to these systems. With the establishment over the past seven years of a number of systemically important clearing and settlement systems that adequately and efficiently control systemic risk, the Bank conducted an extensive review in 2005 of its oversight strategy and processes. As a result, the Bank decided to implement more formalized internal processes, including those for handling system changes and conducting annual audits. The Bank and the Department of Finance reviewed the operation of the Payment Advisory Committee, which resulted in a clearer mandate and oversight processes.

Over the past few years, the Bank has also enhanced its oversight resources to provide for greater analytical capability and better backup for important staff functions. These changes have enhanced the Bank's ability to carry out high-quality oversight of systemically important systems with a small number of staff focused on risk issues, while collaborating with the private sector to bring about safe and efficient clearing and settlement systems.

The Bank has also become more involved in the co-operative oversight arrangement for the Society for Worldwide Interbank Financial Telecommunication (SWIFT). SWIFT is the principal payment-messaging service provider for financial institutions around the world and for critical systems such as the LVTS and CLS Bank. The co-operative arrangement has been made more robust through a documented clarification of roles and responsibilities of the lead overseer (the National Bank of Belgium), other central banks, and the external auditors of SWIFT.

In line with international developments, changing perceptions of best practices, and domestic imperatives, the Bank of Canada continues to work with the operators and participants of systemically important Canadian clearing and settlement systems in their efforts to enhance arrangements for continuity of operations. These systems are at the centre of Canada's financial system, and serious economy-wide repercussions could arise if their operations were not extremely reliable. In 2005, the operators of these systems took steps to make their continuity of operations more robust by locating business staff at separate sites and by improving their ability to recover from severe operational disruptions in less than the current target of two hours.

The Bank has also been active in increasing its own ability to operate in a wide variety of circumstances. In 2005, it completed a three-year effort to improve the ability of its backup site to respond effectively to serious operational disruptions. It is examining other potential changes to its business-continuity plans, including the possibility of geographically splitting its banking-service operations to reduce the potential impact of so-called "wide-area disruptions." The Bank has also communicated its views on the crucial role of systemically important clearing and settlement systems to certain emergency-management organizations, with a view to having them give priority to supplying these systems with essential inputs, such as hydro, diesel fuel, or other municipal services.

## Published Research Relevant to the Bank's Oversight Function

During 2005, the Bank published the following work carried out by its staff:

- McVanel, D. 2005. "The Impact of Unanticipated Defaults in Canada's Large Value Transfer System." Bank of Canada Working Paper No. 2005-25.
- Arjani, N. 2005. "Simulation Analysis: A Tool for Examining the Balance between Safety and Efficiency in Canada's Large Value Transfer System." Bank of Canada *Financial System Review* (December): 55–63.

Bank staff collaborated with others in the following areas:

- Tripartite Study Group (Bank of Canada, Department of Finance, Canadian Payments Association). 2005. "Conditions for Direct Participation in the ACSS." Consultation Report, Canadian Payments Association, June.
- With the Bank of England, the Bank of Finland, and the Federal Reserve Bank of New York, the Bank of Canada enhanced the functionality of a payment system simulator created by the Bank of Finland. The simulator is a useful tool for carrying out research on clearing and settlement systems.

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# The Market for Financing of Infrastructure Projects through Public-Private Partnerships: Canadian Developments

*Elizabeth Woodman*

This report examines developments in the market for private financing of public infrastructure projects through public-private partnerships (PPPs). In Canada, as in other G-10 countries, there is a growing need for governments to allocate capital to upgrade aging public infrastructure. At the same time, infrastructure investment is gaining increasing acceptance among institutional investors, particularly life insurers and pension funds; its long-term nature is well suited to their investment horizons. To take advantage of the availability of capital and to draw on the private sector's skills and expertise, some Canadian provinces plan to increase the use of PPPs, which suggests that the market could grow considerably over the next decade or more.

This report begins with a review of recent developments in the PPP market, including a brief discussion of how an increased focus on infrastructure investment is prompting a greater role for PPP. It then outlines the characteristics of a typical PPP; the international experience; the structuring and financing of a PPP, using examples of recently launched projects; PPPs as an investment; and requirements for the development of a viable, efficient PPP financing market in Canada.

## Investment in Public Infrastructure Required

The need to address what is perceived to be a large and growing deficit in public infrastructure[1] has become a key public policy issue.[2] Much of Canada's existing stock of infrastructure requires repair or replacement, partly because of decisions to defer investment during the 1990s, when government spending at all levels was reduced in an effort to eliminate large fiscal deficits (Mirza and Haider 2003; Harchaoui, Tarkhani, and Warren 2004). Investment has also lagged in terms of new facilities to accommodate growth and the specific requirements of an aging population.

Addressing the infrastructure gap is likely to require increased spending over the medium term. To this end, some provincial governments have already increased the share of overall budget expenditures allocated to infrastructure investment. Several provinces are also looking at more efficient and innovative ways to deliver infrastructure and the associated services. One alternative, PPPs, has been shown to offer an efficient and cost-effective method of alternative delivery, provided that PPP contracts are well designed. Some provinces have recently created agencies dedicated to PPPs in order to build the public sector expertise required to develop a more effective, efficient, and transparent process for the implementation of PPPs.[3]

## What Are PPPs?

There is no widely accepted definition of a PPP and, in practice, these arrangements are quite

1. The stock of infrastructure includes highways, public transit and transportation facilities, water supply, waste-water-treatment facilities, prisons, ports, schools and universities, hospitals, and utilities, some of which are owned by the private sector (e.g., railways).

2. See, for example, TD Bank Financial Group (2004). Estimates of the magnitude of the infrastructure "deficit" vary considerably, partly because of definitional differences and the high level of subjectivity involved in assessing "need" (Dodge 2005).

3. These are Partnerships B.C. (May 2002); Quebec's Agence des partenariats public-privé du Québec (Dec. 2005); and Ontario Infrastructure Projects Corporation (Nov. 2005), which replaces SuperBuild Ontario, created in 1999. Alberta has recently (2003) prepared a framework to evaluate infrastructure projects for PPP potential.

diverse. The Canadian Council for Public-Private Partnerships (CCPPP) defines a PPP as "a cooperative venture between the public and private sectors, built on the expertise of each partner, that best meets clearly defined public needs through the appropriate allocation of resources, risks and rewards." PPPs permit private financing, design, construction, operation and, possibly, temporary ownership of an asset, while at the same time, the government remains involved as a partner. Such an arrangement offers an alternative to both traditional government delivery and privatization; projects can be structured according to the desired level of private sector involvement and the appropriate level of risk sharing.[4]

One benefit of PPP is that risks can be allocated to the partner best able to manage a particular risk, thus permitting a more efficient process. This requires the formal identification, quantification, and pricing of risk. In practice, the proper pricing of risk presents a considerable challenge, since there is no market for the provision of public goods and services. Ideally, efficient pricing mechanisms would develop over time as more PPP projects are undertaken. Risks that can be transferred to the private sector include those associated with design and construction, financing, operation, maintenance, and changes in technology.

For a PPP to be effective, it must demonstrate that it offers taxpayers value for money (VFM). VFM is complex to measure, since it goes beyond a comparison of the capital cost of a PPP relative to that of traditional procurement. Ideally, a PPP would be structured to put private capital at risk over the project's full life cycle, which might be from construction through to operation and maintenance. If risk is properly priced and incentives appropriately managed within well-developed contracts, PPP should contribute to greater efficiency and innovation, increasing the likelihood that more projects can be completed on time and within budget. The private sector can add VFM through a PPP in several ways, including exploiting economies of scale from multiple operations; facilitating the introduction of user charges, thereby achieving a better balance between supply and demand; integrating operational requirements in the basic design; and utilizing knowledge of and experience with new technologies (Allan 1999, 19).

Not all projects are well suited to PPP. Many projects (such as public transportation) that offer a public good requiring a high level of government subsidy are best handled using traditional government delivery. The international experience demonstrates that PPPs account for only a small fraction of overall capital spending on infrastructure.[5] Typically the projects felt to be best suited for PPP are large and capital intensive; have identifiable revenue streams; have some risks that can be transferred to the private sector; offer an opportunity for innovation in design, construction, or operation; have defined service specifications that are easily measured; and target areas where sufficient private sector expertise exists to permit a competitive process. From the perspective of the government and taxpayers, it is desirable that PPP projects are in the public interest, demonstrate VFM and, within the constraints of commercial confidentiality, are undertaken within a transparent process with full public accountability.

In Canada, PPPs have been used for a number of years. The best known are large transportation projects, such as Highway 407, an electronic toll highway in southern Ontario, and the Confederation Bridge that links New Brunswick and Prince Edward Island. There have also been numerous smaller projects in areas such as waste-water treatment, education, health care, and municipal facilities, such as courthouses and recreational centres. Although not all provinces have embraced PPPs, their use has recently gained momentum, particularly in British Columbia, where the assessment of projects for PPP potential is becoming a routine aspect of infrastructure development.[6]

4. In traditional government delivery, the private sector is typically engaged on a short-term basis to design and build a project. Its subsequent maintenance and operation are the responsibility of the public sector, although, over the past two decades, contracting out has become more common. See Levac and Wooldridge (1997).

5. Even in countries with established PPP markets, such as the United Kingdom, PPPs account for less than 15 per cent of total government capital spending. British Columbia and Ontario plan to use PPPs for about 10 per cent of planned investment.

6. A project tracker maintained by the CCPPP lists 54 PPPs that have been announced over the past few years, most of them in British Columbia and Ontario. Most of these projects are in health care and transportation. See <www.pppcouncil.ca/resources_project_tracker.asp>.

Table 1

**Selected Recently Launched PPPs**

| Project | Province | Model | Value (Can$ millions) |
|---|---|---|---|
| Sea-to-Sky Highway | B.C. | DBFO 25 yr. (2/3 capital cost) | 516.0 |
| Canada Line (rapid transit) | B.C. | DBFO 35 yr. | 1,900.0 |
| Kicking Horse Canyon Highway upgrade (Phase 2) | B.C. | DBFO 25 yr. | n/a |
| William Bennett Bridge | B.C. | DBFOM 27 yr. | 157.3 |
| Abbottsford Hospital & Cancer Centre | B.C. | DBFOM | 355.0 |
| S.E. Edmonton Ring Road | Alberta | DBFOM 30 yr. | 390.0 |
| Bruce A Nuclear Restart Project | Ontario | n/a | 4,250.0 |
| Royal Ottawa Hospital | Ontario | DBFO 20+ yr. | 148.0 |
| William Osler Health Centre | Ontario | DBFO 25 yr. | 550.0 |
| Trans-Canada Highway (final) | N.B. | DBFOM 25 yr. | 543.8 |

## International Experience

PPP is gaining increasing acceptance internationally as a model for the alternative delivery of public infrastructure and services, and a growing number of countries have implemented PPP programs. The United Kingdom, which began using PPPs in the 1980s, has the longest track record. Under the Private Finance Initiative (PFI), launched in 1992, nearly 700 projects totalling about £43 billion, have been delivered to date. Australia also has extensive experience with PPPs; the capital value of Australian PPPs has exceeded AUD$20 billion (Malone 2005). Standard & Poor's (2005) notes that PPPs are on the rise globally, particularly in Europe, where Italy, Spain, Germany, and Portugal have worked to improve the requisite legal and institutional framework to facilitate their development. With more countries making use of PPPs, Canadian governments are likely to face greater competition in the future in their efforts to attract domestic and foreign capital and companies interested in bidding on projects.

## Structuring and Financing of Recent Canadian PPPs

Many recently launched PPPs follow models that involve a high level of private sector involvement and risk sharing. Because of the complex, long-term risk-sharing arrangements involved, the terms of each PPP are unique. Nonetheless, most can be classified into various models according to the level of private sector involvement and the allocation of risks to each sector. As indicated in Table 1, many projects have been structured using a "design, build, finance, operate" (DBFO) model or a slight variation that includes maintenance (DBFOM). Under these types of arrangements, the private sector partner—usually a consortium—is responsible for engineering, design, and construction and typically assumes many of the associated risks (e.g., missed deadlines or cost overruns). The private sector usually provides the construction capital. But for many projects, particularly those that are large and capital intensive (e.g., Canada Line), the capital costs are often shared with the public sector. In the DBFO model, the private sector partner assumes operation of the asset upon its completion, under the terms of a long-term contract of,

generally 25 years or more.[7] The contract is typically structured so that investors receive "availability" payments that commence once construction is completed.[8] For example, in a number of hospital PPPs, the private sector receives payment for the facility and for the provision of non-clinical services. In all DBFOs, the asset is returned to the public sector at the end of the contract.

PPP financing is structured according to the unique features of each project, including the skills and resources brought together in the project team. Generally, equity represents a small share of the overall financing (between 10 and 15 per cent). It is provided by the project team, which, from a financing perspective, may include individual investors, infrastructure funds that pool the capital of several institutional investors, banks, and the financing arms of engineering/construction firms.

Three main types of debt financing have been used for the recent DBFO PPPs: bank loans, private placements, and broadly marketed bond placements (a type of private placement with a broader distribution). It is difficult to obtain detailed information because of commercial confidentiality, but it would appear that debt financing for most of the projects listed in Table 1 was provided through bank loans—typically from large European banks with broad experience in PPP—or through private placements. At least two projects were financed through broadly marketed bond placements.[9]

Given the long-term nature of PPPs, there has been a limited appetite among Canadian banks to lend to such projects. They have been involved in many aspects of the PPP market, however, including structuring deals and acting as lead underwriters in debt placements. The involvement of domestic banks may change in the future if a liquid, secondary market develops to provide debt and equity investors with an exit opportunity. In the United Kingdom, where there is a longer history of PPPs and the market has achieved "critical mass," investors have been able to reduce their PPP debt exposure through sales in the secondary market, most notably in the first-ever securitization of U.K. PPP loans. In November 2004, Depfa Bank Plc securitized 24 PFI loans with a capital value of £392 million.

## PPP as an Investment

Over the past few years, there appears to have been a greater appetite among Canadian institutional investors for longer-term investments, such as infrastructure. Defined-benefit pension funds, in particular, are increasingly viewing infrastructure as a distinct asset class with unique properties relative to publicly traded equities and bonds. Infrastructure investment provides relatively stable long-term cash flows, as well as portfolio diversification, owing to its low correlation with publicly traded equities and, in some cases, a positive correlation with inflation (i.e., in regulated industries, where inflation is a key consideration in setting prices). Since the decline in global equity markets in 2000–03, defined-benefit pension funds have been investing more in assets with characteristics that better match their liabilities, which are long term and often indexed to inflation. Since infrastructure, including PPPs, is a long-term financial asset with cash flows that may be linked to inflation, it provides a good match to pension liabilities. Life insurers, whose liabilities are also long term have a much longer history of asset-liability matching. Recent industry consolidation has also given the larger remaining insurers a greater capacity to make the large minimum investment typically required.

Canadian pension funds began targeting infrastructure as a distinct asset class in about 2000. To date, investments have been made by only a handful of the largest public sector funds, partly because the investment required is large and because internal resources must often be developed to manage the asset class.[10] A number of these funds plan to invest as much as 10 to

7. Note that PPPs are often structured to include both construction of the asset (capital costs) and its maintenance and operation (operational costs, including service delivery).
8. Alternatively, some PPPs are structured so that the investors earn revenue from volume-based user charges (e.g., toll highways).
9. In the United Kingdom, 70 per cent of debt financing has been in the form of bank loans, and 30 per cent has been through the bond market. Market participants expect that an increasing share of financing will come from the bond market.
10. Infrastructure funds provide a means by which pension funds can invest without the responsibility of actively managing the investment. This is left to the fund manager.

15 per cent of their aggregate assets in infrastructure, although until recently, opportunities have been limited, particularly in Canada (Tuer and Woodman 2005). Most large investments have been made in foreign infrastructure projects, mainly in the United Kingdom, Australia, and the United States.

Typically, DBFO PPPs provide less potential for the large equity investment preferred by public sector pension funds than, for example, an investment in a privatized utility. Nonetheless, these types of PPPs have similar features, providing investors with stable, long-term cash flows that, ideally, offer returns somewhere between those typically earned on publicly traded equities and bonds. They are priced to take into account full life-cycle costs, including the cost of transferring certain functions and risks to the private sector. In other words, they are structured so that the private sector assumes responsibility and is accountable for delivering the project on schedule and within budget. The private sector will also assume operational and, often, maintenance risks. Investors, particularly equity investors, have a greater level of accountability and accept more risk than they would by simply purchasing a government bond. PPP investments must therefore offer returns commensurate with this risk.

Several of the projects listed in Table 1 were financed with capital from Canadian institutional investors. Public sector pension funds have participated both as equity partners and in debt offerings, although most prefer equity. The Ontario Municipal Employees' Retirement System (OMERS), one of the first pension funds to invest in infrastructure, has recently made its single largest infrastructure investment, as an equity partner, in the Bruce A Nuclear Restart project. Life insurers have typically participated only in debt offerings, both as individual investors and through infrastructure funds.

## Developing a Viable PPP Market in Canada

Although a number of PPP projects have been developed in Canada, the market is still considered to be in its infancy relative to established markets. In contrast to the United Kingdom, for example, where there is an established PPP program that has tailored legislation and regulation, as well as ongoing, predictable long-term funding, Canadian PPPs have tended to be assessed on a case-by-case basis with no overall framework or strategy. As indicated earlier, a more coordinated, strategic approach to PPPs appears to be emerging in some Canadian jurisdictions, and PPPs are gaining wider use.

In practice, establishing a viable PPP market is quite challenging. Long-term political commitment to PPP is required, and the appropriate infrastructure and skills must be put in place to ensure an efficient, effective, and transparent process. Past experience with PPPs, both within Canada and in other jurisdictions, has demonstrated that, from a practical perspective, there is a long learning curve associated with the use of PPPs as a means of alternative asset procurement and service delivery.[11] Nonetheless, Canadian governments have the advantage of being able to learn from their own past experiences and from the experiences of other jurisdictions.

The United Kingdom, for example, created a centralized agency to coordinate PPP efforts (Partnerships U.K.) that has subsequently developed a set of best practices for successful PPPs. These include political commitment at a policy level to encourage the private sector to develop the resources needed to bid for contracts, enabling legislation, development of private and public sector PPP expertise, project prioritization, standardized contracts, and a regular and predictable flow of projects (deal flow) (International Finance Services 2003). Since 1997, deal flow in the United Kingdom has been about 70 projects per year, with an aggregate value between £2.5 billion and £5 billion, excluding the very large transportation PPPs, such as the London Underground.

The United Kingdom has identified two fundamental requirements for a PPP: first, the private sector must bear some of the risk of the project, and second, the PPP must demonstrate VFM from a taxpayer perspective.[12] In the United

11. PPPs are often quite controversial, partly because of fears that greater use of them will result in an erosion of service quality and a loss of public sector jobs. There is an extensive literature on the economics of PPPs and on the benefits to the public sector and taxpayers that have accrued, as well as some of the mistakes that have been made. For a discussion of some of the issues, see Allan (1999) and Poschmann (2003.)
12. See Allan (1999) for a good discussion of this.

Kingdom and increasingly in Canada, VFM is determined by developing a public sector comparator (PSC) for each project. A PSC is essentially a public sector alternative for delivering the service, and its development requires an explicit identification and quantification of project risks. The comparison of the PSC and PPP is undertaken from the perspective of cost over the full life cycle of the project, in net present-value terms, looking at the costs and benefits of the PPP relative to those of traditional procurement. Government delivery would remain the preferred option if the analysis fails to demonstrate that the PPP offers VFM relative to traditional procurement.

It has been suggested that among the obstacles to the development of the PPP market in Canada are a lack of public knowledge of and support for PPPs. At the forum, "Public-Private Partnerships: Dispelling the Myths," held in Toronto in October 2005, speakers highlighted the importance of a high level of political support and commitment to PPPs and to building an informed public debate to familiarize citizens with the issues. Other factors were identified as similar to the best practices recognized by Partnerships U.K.

One area where Canada differs from other countries is in the absence of active financial guaranty (monoline) insurers.[13] Monolines enhance the credit rating of lower-rated investment-grade PPPs through the provision of an unconditional and irrevocable guarantee to continue the payment of interest and principal in the event of a default. Historically, monolines have not been active in Canada,[14] but, to date, this has not been an impediment to financing projects. The large institutional investors that have been investing in PPPs have been able and willing to hold lower-rated, investment-grade debt.

13. These insurers, are referred to as "monolines" because they are restricted to only one business line—insuring the repayment of third-party debt.
14. Regulators have developed a tentative regime to regulate monolines, supporting their entry into the domestic market. But a regime that would meet both the business needs of monolines and the regulator's prudential mandate has not been finalized. These firms have yet to enter the Canadian insurance market.

In summary, many of the conditions required to support the development of a Canadian PPP market are in place. Governments appear to be committed to investing in infrastructure, including PPPs. Within the private market, there is an appetite for longer-term financial assets, and there is a pent-up demand for those investments in Canada. Adapting lessons learned from earlier experience with PPPs in Canada, and in other jurisdictions, should help to develop a viable, efficient PPP market.

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# Using the Contingent Claims Approach to Assess Credit Risk in the Canadian Business Sector

*Michal Kozak, Meyer Aaron, and Céline Gauthier*

In analyzing the financial system, central banks are interested in systemic risk. This can generally be taken to include risks that may lead to substantial problems for the financial system and ultimately result in a significant decline in real GDP. Hence, monitoring the risks facing Canadian financial and non-financial corporate sectors is an important part of overall financial system surveillance.

Risk in the corporate sector can be assessed in different ways. A large body of literature links risk to balance sheet ratios of profitability, liquidity, and leverage (Aaron and Hogg 2005; Altman 1983; Vlieghe 2001). Other approaches use financial market information to assess risk.

This report explores one such method, the contingent claims approach (CCA), which relies on both market information (including a measure of risk stemming from the volatility of market prices) and balance sheet information to model corporate credit risk.

Although the CCA is an interesting modelling tool for analyzing credit risk, it is data and computationally intensive. It can also be difficult to implement, since it requires matching different types of data—usually obtained from different sources—for a large number of companies. Hence, judgment has to be exercised in balancing the surveillance requirements with the cost of data gathering and integration.

This report uses the Canadian non-financial corporate sector and the banking sector to explore the implementation of the CCA for macrofinancial surveillance. It begins with a brief overview of the methodology, together with the issues that arise in applying CCA at a sectoral level. Next, CCA-based risk indicators are presented for some industry sectors and for the entire non-financial corporate sector. This is followed by an application to the Canadian banking sector. The report concludes with an evaluation of the CCA for macrofinancial surveillance, and outlines further avenues of research.

## The CCA: Merton-Type Models

### Distance-to-default measure

The CCA is a method that uses Black-Scholes option-pricing techniques to calculate the likelihood of corporate default. It is an extension of the Merton (1974) model based on the insight that a shareholder has an implicit call option on the value of the assets of the firm. The CCA uses both historical balance sheet data (leverage ratio) and timely and forward-looking equity market information (volatility of returns) to calculate a measure called distance to default (DD).

Distance to default represents the number of standard deviations that the market value of a firm's assets is away from the level of its liabilities. A higher DD (which means that the level of a firm's assets is expected to be farther away from the level of its liabilities) is interpreted as a lower risk of default. This could be caused by an improving leverage ratio, better asset returns, lower asset volatility, or any combination of these.[1]

Market-based indicators derived from Merton models have several advantages over indicators that rely primarily on accounting data. Market indicators are forward looking, they are available at a higher frequency, and the methods for extracting risk measures are broadly accepted.[2] On the other hand, market prices may reflect changes in attributes that could be unrelated to

1. A brief overview of the Merton model is presented in the Appendix.
2. European Central Bank (2005); Sveriges Riksbank (2005); Danmarks Nationalbank (2005); Persson and Blåvarg (2003).

financial stability. For example, an increase in market prices would be reflected in a higher DD (lower default risk), even though the price increase was due to market overreaction to good news or herding behaviour, rather than being the result of improved fundamentals. Nevertheless, market-based indicators have been shown to have leading information on corporate distress (Chan-Lau and Gravelle 2005; Chan-Lau, Jobert, and Kong 2004; Dionne et al. 2006; Tudela and Young 2003; and Gropp, Vesala, and Vulpes 2002).

## Assessing sector-level risk

The CCA can also be used for sector analysis. This can be done by applying the CCA to each firm in the sector and aggregating the results into a sector measure. This approach has the advantage of providing information on the distribution of individual DD measures, which allows the analysis to focus on the vulnerable tails of these distributions.[3] The disadvantage is in the cost of data integration, which can be substantial for frequent surveillance.

An alternative approach is to apply the CCA to sector-level data (Gapen et al. 2004). This approach treats each sector as a single firm by aggregating firm-level debt and equity information for all companies in a particular sector. Aggregating firm-level debt and equity information requires less computation and is easier to update regularly. Also, in aggregating the market values of equity and calculating its volatility, we implicitly take into account the individual volatilities and their correlations. This application of the CCA to sector-level data explicitly gives more weight to larger firms. Hence, these aggregate measures should be sensitive to systemic vulnerabilities arising from the deteriorating financial condition of a large firm or that of a critical mass of smaller firms.[4]

Regardless of the approach taken, it is important to recognize that extending Merton-type models to sector-wide analysis requires a different interpretation of the DD measure. It may not be appropriate to interpret a sector-level DD measure as a risk of "sector default." But since the sector-level DD will reflect the risks of the underlying firms, it should reflect the overall vulnerability of the sector.

This report uses both approaches. For the non-financial sector, where it is unlikely that any single non-financial corporation is systemically important, the CCA is applied to the sector-level aggregation.[5] For the major Canadian banks, which could be systemically important, the CCA is applied at both the individual and sector-level aggregation.

## Methodology and data

All market data are from Thompson Financial Datastream. The balance-sheet data for the public non-financial companies are from the *Globe and Mail* database.[6] The balance sheet information for the Canadian banks was obtained from the monthly returns filed by the banks with the Office of the Superintendent of Financial Institutions. The distance-to-default measures were estimated using the method set out in Chan-Lau, Jobert, and Kong (2004).[7]

Corporate bond defaults are measured by the number of public companies that defaulted in a given year as a proportion of all companies in an industry rated by Standard & Poor's.[8] Because of

3. Aaron and Hogg (2005) follow this route, using different balance-sheet ratios to construct an indicator of vulnerability in the corporate sector.
4. Sector-level aggregation may mask the weak firms, since it implicitly assumes that the assets of one firm can be used to back up the liabilities of another firm, which is not strictly true. But a similar masking issue would arise if firm-level DD measures were averaged.
5. There are over 1,500 non-financial public companies in Canada.
6. The public companies in the *Globe and Mail* database represent 55 per cent of total assets of all companies (public and private) in the non-financial business sector in 2004, as reported by Statistics Canada, and the coverage varies by industry. For example, for the forestry industry, the share of assets of public companies in the *Globe and Mail* database represents 45 per cent of total assets (private and public companies) in the industry.
7. For non-financial companies, annual balance-sheet information was used to calculate the default barrier by adding current liabilities and half of long-term debt for all companies in an industry. Taking half of long-term debt is arbitrary and follows the practice presented in other studies. Total liabilities were used for the banks. Annualized equity volatilities were calculated at the beginning of every month, using a one-year rolling window of daily market values of equity. The monthly DD values were calculated following the procedure outlined in the Appendix.
8. Not all of the companies in the *Globe and Mail* database are rated, and, therefore, data on bond defaults might not include the defaults of all companies in the *Globe and Mail* database.

Table 1

**Correlation Between Distance to Default and Bond Defaults**

| Distance to default | Bond defaults |
|---|---|
| Forestry (lagged) | -0.658 |
| Forestry (contemporaneous) | -0.550 |
| Manufacturing (lagged) | -0.146 |
| Manufacturing (contemporaneous) | -0.524 |

**Chart 1 Distance to Default and Bond Defaults**

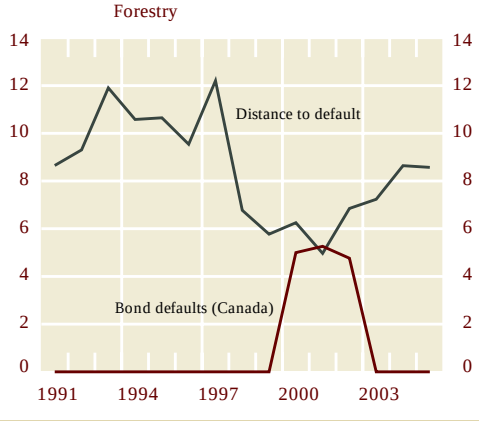
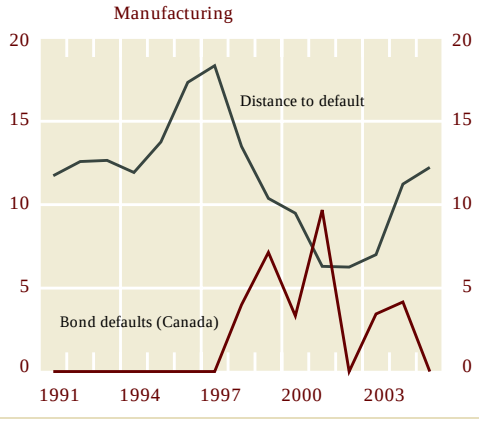



**Chart 2 Distance to Default and Bond Defaults**




data limitations, the sample period for the analysis of the non-financial sector is 1991–2005.

## Assessing Risks in the Non-Financial Corporate Sector

To assess the usefulness of the CCA for macrofinancial surveillance, we applied the CCA to the major non-financial corporate sectors. Each sector underwent a preliminary examination of the leading-indicator properties of DD for corporate bond defaults.

### Industry-level risk measure

Charts 1 and 2 show DD for the forestry and manufacturing sectors. In both sectors, DD began to decrease in 1997 and reached a trough in 2001. Since 2001, DD has shown an upward trend, suggesting that risk in these sectors has decreased.

The correlations between DD (and DD lagged one year) and bond defaults (Table 1) support the expected negative relationship.[9] The high correlation in the forestry sector suggests that DD has some leading-indicator properties for corporate bond defaults, which is desirable for financial-stability surveillance. For the manufacturing sector, contemporaneous correlation is also high, but one-year lagged correlation is rather low. Charts 1 and 2 suggest that DD may, indeed, have some leading-indicator properties for the sectors examined.

### Risk measures for the overall corporate sector

Increased vulnerabilities in a small sector are likely to have a smaller risk of systemic impact than vulnerabilities in a larger sector. But a sector's size or its share of GDP or bank loans are not the only factors affecting its contribution to systemic risk. It is also important to take the correlation of risks among sectors into account. In this section, we propose two different ways to measure risk in the overall corporate sector.

The first approach is to aggregate the balance-sheet and equity information of all companies and then calculate DD for the aggregate corporate

9. Note that the correlations should be interpreted carefully, since the relationship between DD and bond defaults is not linear, and only 14 years of annual data were studied.

sector. An alternative approach uses the market value of assets, one of the main outputs from the CCA. Since the whole corporate sector can be viewed as a portfolio containing the assets (in market value) of all the companies in the corporate sector, we propose the variance of the return on this portfolio as a proxy for the risk in the overall corporate sector.

The resulting DD for the aggregate corporate sector seems to have some leading-indicator properties for bond defaults (Chart 3). The correlation between bond defaults and a DD lagged one year is high (-0.74) and is still significant using a two-year lagged variance (-0.56). Even though the analysis covers a short period, this suggests that the corporate sector DD has some leading-indicator properties for credit risk.

The variance of the corporate sector portfolio also seems to have some leading-indicator properties for bond defaults (Chart 4). The correlation between one-year lagged variance and bond defaults is very strong (0.84) and is still high using a two-year lagged variance (0.69), supporting the leading-indicator properties of the variance measure for bond defaults.[10]

Thus, both measures of aggregate credit risk seem to have some leading-indicator properties for bond defaults.[11] As expected, there is overlap in the information content of these two measures, which are highly correlated (-0.79).

**Chart 3 Distance to Default and Bond Defaults for the Aggregate Corporate Sector**

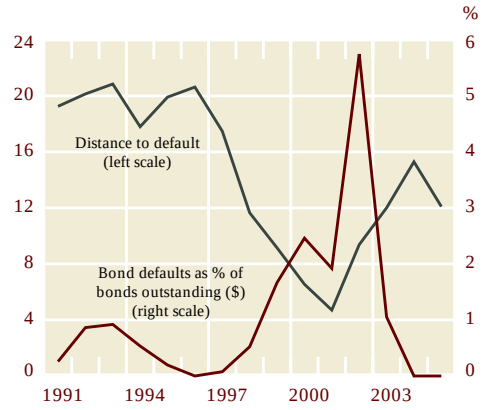
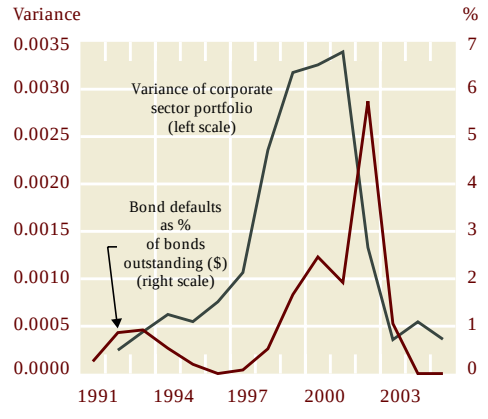



**Chart 4 Variance of Corporate Sector Portfolio and Bond Defaults for the Corporate Sector**

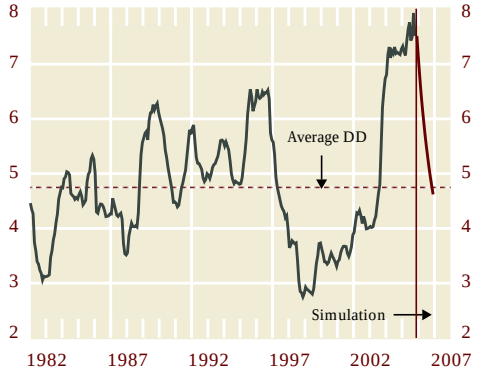



## Assessing Risks in the Banking Sector

In this section, the DD measure is used to assess the overall financial health of Canadian banks. The Canadian banking sector is proxied here by the six largest Canadian Banks (major banks). This is justified by the high concentration of Canada's banking sector, where the major banks held approximately 91 per cent of the banking assets in Canada, as of January 2006.

10. In comparison, the microdata indicator developed in Aaron and Hogg (2005) had a one-year lagged correlation of 0.46. See also Box 2 on page 11 of this issue.
11. A similar correlation exercise with impaired business loans for banks gave much weaker results.

**Chart 5 Average Distance to Default for Major Banks**




## Historical evolution of the risk measure

The average DD for the major banks during the period 1982–2005 is presented in Chart 5.[12] During this period, there have been important changes in the business practices of the major banks and in risk-management and risk-mitigation techniques.[13]

Movements in DD can be broadly related to major credit developments at the banks. For example, the measure fell sharply in the early 1980s, when many developing countries were encountering difficulties in servicing their debt, and was marginally below the mean in 1990 before the 1991 recession. Distance to default was also low following the crash in the technology sector in 2000–01 and the associated concerns about the exposure of some major banks to the telecom and cable sector. But there were also major declines around 1997–98, the period of extreme market volatility triggered by the 1997 Asian crisis and the 1998 Russian default/LTCM events, which are not thought to be particularly stressful for the major banks except, perhaps, for their market operations. Hence, these linkages must be interpreted cautiously, since changes in DD during the periods mentioned could be caused primarily by broader movements in the markets that might be only tangentially related to the risk exposure of Canadian banks.

The underlying drivers of DD (assets/liabilities and asset volatility) have subsequently improved, which has resulted in the observed decrease in risk (increase in DD) since that time. Of most interest is the strong increase in DD in 2003–04. Although all DD drivers improved during those years, the main driver was a strong decrease in asset volatility. This could emanate from a number of sources, such as a fundamental improvement in the riskiness of major

12. The average DD is the asset-weighted average of each individual bank's DD, computed using the procedure outlined in the Appendix. Although some information is lost in the aggregation process, it should provide a good indication of important changes in the risks of major banks.
13. For example, in the early 1990s, there was a major shift towards reliance on fee income at the expense of interest income, and the trading book expanded much more rapidly than the banking book. Moreover, since the mid-1980s, residential mortgage lending has risen at the expense of business lending.

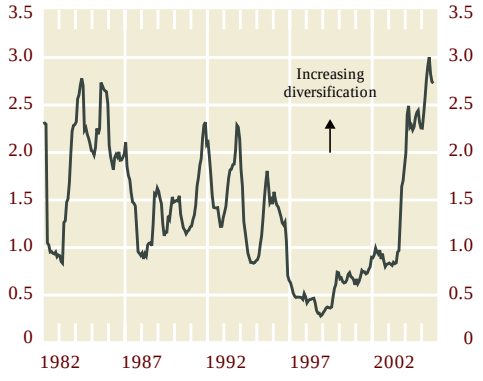
banks, or the banks may simply have benefitted from the low volatility of the stock market as a whole. To see if the latter is the case, a simulation was done using a scenario in which the volatility of the major banks' equity returns to its sample mean.[14] Chart 5 indicates that, should this occur, the recent improvement in the DD measure would be substantially reduced but DD would still be at the historical average.

## Assessing risk diversification in the banking sector

The average DD measure analyzed above does not explicitly account for diversification of risk among the major banks, which requires the incorporation of correlations among these institutions. Calculating DD for a "representative bank" is one way to measure this benefit.[15]

As with the methodology used above for the non-financial corporations, DD for the representative bank is calculated by aggregating the major banks into a single entity. This procedure accounts for the correlation among the major banks and, hence, should include a measure of the diversification benefits.[16] Distance to default for the representative bank will be higher than the average DD because of diversification, and the difference between the two measures should reflect this benefit.[17] The lower the correlation among institutions, the more the system as a whole will benefit from "diversification" effects, and the larger the difference between the representative bank DD and average DD will be. The results are shown in Chart 6. This difference reached a peak recently, indicating good diversification across major

**Chart 6 DD for Representative Bank Minus Average DD**




14. This simulation assumes that all input parameters are fixed except for the volatility of major banks' equity, which returns to its sample average linearly over one year. The correlation between market value of equity and volatility is not significant, suggesting that this assumption is reasonable. A scenario where the volatility of the major banks' equity returns to its 10-year average gave similar results.
15. This approach has been used by the International Monetary Fund in its Article IV reports.
16. The aggregate market capitalization of the major banks and the volatility of their equity, which are used as inputs into the model calculations, will, by definition, include the correlations among the equity-price movements of the major banks.
17. In addition to the diversification effects, the difference may also reflect the effects of aggregation.

banks and that the "sector" is expected to be resilient to shocks. Note, however, that the profile for this measure follows the profile for the average DD (Chart 5). This implies that the diversification benefits seem to be reduced in times of greater stress (lower average DD).[18] Hence, this diversification benefit should not be overstated. In addition, although the DD for the sector incorporates the correlations, it does not account for second-round or network effects, which arise from the linkages between the constituent banks, except to the extent that movements in market prices incorporate such effects.

## Conclusion

The CCA has advantages for macrofinancial surveillance over financial accounts measures, since it uses more timely and forward-looking information. These measures are gaining acceptance among many central banks and international institutions as tools for monitoring systemic risks.

The work summarized here shows that the CCA can be useful for analyzing systemic risks in the non-financial and financial corporate sector. Depending on the surveillance requirements, it can be applied at the firm level or at the aggregate sector level.

Additional research is being done to better understand the value of this tool. For example, Gropp, Vesala, and Vulpes (2002) suggest that DD leads downgrades of European banks by six to eighteen months. This result is being assessed for Canadian financial institutions. Research using simulations is also being conducted to quantify the impacts of aggregation in applying the CCA to sector-level analysis. Lastly, measures from the CCA are being incorporated into studies that are investigating the links between corporate vulnerabilities and macroeconomic variables.

18. It is well known that in bad times, not only does the likelihood of defaults increase, but also the correlation of defaults. The underlying causes of this behaviour and the methodologies to distinguish between them are still not well understood (Forbes and Rigobon 2002).

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**Appendix**

## The Merton Model

The methodology followed here is Merton's option-based model of credit risk. The details of this methodology are explained in Chan-Lau, Jobert, and Kong (2004). The Merton model of credit risk treats the equity of a firm as a call option on the underlying assets of the firm. This formulation allows the calculation of an expected distance to default (DD), which can be taken as a measure of the probability that the market value of the assets will be equal to or less than the liabilities (also known as the default barrier) over the chosen time horizon, which is taken here to be one year.

More formally, the Merton equations for the pricing of a call option are:

$$E = AN(d_1) - Le^{-rT}N(d_2)$$

$$d_1 = \frac{\ln\left(\frac{A}{L}\right) + \left(r + \frac{1}{2}\sigma_A^2\right)T}{\sigma_A\sqrt{T}}, d_2 = d_1 - \sigma_A\sqrt{T}, \qquad (1)$$

where

- $E$ = market value of equity
- $A$ = market value of assets
- $N$ = the cumulative density function of the standard normal distribution
- $L$ = value of liabilities
- $r$ = 1-year treasury bill rate
- $T$ = the chosen time horizon
- $\sigma_A$ = asset volatility
- $\sigma_E$ = volatility of equity.

The Merton framework also links equity volatility and asset volatility through the following relationship:

$$\sigma_E E = N(d_1)\sigma_A A. \qquad (2)$$

Hence, given the book value of debt, the maturity, the firm's equity value, and its volatility, the implied market value of its assets, and the asset volatility can be calculated by solving equations (1) and (2) simultaneously. Now, using the known values of the liabilities and the calculated values of assets and asset volatility from above, the distance to default, which is a measure of the firm's credit risk, can be calculated as:

$$DD = \frac{\ln\left(\frac{A}{L}\right) + \left(r - \frac{1}{2}\sigma_A^2\right)T}{\sigma_A\sqrt{T}}. \qquad (3)$$

Note that a large DD is consistent with low risk, since the firm is a greater number of standard deviations away from the default threshold, and vice versa.

Given the assumptions of a standard normal distribution for DD, the probability of default is calculated as follows:

$$P_{def} = N(-DD). \qquad (4)$$

In practice, the probabilities of default calculated from Merton-type models do not map exactly into observed probabilities for firm default because they rely on risk-neutral pricing, which overstates the true probability of default. Hence, although this measure has been shown to be a complete and unbiased indicator of firm vulnerability, it is appropriate to think of it as a default-likelihood indicator (Gapen et al. 2004; Vassalou and Xing 2004). Commercial vendors such as Moody's KMV use historical data to map these calculated probabilities into estimated default frequencies.

# 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.*

Every day, individual Canadians, businesses, and governments use various payment instruments to purchase goods and services and to make financial investments. For these transactions to be completed, financial institutions need a way to transfer funds and other assets among themselves on behalf of their customers or on their own accounts. The arrangements used to make these transfers among financial institutions constitute a clearing and settlement system. For a number of reasons, the Bank of Canada has a strong interest in the safe and efficient operation of major clearing and settlement systems. In the article, "The Bank of Canada's Role in the Oversight of Clearing and Settlement Systems," Walter Engert and Dinah Maclean set out the Bank's mandate for regulatory oversight of clearing and settlement systems, the strategy that is followed, and the key activities relevant to the conduct of oversight.

# The Bank of Canada's Role in the Oversight of Clearing and Settlement Systems

*Walter Engert and Dinah Maclean*

Every day, individual Canadians, businesses, and governments use various payment instruments to purchase goods and services and to make financial investments. These instruments include cash, cheques, debit and credit cards, e-money, and large-value electronic payment orders. All of these payment instruments, except cash, involve a claim on a financial institution such as a bank, credit union, or caisse populaire. And for all of these transactions to be completed, financial institutions need a way to transfer funds among themselves on behalf of their customers, or on their own account.

The arrangements used to make these transfers among financial institutions constitute a clearing and settlement system for these payments. More generally, a clearing and settlement system is the set of instruments, rules, and technologies that facilitate the transfer of funds and other assets among the system participants.

The Bank of Canada has a strong interest in the safe and efficient operation of major clearing and settlement systems, for a number of reasons. For instance, the system used to settle large-value payments among financial institutions is also the mechanism used to implement monetary policy in Canada.[1]

In addition, since clearing and settlement systems underpin virtually all of the transactions undertaken in the economy, their safe and efficient operation is important to the sound functioning of the economy. Disruptions in major systems can have serious implications for participants, which can extend to the financial system and to the economy more generally.

As a result of these various considerations, the Bank of Canada oversees those clearing and settlement systems that are judged to have the potential to generate systemic risk. This article sets out the Bank's mandate for such oversight, the strategy that is followed, and the key activities relevant to the conduct of oversight.

## The Bank's Oversight Mandate

The Payment Clearing and Settlement Act (PCSA) was proclaimed by Parliament in July 1996. This legislation gives the Bank of Canada responsibility and authority for the oversight of major clearing and settlement systems operating in Canada, for the purpose of controlling systemic risk. In this context, systemic risk is defined as the risk that the default of one participant in a clearing and settlement system could lead, through the activities of the system, to the default of other institutions or systems.

A clearing and settlement system brings together various financial system participants in a common arrangement, such as a clearing house, where the participants are explicitly interlinked so that the behaviour of one participant can have implications for others. In such an arrangement, each participant could face potentially significant risks and liabilities depending on the behaviour of other participants and on the design of the system. As a result, spillover or domino effects with broader economic consequences can occur if the system is not properly designed and operated.

The PCSA is the government's recognition of the essential role of major clearing and settlement systems in the Canadian economy, and of the importance of their regulatory oversight. Canada was the first G-10 country to adopt legislation that specifically requires the central bank to

1. For a discussion of the implementation of monetary policy in the large-value payments system in Canada, see Howard (1998).

oversee the control of systemic risk in major clearing and settlement systems.

In establishing the oversight role of the Bank of Canada with regard to the design and operation of clearing and settlement systems, the PCSA:

- provides for the collection of information from clearing and settlement systems to determine their eligibility for oversight, and to determine whether the operation of an eligible system has the potential to create systemic risk;
- empowers the Bank to designate an eligible system as being subject to Bank of Canada oversight, where the Governor is of the opinion that such a system may be operated in a manner that could pose a systemic risk;[2]
- requires the Bank to satisfy itself that designated clearing and settlement systems have appropriate risk controls in place to deal with potential systemic-risk concerns;
- requires every designated system to provide the Bank of Canada with reasonable notice in advance of any change to be made that is of a significant nature in relation to the designated system;
- provides the Bank with the authority to approve the participation of authorized foreign banks in a designated system;
- provides the Governor of the Bank with the power to issue written directives to the operator of a designated system to refrain from actions that, in the opinion of the Governor, are likely to result in systemic risk being inadequately controlled, or to take actions to remedy a situation in which, in the opinion of the Governor, systemic risk is likely being inadequately controlled;[3] and
- provides that failure to comply with the Act, with a request for information from the Bank, or with a directive, can lead to legal proceedings and court orders to comply and to the assessment of penalties.

## The Bank's Oversight Strategy

The Bank of Canada has stressed several key principles to frame its oversight strategy and to guide the conduct of its oversight activities.

- The Bank judges whether a designated clearing and settlement system meets its minimum standards (see below), but the Bank does not specify or decide how a system should meet these standards. System owners and operators determine how to meet the Bank's standards, which leads to efficient solutions.
- The Bank promotes a co-operative approach for voluntary action by a designated system to meet its concerns.
- The Bank stresses transparency. The Bank aims to develop policies that are well founded, clear, and publicly available.

Essentially, the Bank's oversight strategy is to establish minimum standards that condition the behaviour of designated systems to control systemic risk. Private sector system operators, in turn, find the most efficient way of meeting these constraints. In addition, as a system evolves, Bank staff review the design and rule changes proposed by system operators to satisfy themselves that systemic risk continues to be well controlled. The Bank also periodically confirms that systems are operating as expected to mitigate systemic risk; for example, through audits.

The private sector's central role in designing and operating systems, subject to minimum standards established by the Bank of Canada, is important for achieving both safe and efficient systems. For example, significant private sector involvement is an important reason why Canada's large-value payments system is based on the netting of payment orders, as opposed to real-time gross settlement (RTGS) principles.[4]

2. For such designation to take effect, the Minister of Finance must agree that it is in the public interest to designate the clearing and settlement system.
3. For such a directive to take effect with regard to a system established by federal statute, the Minister of Finance must agree with the issuance of the directive.
4. RTGS refers to the continuous (real-time) settlement of funds or securities transfers individually, on an order-by-order basis. Netting refers to a process whereby individual obligations among system participants are offset against one another (over a day, for example) to produce a single net payable or receivable balance for each participant. This considerably reduces the number and value of obligations to be settled, which, in turn, can reduce risks and costs. However, netting systems are more complex analytically and from a legal perspective, compared with RTGS-based systems. For more on netting and risk management, see Engert (1993).

More generally, the Bank's approach to oversight provides incentives for the safe and efficient operation and evolution of systemically important clearing and settlement systems.

## Implementing Oversight

### Governance

Responsibility for decision making on oversight issues rests ultimately with the Governor and deputy governors of the Bank. Under the PCSA, the Governor has specific responsibilities for key oversight decisions, such as the designation of systems and the issuance of directives.

In practice, the Governor has delegated some decision-making powers to the Deputy Governor responsible for Financial Stability and to the Bank's Adviser for Regulatory Policy—the key operational officer for oversight at the Bank. Strategic considerations, such as policy development, are also discussed by the Bank's Financial System Committee, a committee that includes all of the Bank's deputy governors.

A number of important activities are required to support the Bank's oversight role, and the main ones are described in the rest of this section.

### Establishing minimum standards

As noted above, the Bank establishes minimum standards for designated clearing and settlement systems, and system operators determine how to best meet those standards. The Bank's *Guideline Related to Bank of Canada Oversight Activities under the Payment, Clearing and Settlement Act* sets out the general risk-control framework for designated systems. The *Guideline* also provides the specific minimum standards that designated systems are expected to meet so as to control systemic risk. (The *Guideline* is available on the Bank of Canada's website at http://www.bankofcanada.ca/en/financial/guide2002.html.)

The Bank's minimum standards incorporate the principles and recommendations contained in the following reports, prepared collaboratively by central banks and securities markets regulators to guide the development of oversight policy around the world.

- *Core Principles for Systemically Important Payment Systems*, Committee on Payment and Settlement Systems (CPSS), January 2001.
- *Recommendations for Securities Settlement Systems, Report of the CPSS-IOSCO Joint Task Force on Securities Settlement Systems*, November 2001. (IOSCO refers to the International Organization of Securities Commissions.)
- *Recommendations for Central Counterparties, Report of the CPSS-IOSCO Joint Task Force*, November 2004.

Bank staff participate actively in the international committees that establish and review these standards for systemically important systems.[5]

#### *Designation as systemically important*

Under the PCSA, the Bank of Canada reviews eligible clearing and settlement systems for their potential to pose systemic risk. A system is eligible for review by the Bank if

- it has three or more participants, one of which is a bank;
- it clears or settles Canadian-dollar payment obligations; and
- the payment obligations are ultimately settled through accounts at the Bank of Canada.

If the Governor of the Bank forms the opinion that a system has the potential to pose systemic risk, the system may be designated as subject to the PCSA, provided the Minister of Finance agrees that this is in the public interest.

When deciding if a system should be designated under the PCSA, the Bank considers

- the size of individual payment obligations and the aggregate value of payment obligations processed by the system on any given day;
- the size of payment obligations owed to and by participants in the system relative to each participant's capital; and

5. These reports are available on the Bank for International Settlements website at http://www.bis.org/cpss/index.htm. For a discussion of the development of these international standards and their application in Canada, see Goodlet (2001).

- the role played by the system in supporting transactions in financial markets or in the economy more generally.

Systems that handle small-value payments (either as individual payments or aggregate payment obligations) are unlikely to be designated, since they typically do not pose systemic risk. Nevertheless, the Bank monitors such systems for changes in their situation. Systems that handle large-value payment obligations are much more likely to generate systemic risk, and so are much more likely to be designated.

The following clearing and settlement systems have been designated as being subject to the PCSA:

- the Large Value Transfer System, which clears and settles large-value payments;
- CDSX, which clears and settles securities transactions; and
- CLS Bank, which clears and settles foreign currency transactions.

Box 1 provides brief descriptions of major clearing and settlement systems in Canada.

## Assessment and review of systems

Following designation, and central to the oversight process, the Bank assesses whether a designated system meets the minimum standards set out in the *Guideline*. Such assessments are made at the time that the system is initially designated and when significant changes are proposed by the operators of the system.[6]

Bank staff also conduct ongoing reviews of designated clearing and settlement systems so as to be aware of current and emerging trends. Importantly, as systems evolve and develop, the Bank assesses proposed changes and must be satisfied that systemic risk remains controlled.

An important part of the Bank's oversight program is an annual audit of designated systems. In the case of the LVTS and CDSX, this audit is conducted in accordance with provisions of the Canadian Institute of Chartered Accountants Handbook regarding opinions on control procedures at a service organization. The Bank of Canada can influence the scope of the audit and can discuss the results with the auditors.

Given the global nature of CLS Bank, oversight is conducted according to a co-operative arrangement involving 20 central banks (Box 1). Since the operating organization of CLS Bank is incorporated under U.S. and New York State laws, the U.S. Federal Reserve is the primary supervisor and lead overseer of CLS Bank.[7]

The Federal Reserve supervises CLS Bank partly on behalf of the co-operative oversight group of central banks. This group meets regularly (at least twice a year) to consider issues related to foreign-exchange-settlement risk and to the oversight of CLS Bank. In this context, the Federal Reserve provides an annual supervisory report on CLS Bank, as well as information regarding significant developments affecting CLS Bank. More generally, the Federal Reserve responds to concerns and questions from members of the oversight group, as needed. In its conduct of oversight, the Federal Reserve applies the principles and recommendations developed collaboratively by the G-10 central banks and securities regulators (noted above).

## Managing relations with system operators

An important part of carrying out the Bank of Canada's oversight mandate is fostering effective, co-operative relations with the operators of designated systems. System operators have ongoing legal obligations to provide advance information on proposed changes to rules or to system design, and to co-operate with regard to annual audits. For its part, the Bank is responsible for making its requirements and expectations clear, for responding to system developments promptly, and for raising any concerns expeditiously.

Both the Bank and the system operators benefit from co-operative and timely interaction. And

6. Bank of Canada staff were also involved in discussions regarding the design of the three designated systems (the LVTS, CDSX, and CLS Bank) during their development, with a particular interest in adequate risk containment in these systems.

7. Given that CLS Bank is incorporated under U.S. laws as an Edge Act Corporation (a special-purpose bank), and that the vast majority of foreign currency trades involve the U.S. dollar, which has implications for U.S.-dollar markets, the Federal Reserve has strong incentives for ensuring the sound oversight of CLS Bank.

Box 1

## Major Clearing and Settlement Systems in Canada[1]

The **Large Value Transfer System (LVTS)** is an electronic transfer system that processes large-value Canadian-dollar payments. Average daily number of transactions processed: about 18,000. Average daily value of transactions: $145 billion. Owned and operated by the Canadian Payments Association. Designated by the Bank of Canada for oversight.

**CDSX** clears and settles securities transactions in Canada. Average daily number of trades settled: about 300,000. Average daily gross value of trades settled: $200 billion. Owned and operated by The Canadian Depository for Securities Limited. Designated by the Bank of Canada for oversight.

**CLS Bank** is a global system that clears and settles foreign exchange transactions. Average daily number of trades settled: about 220,000. Average daily value of trades settled: US$2.6 trillion. Owned by a consortium of major international banks through CLS Group Holdings AG (London); operated by CLS Bank International in New York. Overseen cooperatively by a group of central banks whose currencies are settled by CLS Bank. The U.S. Federal Reserve is the lead supervisor and oversight agency. Canadian-dollar operations have been designated by the Bank of Canada for oversight.

The **Automated Clearing Settlement System (ACSS)** processes paper-based and electronic payment items, largely retail (small-value) payments. Average daily number of transactions processed: about 20 million. Average daily value of transactions: $18 billion. Owned and operated by the CPA. Not designated for oversight by the Bank of Canada.

The **Canadian Derivatives Clearing Corporation (CDCC)** is a clearing house for derivative instruments traded on the Montreal Stock Exchange, which is also the owner of CDCC. Not designated for oversight by the Bank of Canada.

1. For more information on these systems, see the Bank of Canada's website: <www.bankofcanada.ca/en/financial/payments.html>.

the Bank seeks to establish arrangements whereby it receives advance information on proposed rule and system changes. This provides opportunities for discussion early in the design-change process, so that any concerns can be dealt with efficiently. To this end, the PCSA authorizes the Bank to enter into an agreement with the operators of a designated system to establish a framework for interaction on matters related to the control of systemic risk.

Primary responsibility for the reliable day-to-day functioning of a designated clearing and settlement system rests with the system's operator and participants. The Bank, in carrying out its oversight responsibilities, does not ordinarily get involved in the operations of designated systems. The Bank does, however, provide regular operational services to clearing and settlement systems, which are discussed in Box 2.

## Coordination

The Bank also needs to coordinate its oversight activities with other involved agencies. For instance, the federal Department of Finance oversees the activities of the Canadian Payments Association (CPA) generally, following from provisions of the Canadian Payments Act (2001). The CPA also owns and operates the LVTS, which is subject to oversight by the Bank of Canada. Accordingly, the Department of Finance and the Bank of Canada routinely consult and exchange views with regard to CPA activities of mutual interest. As well, the Bank provides advice to the Department of Finance on the development of federal policy more generally regarding payments system issues in Canada. To facilitate such interaction, officials of the Bank and the Department of Finance meet regularly (as the Payments Advisory Committee).[8]

The Bank of Canada coordinates its oversight of CDSX with the Ontario Securities Commission and the Quebec Autorité des marchés financiers. In addition, as discussed above, the Bank participates in a co-operative oversight arrangement regarding CLS Bank, with other central banks around the world.

The Bank of Canada has additional roles that are associated with its oversight responsibilities.

8. The Bank of Canada is also involved in the governance of the CPA (Box 3).

**Box 2**

## Bank of Canada Operational Roles in Clearing and Settlement Systems

As well as oversight, the Bank of Canada has operational roles related to clearing and settlement systems.

- The Bank of Canada provides settlement assets, through Bank of Canada accounts and standing liquidity facilities, for LVTS participants.[1]
- The Bank takes pledges of collateral from LVTS participants to facilitate risk management in that system.
- The Bank acts as settlement agent for CDSX. In this regard, the Bank provides a settlement account to CDSX to eliminate "banker risk" for this system. The Bank receives, through the LVTS, payments from CDSX participants that owe funds to CDSX, and the Bank subsequently makes payments to participants entitled to receive funds from CDSX.
- Similarly, the Bank acts as settlement agent for CLS Bank, by providing a settlement account to CLS Bank and by receiving and then making Canadian-dollar payments through the LVTS as agent on behalf of CLS Bank.
- To mitigate major disruptions caused by operational failure of the LVTS, the Bank is prepared to assist, if necessary, by entering payments directly across participants' settlement accounts with the Bank of Canada. A similar contingency service is provided for CDSX.
- Similarly, to mitigate major disruptions caused by operational failure of a Canadian settlement member of CLS Bank, the Bank of Canada is prepared to assist, if necessary, by entering payments directly across CLS Bank's and participants' settlement accounts with the Bank of Canada.
- The Bank is the banker for the federal government, and for some foreign central banks and intergovernmental organizations, and processes large-value transactions on their accounts.
- The Bank of Canada is also a participant in the LVTS, ACSS, and CDSX, processing a small number of transactions on its own behalf.

These operational roles are conducted separately from oversight activities. But operational expertise can inform oversight decisions when assessing aspects of proposed changes in a designated system.

1. For more on these arrangements, see Daniel, Engert, and Maclean (2004–05).

Box 3

## The Bank of Canada and Governance of the Canadian Payments Association

The Canadian Payments Association (CPA) is a non-profit organization created by an Act of Parliament in 1980. Its mandate is to establish and operate national payments systems, to facilitate the interaction of the CPA's systems with others involved in the exchange, clearing, and settlement of payments, and to facilitate the development of new payment methods and technologies.

The CPA also has public-policy objectives to promote the efficiency, safety, and soundness of its clearing and settlement systems and to take into account the interests of its users.

The CPA is governed by a 16-person Board of Directors, three of whom are appointed by the Minister of Finance. As well, a senior officer of the Bank of Canada is the Chair of the CPA's Board of Directors.

Since the CPA operates the LVTS, which has been designated for oversight by the Bank of Canada, the CPA Chair and the Bank's oversight responsibilities are separated within the Bank, and an arm's-length relationship is maintained. Accordingly, there are separate reporting lines for these roles within the Bank. The CPA Chair does not have any oversight role or responsibilities, and the CPA Chair never represents or speaks for the Bank with regard to oversight matters.

For example, the Bank participates in the Financial Institutions Supervisory Committee (FISC), a forum of federal agencies that facilitates the exchange of information related to the supervision of federally regulated financial institutions.[9] The Bank has a responsibility to inform its FISC partners about key developments in clearing and settlement systems that could affect risks faced by individual institutions and by the financial system more generally.

Finally, the Bank has a number of broader international responsibilities that arise from its oversight role. These include participating in the Committee on Payment and Settlement Systems (CPSS), as indicated above. The CPSS is the central bank committee that collaboratively sets standards that guide oversight policies around the world. As well, the CPSS conducts analysis and research on a range of issues relevant to clearing and settlement systems. (For more on the CPSS, see http://www.bis.org/cpss/index.htm.)

## Research

Research by Bank of Canada staff on risk issues, specific clearing and settlement systems, and the more general payments environment is important for developing the knowledge required to provide policy advice for oversight. This research also helps support the Bank's contributions to international committees, including those that develop standards for systemically important systems. A challenging research agenda is also important for attracting and retaining staff and for staff development.[10]

9. The Bank also has a broad interest in the FISC, owing to the Bank's role in the financial safety net as the lender of last resort. The FISC is comprised of the Superintendent of Financial Institutions, the Governor of the Bank of Canada, the Chair of the Canada Deposit Insurance Corporation, the Deputy Minister of Finance, and the Commissioner of the Financial Consumer Agency of Canada. For more on the FISC and related matters, see Engert (2005) and Daniel, Engert, and Maclean (2004–05).
10. For recent examples of such research, see Northcott (2002); McPhail and Vakos (2003); McVanel (2005, 2006); Arjani (2005, 2006); Chande, Lai, and O'Connor (2006); and Garcia and Gençay (2006).

## Concluding Remarks

Much of the Bank of Canada's analysis of clearing and settlement systems is provided through its various publications, such as the *Bank of Canada Review* and, especially, the *Financial System Review*. In addition, the Bank's website presents substantial information on clearing and settlement systems, with emphasis on the Bank of Canada's roles and activities. Staff working papers provide related analysis and research. Comments on all of these documents are welcomed.

In the past, the Bank of Canada has provided a high-level annual summary of its oversight activities in its *Annual Report*. Starting in this issue of the *Financial System Review*, a more detailed annual summary will be provided as an article in the Policy and Infrastructure Developments section to allow for a fuller account of the year's activities.

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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 the article, "The Impact of Unanticipated Defaults in Canada's Large Value Transfer System," Darcey McVanel examines how robust individual participants in Canada's Large Value Transfer System (LVTS) are to defaults by other participants in the system. The LVTS is designed to meet international risk-proofing standards at a minimum cost to participants in terms of collateral requirements. It does so, partly through collateralized risk-sharing arrangements, whereby participants may incur losses if another participant defaults. The LVTS is designed to be robust to default. Its rules, however, do not mean that individual participants are robust to default. The author studies participants' robustness to default by simulating unanticipated defaults, calculating the loss allocations that other participants would have to bear, and comparing these loss allocations with participants' collateral in the LVTS and with their capital positions. She finds that all participants are able to withstand the loss allocations that result from the largest defaults that she can simulate using actual LVTS data.

Many countries prohibit large shareholdings in their domestic banks. In "Ownership Concentration and Competition in Banking Markets," Alexandra Lai and Raphael Solomon ask whether such prohibitions hinder competition. The authors study a loans market with two banks. Managers choose loan levels and appropriate part of the cash flow; either a controlling shareholder or the manager chooses the bank's debt. The holders of large blocks of shares (blockholders) are more likely to win control. The authors show that banks with controlling blockholders would issue more debt, since the blockholder "disciplines" the manager by reducing free cash flow. More debt leads the manager to issue more loans, thus providing a more competitive market. Since controlling blockholders result in increased competition, shareholding restrictions inhibit competition. The authors ignore possible self-dealing by blockholders, but note that good governance and banking supervision can address self-dealing. The authors conclude that prohibitions on concentrated ownership merit further study.

Central bankers have a long-standing interest in how financial assets move together over time and, in particular, during times of market stress. To understand this, central bankers need a model of the time-varying covariance matrix of asset returns. In "Using High-Frequency Data to Model Volatility Dynamics," Gregory H. Bauer presents a new model of the covariance matrix that he developed with Keith Vorkink of MIT. The model has several advantages over existing methods. High-frequency data are used to construct daily estimates of the volatilities of, and correlations between, stocks with different market capitalizations. A new mathematical technique is then used to model the evolution of this matrix over time. The authors show that this evolution can be explained by a small number of variables. In the future, they hope to use the model to understand the dynamics of international assets.

# The Impact of Unanticipated Defaults in Canada's Large Value Transfer System

*Darcey McVanel**

Canada's Large Value Transfer System (LVTS) is designed to meet international risk-proofing standards at a minimum cost to participants in terms of collateral requirements.[1] It does so partly through collateralized risk-sharing arrangements whereby participants may incur losses if another participant defaults, but the system itself is robust to default. The LVTS is designed so that participants pledge sufficient collateral to cover at least the largest possible payment obligation to the system. This does not mean, however, that *individual participants* are robust to default. Participants are responsible for managing their own risks to protect themselves from potential losses stemming from the default of another participant.[2] In the paper summarized here, the ability of participants to withstand such defaults is assessed by simulating unanticipated defaults in the LVTS. (In reality, there have not been any defaults in the LVTS.)

## Key Features

The LVTS forms the core of the Canadian payments system. It substantially reduces systemic risk and allows Canada to meet the best international practices for handling large-value payments by applying the following risk-control elements:

- The net amount that each participant is permitted to owe is subject to bilateral and multilateral limits. Individual payments are subject to risk controls to ensure that they do not exceed these limits.
- At the beginning of each business day, participants pledge collateral to the Bank of Canada with a value sufficient to cover the largest permitted net debit position from a single participant. This will provide the liquidity required to settle the system should one of the participants default.
- The Bank of Canada guarantees settlement in the extremely unlikely event that more than one participant defaults on a single day and that the sum of the exposures exceeds participants' pre-pledged collateral.

These elements provide participants with certainty of settlement for those payments that pass the risk-control tests.

Participants can send their payments through one of two payment streams. In the first stream, participants pledge their own collateral to cover their obligations. This stream is referred to as "defaulter pays," since, in the case of a default, the defaulter's own collateral is used to generate liquidity to settle the system. The second stream is termed "survivors pay," since, in the case of a default, the non-defaulting participants share the costs of settling the defaulter's obligations. While participants in this stream clearly bear risks related to the exposures of other participants, this stream has much lower collateral costs than the first.

In the survivors-pay stream, participants determine the limits of the exposure they are willing to assume vis-à-vis other participants and extend lines of credit accordingly. Each participant must then pledge collateral to cover a standard percentage (currently set at 24 per cent) of the largest bilateral credit limit (BCL) it has extended to any other participant. This is the maximum amount that the participant will have to contribute if one or more participants to which it has granted a BCL defaults. On the reciprocal side, each participant can incur a net bilateral position equal to the BCL that has been established for it by the grantor and a net multilateral

1. For a full description of the LVTS, see Dingle (1998).
2. A participant is in default if it cannot meet its end-of-day net debit position.

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

position equal to a fixed percentage of the *sum* of the credit lines granted to it. (See Box 1 for an example.)[3]

Participants who end the day with an overall net debit position must find either the funds or the collateral to settle their position; otherwise, the participant is in default.[4] Since participants in the survivors-pay stream can incur a net debit position that exceeds their collateral, default is possible in the LVTS.

If a participant defaults, its own collateral will first be used to absorb its losses. Other participants will then share in the remaining losses in proportion to the size of the BCLs they have granted to the defaulter. Participants have control over the size of the BCLs that they grant to the defaulter. They also have the incentive to set them small enough to be able, from a solvency perspective, to withstand the losses incurred in the event of another participant's default. In this study, maximum-impact defaults are generated based on actual LVTS data in order to test whether participants are indeed setting BCLs at a level sufficient to withstand their losses.

## Methodology and Data

The study period spans the 170 business days from 1 March to 29 October 2004. The average daily volume and value of payments over this period were 17,063 and $130.2 billion, respectively. Data on participant transactions, collateral, and bilateral credit limits are used to determine participants' maximum positions, shortfalls, and loss allocations.[5] Participants' Tier 1 capital is used to determine whether they can withstand their losses.[6]

If a participant is closed by its regulator during the LVTS day, it will immediately become ineligible for further participation in the system. Our defaults are generated by assuming that each

**Box 1**

### Example of Credit Limits

Participant *A* grants a *BCL* of 10 to participant *B* and one of 20 to participant *C*.

*A* must therefore pledge collateral of 0.24 (20).

*B* and *C* grant *BCL*s to *A* equivalent to the *BCL* granted to them by *A*.

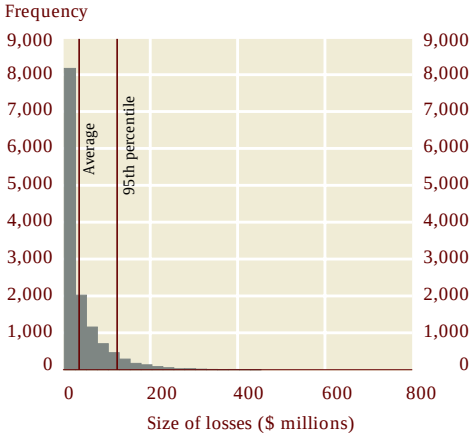
*A* can incur a net debit position of:

- up to 10 with *B*
- up to 20 with *C*
- overall (*B*+*C*) up to 0.24 (10+20) = 7

(Note that, since there are 15 participants in the LVTS, the multilateral constraint is less restrictive than this example would suggest.)

3. For a more detailed discussion of credit limits in the LVTS, see McPhail and Senger (2002, 46).
4. Participants can use both the collateral supporting their defaulter-pays obligations, as well as their survivors-pay collateral.
5. We thank the Canadian Payments Association for providing these data.
6. Data for federally regulated financial institutions are obtained from the website of the Office of the Superintendent of Financial Institutions, and data for all others from the websites of the institutions themselves.

**Chart 1 Size Distribution of Participants' Losses**




participant is closed by its regulator and is, therefore, ineligible to participate after the point when it reaches its maximum net debit position. Participants' maximum negative positions are found by simulating actual LVTS activity over our time period, using the Bank of Finland Payment and Settlement Simulator.[7] In each case, this position is compared with the participant's collateral to determine whether survivors would incur losses. Survivors' losses are then calculated according to LVTS Rules, with survivors sharing in the losses in proportion to the size of the bilateral credit limit that they granted to the defaulter.[8] Survivors' losses are compared with participants' Tier 1 capital holdings, and participants are deemed able to withstand their loss if their Tier 1 capital after the loss exceeds the level required by their regulator.

## Results

A participant is said to have incurred a shortfall in each case where it is closed with a net debit position that exceeds the value of its collateral. Shortfalls occur in almost half of all cases. The size of the average shortfall is relatively small, about 20 per cent of the maximum allowed (based on BCLs granted), and on each participant's worst day, shortfalls are, on average, about 80 per cent of the maximum possible.

Chart 1 illustrates the size distribution of survivors' loss allocations, which are generally very small. Large participants bear nominal losses that are approximately four times larger than those of small participants, implying that the largest losses are borne by those participants most able to bear them. Loss allocations as a proportion of Tier 1 capital are very small—just 0.35 per cent, on average. But small participants absorb the largest loss allocations as a proportion of Tier 1 capital, especially on the worst days, meaning that small participants take on relatively more risk. In the worst case, losses can be as high as one-third of capital. Even here, however, the participant's capital remains higher than that required by its supervisor. Therefore, even the most significant loss would not cause any participant to fail.

7. We thank the Bank of Finland for providing the Bank of Finland Payment and Settlement Simulator for our use.
8. See McVanel (2005) for the exact formula.

To summarize, LVTS participants are in general easily able to withstand losses resulting from the default of another participant. Furthermore, the losses found in this study are probably larger than would be seen if a participant were actually to default. First, the largest possible shortfalls were created, based on the data, to maximize survivors' losses. Second, the default was assumed to be unanticipated. This prevents participants from reducing or eliminating BCLs to the defaulter to avoid sharing losses. Finally, it was assumed that survivors do not recover any of their losses.

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# Ownership Concentration and Competition in Banking Markets

*Alexandra Lai and Raphael Solomon**

Do restrictions on the ownership structure of banks limit competition? This question is relevant to more than 50 countries, including Canada, that either prohibit individuals and corporations from holding more than a given fraction of a bank's shares or require that large shareholders be reviewed by the government or by the central bank.[1]

While there are good prudential or governance rationales behind rules requiring dispersed shareholdings, these rules have their own drawbacks. For example, they may reduce access to cheaper capital and increase operating costs. This article focuses on the operational problems associated with shareholding restrictions. These problems arise in situations of potential conflict of interest between the different stakeholders of a firm. In this study, we model the conflict of interest that arises between bank shareholders and bank management, and ask whether restrictions on the ownership structure of banks can restrict competition. Since our work is not calibrated to the data of any particular country, and since we model only one potential cost to shareholding rules without modelling their benefits, we cannot directly evaluate any particular country's shareholding rule. We do, however, shed light on a potential cost of shareholding rules that might prove substantial for countries with less than perfectly competitive banking sectors.

There is a substantial literature on ownership concentration. While most empirical work in this area has examined non-bank firms, Caprio, Laeven, and Levine (2004) provide empirical evidence of a positive relationship between ownership concentration and value for a sample of 244 publicly traded banks across 44 countries. There is some evidence of a positive relationship between control by blockholders (the owners of large blocks of shares) and firm performance in the United States. Barclay and Holderness (1989) and subsequent studies confirm that large blocks of shares trade at a premium, evidence of net private benefits from large block ownership. There is also some evidence that block formation and block trades are associated with excess stock price increases, suggesting shared benefits from such control (Mikkelson and Regassa 1991; Barclay and Holderness 1991, 1992). Hence, private benefits need not reduce the wealth of minority shareholders. Indeed, Holderness and Sheehan (1998) present evidence from the United States that large blockholders are constrained from expropriating cash flows and from other actions inimical to the interests of minority shareholders. Barclay and Holderness (1991) further find that this increase in firm value is limited if the blockholder does not exercise control (which they define to be actions such as changing the composition of the board or replacing the management).

All of the above studies deal with blocks held by external investors and not with managerial (inside) shareholdings. Morck, Shleifer, and Vishny (1988) find that firm value initially increases with small amounts of managerial ownership, decreases with managerial ownership for an intermediate range of shareholdings, and then increases again for very large managerial shareholdings. McConnell and Servaes (1990), on the other hand, find that firm value increases with managerial ownership up to 40 to 50 per cent and decreases thereafter.

## Key Model Features

To formalize the operational problems associated with shareholding restrictions, we set up a game-theoretic model of two competing banks, in which bank managers choose the level of

1. In Canada, neither individuals nor corporations may hold more than 20 per cent of the voting stock of banks with assets greater than $5 billion.

* This article summarizes Lai and Solomon (2006).

loan activity (quantities) and appropriate a fraction of the bank's residual cash flow for themselves (for example, in the consumption of benefits or perks). But either the bank manager or the controlling blockholder can choose the level of the bank's risky borrowing and, thus, the bank's capital structure.[2] To obtain control, the holder of a block of shares must engage in costly monitoring. Monitoring does not guarantee control, but it gives the blockholder the possibility of control. The more shares the blockholder owns, the more likely it is to win control. If there is no blockholder, or if the blockholder fails to obtain control, then the manager chooses the bank's capital structure. The timing of the game is as follows. First, the two potential blockholders simultaneously decide whether to acquire a controlling share of the bank and whether to monitor management. Next, either the manager or the controlling blockholder chooses the capital structure of their bank. The proceeds of any debt sold are distributed to equity holders, rather than being used to finance operations. Finally, the managers of the two banks compete in the market for loans, repay debt holders, and appropriate residual cash flow.

## Results

There are three possible outcomes for the banking industry: (i) both banks are controlled by a blockholder, (ii) both banks are controlled by a manager, or (iii) one bank is controlled by a blockholder and the other by the manager. We find that controlling managers always issue less debt than controlling blockholders. As a result of their debt choices, banks controlled by managers extend fewer loans than those controlled by blockholders. Competition for loans is thus fiercest in an industry where both banks are controlled by blockholders and tamest in an industry where both banks are controlled by managers.

From a blockholder's perspective, issuing debt has two consequences. First, it "disciplines" a manager by reducing the amount of free cash flow from which the manager can appropriate. Second, it creates a strategic effect in the loans market vis-à-vis the other bank, as demonstrated by Brander and Lewis (1986). Specifically, holding fixed the amount of debt at the rival bank, a unilateral increase in one bank's debt induces that bank to extend more loans while inducing the other bank to extend fewer loans.[3]

Why would a manager whose bank has already increased the riskiness of its balance sheet by issuing debt become even more aggressive and expand the bank's loan portfolio? The key is that the bank has limited liability. In the presence of debt, extremely negative shocks give the bank a return of zero, while beneficial shocks give the bank a positive return, which actually increases as more loans are issued. Thus, the issuance of debt by one bank causes that bank's manager to compete more aggressively in the loans market relative to a market where neither bank issues debt. This raises the market share and profits of the indebted bank at the expense of the rival bank, since the issuance of debt makes the industry less profitable overall.

In a symmetric (Nash) equilibrium, where both banks issue debt, each bank's lending operations are less profitable than they would be were the two banks to function as a single (merged) entity. However, an increase in debt at both banks may increase the value of both banks. The commitment to repay debt implicitly transfers resources from the manager to the shareholders. Free cash flow has two uses: repayment of the debt and appropriation for the manager's private benefit. Larger debt repayments necessarily entail less appropriation, thus increasing the value of the bank. Moreover, the banking industry is more competitive than it would be if less debt were issued, and consumer welfare also increases as more debt is issued. Since managers issue less debt than blockholders, the presence of controlling blockholdings increases the value of banks, as well as competition in the loans market.

We find that a minimum size of shareholding is necessary to induce a blockholder to monitor. This is because the probability of winning control and, hence, the expected benefits of control, increase with the size of the block held, while the cost of monitoring is fixed. We also find that this minimum holding is larger for the blockholder facing a rival bank with its own blockholder

2. We do not consider other regulatory constraints, such as minimum capital requirements, that banks face when making portfolio decisions.

3. This is a simple result of downward-sloping reaction functions arising from the Cournot game.

than it is for the blockholder facing a rival bank with dispersed ownership.[4]

We distinguish three classes of bank shareholding rules that restrict ownership concentration to a designated level: (i) non-restrictive—the maximum shareholding is such that a blockholder would monitor management even if the rival bank also had a blockholder, (ii) moderately restrictive—the maximum shareholding is such that a blockholder would monitor management if the rival bank did not have a blockholder but would not monitor if the rival bank had a blockholder, and (iii) highly restrictive—the maximum shareholding is such that a blockholder would never monitor management, regardless of the ownership structure of the rival bank.

When shareholding rules are non-restrictive, blockholders that subsequently monitor management form at both banks. When shareholding rules are moderately restrictive, blockholders form at both banks, but neither monitors management; hence, industry outcomes are the same as if both banks were widely held. Finally, when shareholding rules are highly restrictive, investors are dissuaded from acquiring blockholdings, and both banks have dispersed ownership.

## Implications

Our analysis suggests that legal restrictions on the concentration of ownership can affect the value of bank shares, as well as competition in the loans market. Shareholding restrictions affect banking competition through the capital structure of the bank. Our model does not, however, consider regulatory capital requirements that may affect the decisions of either blockholders or managers regarding capital structure. Marginally relaxing the shareholding restriction will affect competition only in cases where the restriction has not prevented blockholding and monitoring from occurring. If ownership restrictions are severe enough to prevent blockholding or monitoring (even if blockholdings form), then a marginal increase in the maximum shareholding will, generally, not affect bank value or competition in the loans market. For a relaxation of restrictions on bank shareholding to be beneficial, the increase in maximum shareholding may need to be substantial.

Our model also abstracts from other conflicts of interest between equity holders and debt holders (risk shifting) and between blockholders and minority shareholders (self-dealing). While the problem of risk shifting is particularly relevant to highly leveraged institutions, such as banks, capital requirements and positive franchise values mitigate the problem. Moreover, risk shifting is associated with leverage and not with ownership concentration.

Restrictions on bank shareholding date back to the 1960s in some countries. There have since been two important developments. First, corporate governance in the general corporate sector and in the banking sector improved significantly in the 1980s and 1990s. This included changes such as an increased emphasis on outside directors, new rules for electing boards, and more internal oversight. Second, since the implementation of Basel I in 1992, the supervision of banks has increased, particularly that of large, multinational banks. Taken together, these changes vastly reduce the scope for self-dealing by the holders of large blocks of shares. The prevention of self-dealing as a justification for limited concentration, while fairly valid in the 1960s, is, therefore, less important today in most industrialized countries. We believe that it is relevant to consider the potential costs of this regulation, and we have modelled one such cost.

In almost all of our simulations, a rule restricting ownership concentration to no more than 20 per cent leads to two outcomes.[5] In the first, blockholders never exist; in the second, blockholders exist but do not monitor and never gain control. Since we do not calibrate the model (this would require good estimates of the demand for loans, agency costs, and monitoring costs), it is difficult to say whether restricting ownership to 20 per cent is excessive. But our results indicate that restrictions on bank shareholding can discourage monitoring, thus reducing competitiveness in the loans market.

4. This is the case for almost all of the parameterizations in our numerical examples.

5. The median and modal restriction among countries in the World Bank database (Barth, Caprio, and Levine 2001) is 20 per cent.

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# Using High-Frequency Data to Model Volatility Dynamics

*Gregory H. Bauer**

The covariance matrix of asset returns is important for a wide range of individuals.[1] Academics use estimates of the covariance matrix to test asset-pricing theories. Portfolio managers use the covariance matrix in designing tracking strategies where the return on their portfolio is designed to closely follow the return on a benchmark portfolio. Risk managers use the matrix to construct measures such as "value at risk." Corporate managers require accurate measures of covariances for hedging strategies.

Central bankers also have a profound interest in this concept. An assessment of financial market stability and contagion depends on measuring the time-varying variances and covariances that make up the matrix. For example, research has shown that there is an "excess" comovement of international equity markets during market downturns (e.g., Connolly and Wang 2003; Ribeiro and Veronesi 2002). Whether this is a rational response to current economic conditions or the result of irrational "contagion" remains an open question.

It is a key stylized fact in empirical finance that the variances and covariances of asset returns fluctuate over time.[2] Central bankers and others, therefore, require a model of a time-varying or "conditional" covariance matrix.[3] Several distinct methods for estimating a conditional covariance matrix have evolved in the literature, but since an asset's true volatility cannot be observed, researchers must treat the elements of the covariance matrix as non-observed or "latent" processes. This greatly complicates the modelling of the covariance matrix. If the actual matrix could be observed, the causes of time-varying market volatilities and correlations could be measured more accurately.

## Realized Volatility

The concept of "realized volatility" has recently been developed to provide more precise estimates of the volatility of a single asset or index. Assets such as stocks and bonds trade second by second throughout the day. These high-frequency data can be recorded and aggregated to yield a relatively precise estimate of the daily volatility of the asset. The resulting realized volatility is not latent, but observed, which results in more accurate forecasts.[4] While most papers have focused on estimates of the volatility of a single asset, it would be interesting to see whether a better estimator of the entire conditional covariance matrix could be created in this way.

In "Multivariate Realized Stock Market Volatility," Gregory Bauer (Bank of Canada) and Keith Vorkink (MIT) introduce a new model of the conditional covariance matrix. High-frequency data for a number of stocks are recorded during

1. A *covariance* measures how the price of one asset moves over time in relation to the price of another. A *covariance matrix* is a mathematical concept that measures how several asset prices move together over time. It is composed of the variances of the individual assets and the covariances between them.
2. For a comprehensive survey of the literature on volatility modelling and forecasting, see Andersen et al. (2005).
3. "Conditional" refers to market participants using current information to make optimal forecasts.
4. Andersen and Bollerslev (1998) introduced the idea of using high-frequency data to construct estimates of the daily realized volatility of a single asset. Andersen et al. (2003) formalized the definition, which was applied to equity markets in Andersen, Bollerslev, Diebold, and Ebens (2001) and exchange rates in Andersen, Bollerslev, Diebold, and Labys (2001). Constructing realized volatilities requires care because of the institutional trading features present in high-frequency data.

* This summary is based on Bauer and Vorkink (2006).

the day. Once aggregated, the data can be combined to construct estimates of the daily conditional covariance matrix. By using this approach, the variances and covariances of a number of assets can be treated as being observed. As a result, more accurate estimates of the factors driving the conditional covariance matrix can be found.

Bauer and Vorkink apply their new approach to the cross-section of size-sorted U.S. stock portfolios. While earlier papers have examined asset-price volatility in the cross-section of small and large firms,[5] they used existing models of latent volatility to capture the variation in the covariances. In contrast, Bauer and Vorkink use high-frequency data to construct daily measures of the realized covariance matrix of small and large firm return indexes over the 1988 to 2002 period. Their measures of volatility are more precise than those in previous work and allow for a more detailed examination of the causes of conditional covariances.

Once the matrix of realized variances and covariances has been constructed, a new factor model is used to capture its dynamics.[6] The factors are functions of past volatilities and other variables that can help forecast future volatility. A number of possible sets of variables from the academic finance literature are then examined to see how well they forecast the covariance matrix. The authors note that while researchers have examined different variables for their ability to forecast stock market returns, there is much less evidence that the variables forecast stock market volatility.[7]

## Results

Bauer and Vorkink evaluate their model of the daily conditional covariance matrix in two ways. First, they use a set of standard statistical tests and find that, in general, the factor model performs well in describing how the volatility matrix changes each day. Surprisingly, however, there does not appear to be a lot of difference between the alternative forecasting variables used to construct the factors: one set of variables appears to forecast the covariance matrix just as well as another set. This is because a single dominant factor drives the volatilities of all of the different-sized stocks: if the overall market is volatile, then the prices of all stocks on that day are volatile. As long as the forecasting variables are able to capture the dynamics of aggregate market volatility, they will also capture the dynamics of the size-sorted stocks.

The second and more informative method of evaluating the model is to see how well it constructs optimal stock market portfolios. In particular, the authors examine how the model can be used to construct a daily "tracking-error" portfolio.[8] The covariance matrix of the size-sorted stocks is modelled, and the indexes are used to track the portfolio of "value" stocks (i.e., those with high book-to-market ratios). Including variables that forecast stock returns (such as dividend yields) along with lagged volatility factors is found to produce portfolios with superior tracking performance. In other words, variables that forecast returns also forecast risks (i.e., volatility) in the market.

The authors hope to use this method to explore the time-varying relationship among other asset markets and to determine how well alternative variables are able to forecast large movements in market prices. The model can also be used to examine the covariances among international assets with a view to better understanding the transmission of shocks from one country to another, especially during times of market stress.

5. See Conrad, Gultekin, and Kaul (1991); Kroner and Ng (1998); Chan, Karceski, and Lakonishok (1999); and Moskowitz (2003).
6. In the factor model, the variances and covariances of a large number of assets are explained by a small number of variables.
7. For example, there is evidence that a stock market's dividend yield (the dividend-to-price ratio of the index) may help predict the average return on the index, but whether it predicts the volatility of returns (from holding the index) is unknown.
8. A tracking-error portfolio is one in which the portfolio manager uses a small set of assets to "track" or closely follow the performance of the target portfolio. The idea is to minimize the difference between the returns on the tracking and target portfolios. For example, fund managers may combine a number of stocks and derivative products to match the performance of a broad equity market index, such as the TSX composite index. The manager may thus trade in only a few assets to follow the returns on many stocks, which would greatly reduce transactions costs. Because the tracking-error portfolio test is based on the difference between the volatilities on the tracking and target portfolios, it is less influenced by moves in aggregate market volatility that affect both portfolios.

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