

Reports

Introduction

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

Both of the reports in this issue examine the robustness of the Canadian financial system. One focuses on Canadian fixed-income markets, and the other looks at the Canadian financial system more generally.

The Canadian corporate debt market has grown rapidly over the past decade and, by any standard, can be considered well developed. Nevertheless, a significant proportion of the debt issuance by Canadian non-financial corporations takes place in foreign capital markets, especially in the United States. This proportion has remained relatively constant over the past decade. The report, *Development of the Canadian Corporate Debt Market: Some Stylized Facts and Issues*, explores the characteristics of U.S.-dollar borrowing by Canadian corporations and the salient features of Canadian and U.S. capital markets.

In addition to financial markets, the financial system consists of institutions and clearing and settlement systems. Given the growing size and complexity of the financial system, sources of stress can emerge from several avenues. The second report, *Measuring Financial Stress*, discusses one particular new approach for examining the degree of stress under which the Canadian financial system is operating. This new measure complements the many tools used at the Bank of Canada to understand financial conditions.

Development of the Canadian Corporate Debt Market: Some Stylized Facts and Issues

Stacey Anderson, Ron Parker, and Andrew Spence

Table 1
Outstanding Non-Financial Corporate Debt:
December 2002

Per cent

Country	Share of global corporate debt placed		Share of total global corporate debt market	Proportion of debt placed in domestic market
	Internationally	Domestically		
United States	27.8	54.5	48.6	87.3
Australia	1.1	1.3	1.2	80.8
United Kingdom	14.1	5.9	7.7	59.4
Sweden	1.5	0.5	0.7	53.8
Canada	6.7 (4) ^a	1.6 (6)	2.7 (5)	45.5 (15)
France	16.0	2.9	5.8	38.7

a. Figures in parentheses indicate Canada's ranking in a sample of 20 industrialized countries.

Source: Bank for International Settlements *International Banking and Financial Market Developments, Quarterly Review*, June 2003, Tables 12C and 16B

Over the last five to ten years, the Canadian corporate debt market has grown rapidly. The outstanding stock of corporate debt now represents about 30 per cent of the total outstanding stock of debt, up from about 18 per cent in 1990 (Freedman and Engert 2003; Miville and Bernier 1999). This rise in the share of corporate debt is partly the result of fiscal restraint by governments and the resultant decline in the ratio of government debt to GDP over the last eight years.

One striking feature of the debt of Canadian corporations is the proportion issued in U.S. capital markets. In an international context, Canadian non-financial corporations are relatively large users of debt markets (Table 1). Canadian non-financial corporations rank fourth in the world in issuing debt in international markets, primarily in the United States, and sixth for issuance in the domestic market. The relative ease with which Canadian issuers can access the deep, liquid U.S. market is also illustrated in Table 1 by the comparatively low proportion of domestic debt issuance relative to total debt issuance. Indeed, of the major industrialized countries, only France shows a greater reliance on offshore markets by its non-financial corporations.

To better understand the reasons behind the relatively greater reliance of Canadian borrowers on U.S. markets, it is instructive to examine the characteristics of the Canadian marketplace.¹ For instance, the Canadian high-yield market is small relative to that in the United States. In Canada, higher-risk firms receive credit

1. For additional discussion on the use of the U.S. dollar in Canada, see Murray, Powell, and Lafleur (2003).

primarily through bank loans, private placements, and, in some cases, income trusts. These sources of funding are generally supplemented by tapping into the U.S. high-yield debt market, which is accessed by many non-U.S.-resident firms from all over the world and can be thought of as a global rather than a U.S. market.

This use of the U.S. capital markets may well be the result of purely market forces. To gain some insight on this issue, we explore some of the characteristics of U.S.-dollar borrowing by Canadian corporations, U.S.-dollar borrowing patterns by industry, concentration across asset managers and investment dealers, and the scale of large Canadian corporations relative to the size of Canadian banks.

We find that the absolute size of U.S.-dollar-denominated pools of assets and the industrial composition of issuance help to explain why Canadian firms issue U.S.-dollar-denominated debt. In our view, it is unlikely that concentration in the asset-management business or investment banking in Canada is a significant factor, since concentration is similar to that in other markets. The data also suggest that the capitalization of the Canadian banking sector is sufficient to meet the needs of the largest Canadian corporations for Canadian-dollar funding.

Issuance of U.S.-Dollar Debt by Canadian Corporations

A significant proportion of all debt issued by Canadian corporations is denominated in U.S. dollars and raised in U.S. debt markets. Indeed, since 1993, an average of 48 per cent of all corporate debt issuance has been denominated in U.S. dollars. While this share fluctuates from year to year, it has no clear trend (Table 2). The data suggest that Canadian firms use U.S. markets partly because the pool of available funds is simply larger. The majority of issuance in Canadian-dollar debt markets in the early 1990s was in the range of up to Can\$250 million (Chart 1). By contrast, U.S.-dollar-denominated financing saw significantly more issues of up to Can\$500 million in size (Chart 2). In the second half of the 1990s, the size grew in both countries, but the bigger issues tended to be distributed in the U.S. market.

The smaller size of issues placed in Canada is largely a function of the smaller number of asset managers, together with the smaller average size

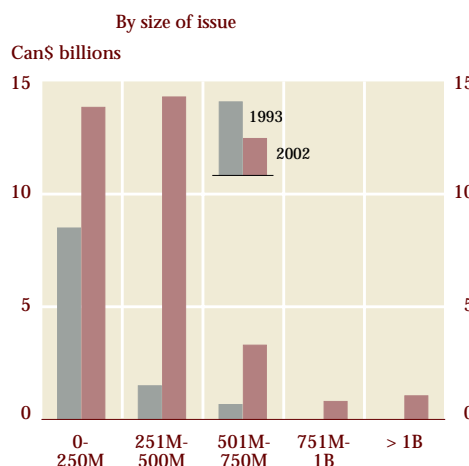
Table 2
Size and Distribution of Debt Denominated in U.S. Dollars and Canadian Dollars by Corporations Resident in Canada

Gross flows

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Average Size - Can\$ millions										
US\$	210	190	160	180	270	260	380	360	450	350
Can\$	90	80	60	98	120	140	130	150	140	140
Distribution - Percentage										
US\$	52	51	62	52	48	51	43	23	54	43
Can\$	48	49	38	48	52	49	57	77	46	57

Source: *Financial Post* New Issues Database

Chart 1 Canadian-Dollar Gross Issuance of Canadian Corporations



Source: *Financial Post* New Issues Database

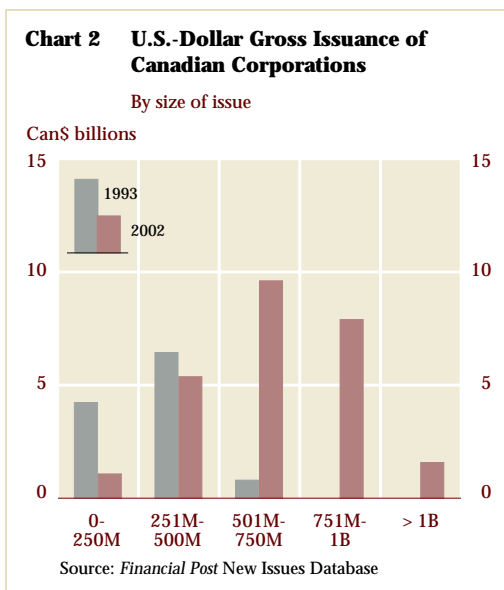


Table 3

Distribution of US\$ Fixed-Income Funding by Industrial Sector: Major Concentrations

Per cent of total US\$ issuance by Canadian firms

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Oil and gas exploration and production	7	10	7	9	7	5	-- ^a	7	11	15
Paper and forestry	8	17	15	8	2	6	9	18	4	4
Metals and minerals	3	6	5	6	--	--	--	--	--	9
Banks	15	14	7	22	24	22	41	33	11	27
Other financial services	3	--	4	7	8	2	6	12	21	12
Movies and entertainment	7	5	--	--	23	20	--	1	--	--
Telecom services	--	--	21	8	12	7	17	13	19	6
Railroads	6	5	--	--	--	5	--	--	5	--
Total	49	57	59	60	76	67	73	84	71	73

a. -- indicates that the industry was not among the top 8 industries by issuance for a given year.

Source: *Financial Post* New Issues Database; Gross flows

of funds under their management. These demand-side factors constrain the size of Canadian-dollar issues because Canadian asset managers must avoid excessive risk concentration in single issues. There are many more asset managers in the United States, with portfolios of much larger size relative to those in Canada. These U.S. asset managers require participation of between US\$50 million and US\$100 million, which would be a significant share of any Canadian-dollar issue. Because the absolute size of the U.S. portfolios is greater, new additions to these portfolios must be larger to have any measurable effect on their overall performance.

Large Canadian firms also benefit from issuing in the U.S. market. Significant cost savings can flow to firms that make single large issues. Distribution costs are also significantly lower if an issue can be distributed across a few asset managers in large amounts. The issue must be large enough, however, to avoid the distortion in price that could result from placing the issue with too few asset managers.

In summary, the differing sizes and requirements of asset managers in Canada and the United States, as well as cost considerations for large issuers, are consistent with differences in both the average issue size and distribution.

Issuance of U.S.-Dollar Debt by Industry

By far the largest, and most consistent, issuers of U.S.-dollar-denominated debt are financial institutions, all of which are assigned very high credit ratings (Table 3). They have accounted for about 22 per cent of the total U.S.-dollar issuance since 1993 and an impressive 41 per cent of issuance in 1999. This likely reflects their multinational status and transborder expansion through the 1990s. Many Canadian banks followed a North American continental expansion strategy, and a good deal of expansion in the trading aspects of their businesses through the 1990s was pursued in London and New York, rather than in Toronto. As well, most Canadian banks have significant U.S.-dollar-denominated loan books, and there are strong incentives for the banks to match these assets with U.S.-dollar liabilities.

Canadian resource companies tend to be fairly regular issuers of U.S.-dollar debt, and this reflects their revenues, given that resource

commodities are priced in U.S. dollars. Pulp and paper, forestry, and oil and gas extraction industries have a fairly steady demand for U.S.-dollar debt, although there are cycles around trends in response to swings in commodity prices. These companies may also shift their debt issuance activity between U.S. and Canadian dollars to arbitrage cyclical differences in interest rates between Canada and the United States to secure the lowest-cost financing.

There appears to be one exception to this pattern, and that is the telecommunications industry, which began issuing large amounts of U.S.-dollar debt in 1995. It appears that most of these companies, which were primarily lower-rated, could secure the necessary financing only in the U.S. high-yield market. This market was deep enough to avoid the single-name exposure limits that simply could not be absorbed in the much smaller Canadian institutional sector.

Finally, for the years 1997 and 1998, the movie and entertainment industry accounted for just over one-fifth of issuance. This resulted from Seagrams radically changing its business lines and embracing businesses in the entertainment industry. The one-off debt-financing activities of Seagrams accounted almost exclusively for the activity in this industry segment. Thus, these transactions have no longer-run implications for either the current structure of Canadian financial markets, or their future viability.

Concentration of Asset Management

The concentration of assets managed by Canadian institutional managers does not appear to differ greatly from that of other major countries. It is thus unlikely to contribute to any significant divergence in the development of capital markets in Canada relative to other countries.

As Table 4 shows, there is considerable concentration across Canadian asset managers, with ten firms controlling 50 per cent of all assets and the top two holding about 25 per cent. Nonetheless, concentration in Canada is similar to concentration in both the United States and Europe. Gini coefficients—the difference between the actual distribution and an equal distribution—do not vary greatly between countries. However, a somewhat lower coefficient for the United States suggests a marginally more equal distribution.

Table 4

Concentration among Asset Managers

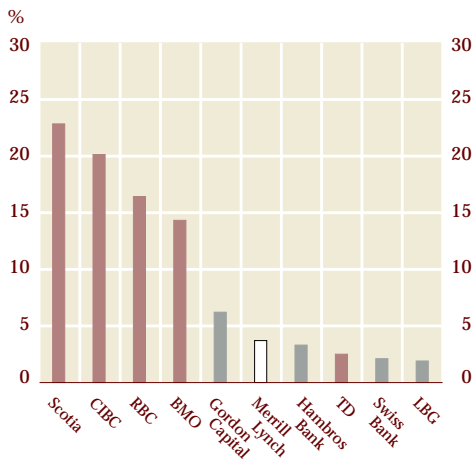
Per cent of assets	Canada ^a (2001)		United States (2001)		Europe (2000)	
	Number of asset managers	Funds under management (Can\$ billions)	Number of asset managers	Funds under management (US\$ billions)	Number of asset managers	Funds under management (€ billions)
10	1	68	2	1,639	1	1,602
25	2	119	6	4,139	4	4,277
50	10	245	16	8,227	11	7,793
Gini coefficient ^b	29.5		25.9		29.6	

a. Data for Canada are for pension funds only.

b. The Gini coefficient is calculated for the top 100 asset managers in each case. The closer the Gini coefficient is to 100, the more unequal the distribution.

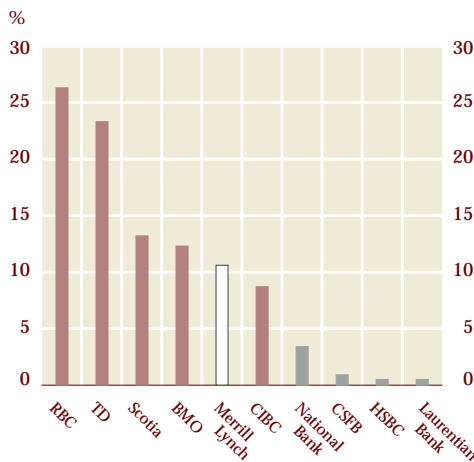
Source: United States and Europe: *Institutional Investor*, various issues; Canada: *Benefits Canada* April 2002

Chart 3 Market Shares of the Top 10 Dealers
(First lead; Canadian-dollar deals) - 1993



Source: Financial Post New Issues Database

Chart 4 Market Shares of the Top 10 Dealers
(First lead; Canadian-dollar deals) - 2002



Source: Financial Post New Issues Database

It is hard to argue that concentration of asset management has impeded the level of development of Canadian fixed-income markets, since concentration is similar across countries. However, the assets managed by the top manager in Canada are small, at Can\$68 billion, compared with those in the United States, at US\$854 billion, and Europe, at €1,602 billion. This may have, through limits on single-name exposures, a strong effect on the size of corporate issues that can successfully come to the Canadian-dollar market at any one time.

Concentration among Dealers

Canadian-resident securities dealers are overwhelmingly dominant in the provision of Canadian-dollar fixed-income services in Canada. Through the 1990s and into the early years of the current decade, Canadian dealers had an average market share of 90 per cent of lead deals, ranging from a low of 82 per cent in 1994 to a high of 97 per cent in 2001. Charts 3 and 4 show market shares for the beginning and end of the period under review. The top dealer tends to win about 25 per cent of all leads, and the same major dealer usually dominates the top spot. Foreign penetration has remained minimal, but Merrill Lynch has emerged as the dominant foreign-based dealer.²

The market share of domestic dealers in local currency deals in the United Kingdom and Australia is considerably smaller, with the United Kingdom at roughly 40 per cent and Australia at 54 per cent. However, domestic concentrations in the United States and Sweden are both relatively high in the range of 80 to 90 per cent.³

For countries with a limited presence of foreign dealers in their domestic fixed-income markets, fixed-income market share is likely a function of credit granted by the banks/dealers and the depth of product lines offered to local-currency-

2. Merrill Lynch first came to Canada in the early 1950s.
3. U.S. data include the fixed-income activities of Deutsche Bank and CSFB. Even though both are European-based banks, both acquired significant former U.S. investment banks that had well-established domestic businesses. Excluding these two institutions reduces the domestic market share to 60 to 70 per cent. U.K. data are based on an informal survey of U.K. authorities and investment dealers. They are subject to a wide margin of error.

based customers (Chart 5). In Canada, for example, very few non-Canadian financial-service providers have fully integrated businesses, and very few have large outstanding credit commitments from which fixed-income business can be levered. An examination of bank balance sheets from the countries mentioned above finds similar degrees of concentration in domestic bank assets. Canadian banks account for 94 per cent of all domestic bank assets, Swedish banks hold about 93 per cent, and domestic banks in the United States provide 90 per cent of all assets to their banking system.

In the countries where foreign participation in the provision of fixed-income services in the local currency is greater, the picture is less clear. In the United Kingdom, the distribution of bank assets is more balanced between domestic and foreign banks, where domestic U.K. banks account for 47 per cent of all bank assets booked, compared with 53 per cent booked at non-British banks. In contrast, Australian banks hold about 85 per cent of the banking system's assets. The apparent inconsistency between fixed-income and credit market shares in Australia may be partly due to the fact that Australia is an English-speaking country close to Asian financial centres, rather than a function of institutional structure. This makes the relationship with the distribution of bank assets more difficult to judge and reflects the difficulties in dividing what are essentially global capital markets according to sovereign legal entities.

The apparent correlation between the granting of credit by domestic banks/dealers and the concentration among domestic dealers suggests that the former may have an important influence on dealer presence in fixed-income markets.

Canada's Corporations: Not Too Big for Canadian Banks to Handle

One hypothesis examined is that corporate borrowers have shifted into foreign capital markets because of the size of the capitalization of Canadian banks relative to the corporations they serve (Chart 6). Specifically, are the balance sheets of the banks large enough to accommodate large, capital-intensive transactions? Furthermore, would they soon run into single-name exposure limits across financial

Chart 5 Fixed-Income and Credit Market Shares of Domestic Intermediaries

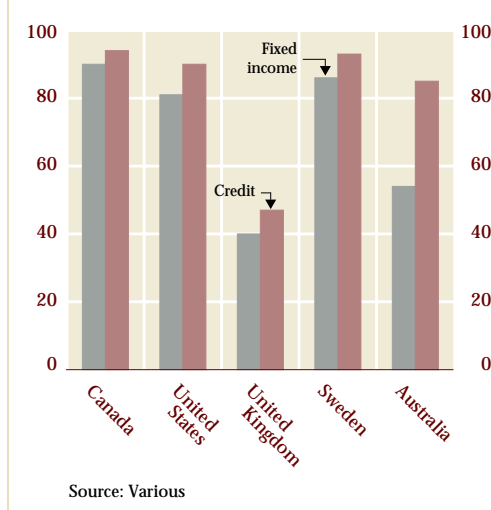
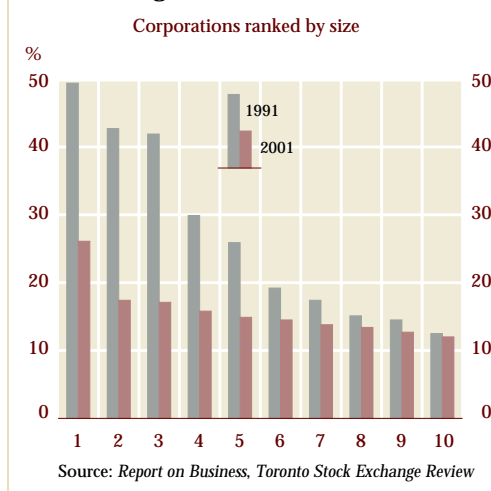


Chart 6 Market Cap of the Ten Largest Corporations Relative to the Big-Five Banks



products that would constrain the depth of development in Canadian financial markets?

The data suggest that this is not a problem. We examined the relationship between the market capitalization of the big-five Canadian banks relative to the market capitalization of the 50 largest firms listed on the TSX. The data suggest that since 1991, the capitalization of Canadian banks has improved relative to the largest corporations. For example, in 1991 the capitalization of the telecommunications company BCE alone was 50 per cent of the combined capitalization of the big-five banks. By 2001, BCE's capitalization amounted to approximately 20 per cent of the combined big-five capitalization, a significant decrease. Moreover, there is less concentration among the top five corporate borrowers. During 1991, the capitalization of the top five borrowers amounted to 190 per cent of the capitalization of the big-five banks, but by 2001 this had fallen to 90 per cent. In short, it would appear that the big-five banks are adequately capitalized to accommodate the Canadian-dollar funding needs of the largest Canadian corporations, and given the relatively stronger growth in the banks' capitalization, they are less likely to run into constraints on single-name exposure now than they would have at the start of the 1990s.

Conclusion

Canadian fixed-income markets are generally well developed and encompass a broad range of activities and products. In the future, corporate demand for the services provided by Canadian fixed-income markets is likely to remain robust so long as household income and consumption flows are denominated in Canadian dollars, and borrowing by governments remains at lower levels than in the 1980s and early 1990s.

The factors examined in this report suggest that the sheer size of the pools of funds available in the United States, the importance of the resource sector in Canada, and expansion into the United States by the Canadian financial sector could explain why a significant proportion of the debt issued by Canadian firms is denominated in U.S. dollars. Firms with and without offsetting U.S.-dollar cash flows are able to borrow in the U.S. market without exposure to currency risk. Our informal survey of Canadian investment dealers indicates that, aside from

firms with net cash flow exposures to the U.S. dollar, a very high proportion of Canadian issuers hedge their U.S.-dollar-denominated liabilities in the swap market. This underscores the fact that financial intermediation between borrowers and savers can take place through various channels and that ready access to the large, liquid U.S. debt market serves as a valuable supplement to the domestic market.

References

- Freedman, C. and W. Engert. 2003. "Financial Developments in Canada: Past Trends and Future Challenges." *Bank of Canada Review* (Summer): 3–16.
- Miville, M. and A. Bernier. 1999. "The Corporate Bond Market in Canada." *Bank of Canada Review* (Autumn): 3–8.
- Murray, J., J. Powell, and L.-R. Lafleur. 2003. "Dollarization in Canada: An Update." *Bank of Canada Review* (Summer): 29–34.

Measuring Financial Stress

*Mark Illing and Ying Liu**

Numerous events over the past decade have been described as “financial crises”—the Mexican crisis of 1994–95, the 1997–98 Southeast Asian crisis, and the Russian debt default and Long-Term Capital Management crisis of 1998 are a few of the better known. How did these events affect the Canadian financial system?

One way of considering this question is to apply the concept of “stress” to the financial system, drawing on analogies from the physical sciences. Stress is often caused by an outside (exogenous) force acting on a system. It leads to changes in the functioning and integrity of the system that, if great enough, can damage the system itself. Such a change can be thought of as a “crisis.”

The size and diverse makeup of the financial system, which consists of financial institutions, financial markets, and clearing and settlement systems, suggests there are many potential sources of stress. According to this perspective, stress is always present to a degree somewhere in the financial system and may pass largely unnoticed until it reaches high levels or becomes widespread. Thus, a measure of financial stress should be a continuum, where extreme values represent crises.

Stress rises when one or more of the following increases:

- expected financial loss
- risk (a higher probability of loss)
- uncertainty (reduced confidence about the probability of loss)

* This report draws on a recent Bank of Canada working paper (Illing and Liu 2003).

Stress results from the impact of a shock on the financial system. The amount of stress present in a system therefore depends on the magnitude of these shocks, the initial conditions present in the system, and the structure of the financial system. For example, a negative shock is more likely to cause a large increase in stress when financial conditions are weak, when cash flows are low, balance sheets are highly leveraged, or lenders are more risk-averse. Shocks may also be propagated through weaknesses in the structure of the financial system, such as market-coordination failures, overloaded computer systems, or highly asymmetric flows of information. The size of the shock and its interaction with weaknesses in the financial system determine the level of stress (Chart 1).

Stress can manifest itself in various ways across the financial system, and disruptions in one market can spill over to others (this is known as contagion). For example, adverse movements in market prices and interest rates can impair the value of financial assets, as is the case during a stock market crash. This can be followed by unusually large deposit withdrawals or interruptions in payment flows that strain banking system liquidity.

How Is Stress Measured?

Although the literature on predicting financial crises in emerging markets is abundant, little attention has been devoted to defining crises or measuring their severity. The standard approach in the empirical literature is to treat stress as a binary variable with either crisis or non-crisis values. Kaminsky and Reinhart (1996, 1999) and Frankel and Rose (1996) are commonly followed examples. Crises are usually defined based on an event study or on the extreme values of one or two variables, such as a sharp

exchange rate depreciation that signifies a foreign exchange crisis.

This approach is popular because it allows the application of binary-choice models to estimate the probability of crises in emerging markets. However, the technique does not distinguish between the severity of different stressful events, and it has not been successfully applied to industrialized economies, where full-blown crises are rare.

As a result, only a few studies have attempted to quantify stress as a continuous variable in the context of well-developed financial systems. Bordo, Dueker, and Wheelock (2000) develop an index for the United States based on bank losses, business failures, real interest rates, and bond-yield spreads.

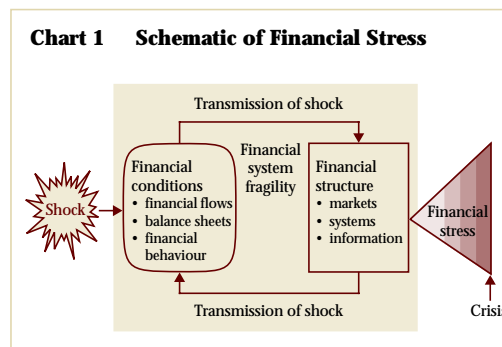
Several organizations have also created stress indexes. BCA Research publishes a monthly stress index for the United States based on variables similar to those in the Bordo et al. index, as well as on several stock market indicators (McClellan 2001). J.P. Morgan Chase & Co. publishes a global Liquidity, Credit, and Volatility Index (LCVI) based on daily bond, foreign exchange, and stock market indicators (Kantor and Caglayan 2002). The financial stress index (FSI) developed by Illing and Liu (2003), which is the basis of this summary report, is the first such measure for Canada.

A Survey of Financial Stress

To improve the accuracy with which our index reflects stress in the Canadian financial system, it was benchmarked against the results from a Bank of Canada survey. Senior staff members were asked to subjectively rank the severity of 41 different events over the past 25 years in terms of how much stress the Canadian financial system was perceived to be under at the time.

The list of events surveyed was drawn from a review of Bank of Canada *Annual Reports* since 1977 and *Monetary Policy Reports* since 1995. Events were included if they were explicitly identified as having had a significant impact on Canadian markets. Ten of these events were ranked as “highly stressful” according to the survey (in chronological order):

- the August 1981 spike in interest rates, when mortgage rates reached almost 22 per cent



- the less-developed countries (LDC) debt crises of the early 1980s, to which Canadian banks were heavily exposed
- the regional Canadian bank failures of 1985
- the October 1987 stock market crash
- the real estate price collapse, loan losses, and debt defaults of the early 1990s
- the Mexican peso crisis (1995)
- the Southeast Asian crisis (1997–98)
- the Russian/LTCM crisis (1998)
- the high-tech stock market collapse (2000)
- the events of 11 September 2001

Variable Selection

The next step involved determining which variables best reflected the qualitative rankings from the survey and weighting them appropriately.

Over 150 different measures of expected loss, risk, and uncertainty were considered. These were drawn from the financial institutions sector and from the foreign exchange, fixed-income, and equity markets. The rankings from the survey helped to determine which variables were best suited for the index. Several alternative weighting schemes were also tested.

The final results are quite robust to the choice of variables and weighting schemes. The specification of the financial stress index that most closely matches the survey rankings includes the following measures of expected loss, risk, and uncertainty.

Variables that primarily reflect expected loss:

- the spread between the yields on bonds issued by Canadian financial institutions and on government bonds of comparable duration
- similarly, the spread between the yields on Canadian non-financial corporate bonds and on government bonds
- because the capacity to repay debt can be affected by short-term fluctuations in interest rates, the inverted term spread is also included in the index (i.e., the 90-day treasury bill rate minus the yield on 10-year government bonds)

Variables that primarily reflect risk:

- the beta (β) variable derived from the total-return index for Canadian financial institutions (β is a measure of how risky a stock, or group of stocks, is relative to the overall market)
- volatility of the Canadian dollar¹
- Canadian stock market volatility²

Variables that primarily reflect uncertainty:

- the difference between Canadian and U.S. government short-term borrowing rates (the difference is adjusted for exchange rate risk using the covered-interest-parity condition)
- the average bid/ask spread on Canadian treasury bills³
- the spread between the rates on 90-day Canadian commercial paper and treasury bills

Weighting Methodology

The daily value of each variable is first weighted by its sample cumulative distribution function. For example, if the value of a variable on a given day exceeds 75 per cent of all previously observed values, then it is given a ranking of 75. Next, each variable is weighted by the relative size of the market to which it pertains. The larger the market's share of total credit in the economy is, the higher the weight.

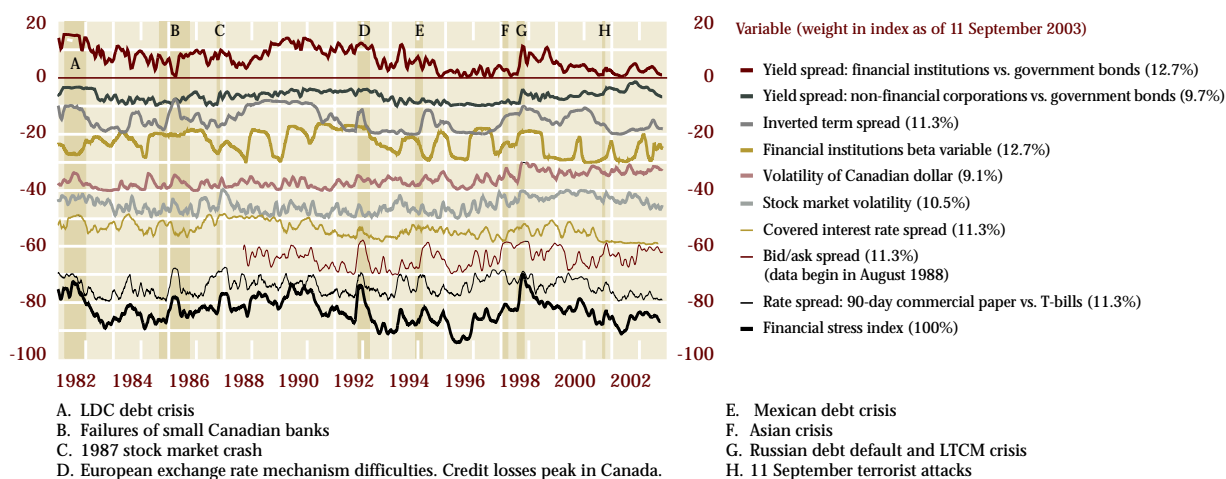
More formally, the index described above can be expressed as

$$FSI_t = \sum_j \left[w_{jt} \cdot \int_{-\infty}^{x_{jt}} f(x_{jt}) dx_{jt} \right] \cdot 100,$$

where x_{jt} is the value of the j th variable (from the nine variables listed above) on day t , and w_{jt} is the credit weight. The integrated term is the estimated cumulative distribution function for x_j based on the historical sample.

1. We use a trade-weighted average of the dollar versus the currencies of Canada's six largest trading partners and apply a general autoregressive conditional heteroscedastic (GARCH) model to measure the volatility.
2. We use the S&P TSX index and apply a GARCH model to measure the volatility.
3. The "bid" and "ask" rates are those at which securities dealers, acting as market middlemen, will sell and buy treasury bills.

Chart 2 Financial Stress Index: Component Breakdown



Note: Shading denotes periods of financial-market stress according to our survey. Variables are graphed proportionately to their weight.

The individual historical contribution of each component to past movements in the FSI is shown in Chart 2.

Alternative Measures of Stress

Alternative measures of stress were constructed using Canadian data and the various methods employed in other empirical studies. These included the straightforward binary measures of stress commonly used in studies of financial stability in emerging markets, as well as the more comprehensive measures of stress for industrialized countries discussed earlier. The last measures were far more successful at matching the survey rankings, while the former frequently identified tranquil periods as being crises. Overall, however, the FSI provided the closest match.

Charts 3 and 4 illustrate four different measures of financial stress for Canada. Although the BCA Research (BCA) and Bordo, Dueker, and Wheelock (BDW) indexes were originally developed for the United States, we apply their respective methodologies to Canadian data. On the other hand, the J.P. Morgan LCVI is based on global data.⁴ Interestingly, movements in the FSI,

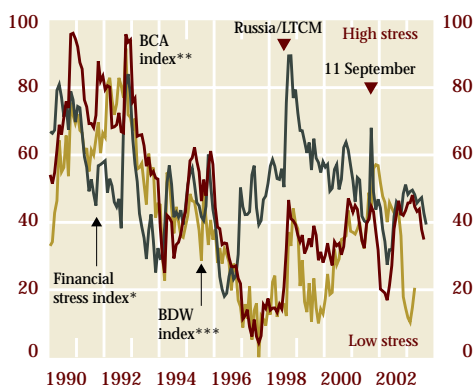
which is based entirely on Canadian data, and the LCVI are quite similar (the correlation coefficient between the two indexes is 0.63).

The Evolution of Stress

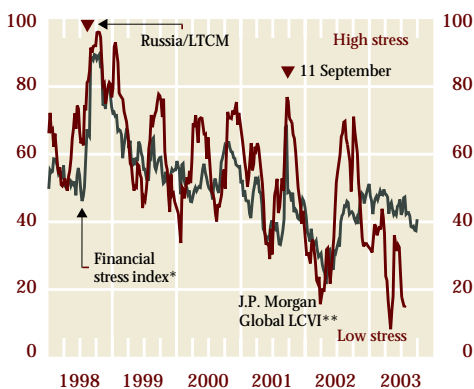
The FSI, BCA, and BDW indexes all reached their highest values during the recession of the early 1990s. This coincided with a collapse of real estate prices in Canada, particularly for commercial properties. Business and personal bankruptcies also rose sharply, as did mortgage and credit card arrears, commercial and industrial loan losses, and bond defaults. The end of this period also witnessed heightened foreign exchange and interest rate volatility resulting from the difficulties of the European exchange rate mechanism in late 1992.

The level of stress generally trended downwards over the 1994–97 period. It rose suddenly in August of 1998, following Russia’s debt default. The subsequent collapse of the world’s largest hedge fund, Long-Term Capital Management (LTCM), marked a period of extreme movements in market prices and rates. The BCA and BDW indexes rose sharply during this period, although they were well below the levels of stress indicated by the FSI and the LCVI.

4. Data for the LCVI begin in October 1997.

Chart 3 Monthly Measures of Financial Stress

* Source: Illing and Liu (2003)
 ** Using McClellan (2001) methodology applied to Canadian data
 *** Using Bordo, Dueker, and Wheelock (2000) methodology applied to Canadian data

Chart 4 Daily Measures of Financial Stress

* Source: Illing and Liu (2003)
 ** Source: J.P. Morgan Chase & Co.

Financial stress also rose sharply following the terrorist attacks of 11 September 2001. Many stock markets were temporarily closed, and bond market trading was widely curtailed. However, the financial system was more robust than it had been during previous shocks, and the effects dissipated quickly. In particular, no serious problems materialized at major banks, securities dealers, or insurance and reinsurance firms.

Recently, financial stress appears to be in the moderate-to-low range. The resiliency of the Canadian financial system to numerous shocks over the past two years has been remarkable. Low and stable inflation has enabled interest rates to remain low, thereby limiting financial pressures on debtors. The balance sheets of financial institutions and non-financial firms are also in a much stronger position than they were a decade ago.

Interpretation and Summary

The financial stress index complements the many other tools used at the Bank of Canada to assess whether financial conditions are improving or deteriorating. The specific level of the index has no implications for policy, and in no sense should the index be seen as a target.

The FSI is an ordinal measure of stress in the financial system, meaning that it is a ranking of the current situation relative to history. A change in the level of the index may not correspond to the same change in actual stress, however.

The weighting of the components by their shares in credit involves a certain arbitrariness. Thus, one cannot claim that this index has the optimal weights for measuring stress. It should be noted, however, that the weights are approximately equal across the components, and thus it is not just one or two components that are driving the behaviour of the index.

The FSI should prove useful for future research on financial stability. In particular, one might find certain threshold levels of the index at which financial pressures spill over into the real economy.

The FSI is intended to capture the contemporaneous level of stress in the system and is not designed to have strong predictive power for future stress. The FSI could therefore be used as a

dependent variable in econometric models to identify and test leading indicators of stress. These models could then form the basis of early-warning indicators of potential instability in the financial system or in the broader economy.

References

- Bordo, M., M. Dueker, and D. Wheelock. 2000. "Aggregate Price Shocks and Financial Instability: An Historical Analysis." NBER Working Paper No. 7652.
- Frankel, J. and A. Rose. 1996. "Currency Crashes in Emerging Markets: An Empirical Treatment." *Journal of International Economics* 41: 351–66.
- Illing, M. and Y. Liu. 2003. "An Index of Financial Stress." Bank of Canada Working Paper No. 2003-14.
- Kaminsky, G. and C. Reinhart. 1996. "The Twin Crises: The Causes of Banking and Balance-of-Payments Problems." Board of Governors of the Federal Reserve System, International Finance Discussion Paper No. 544.
- . 1999. "The Twin Crises: The Causes of Banking and Balance-of-Payments Problems." *American Economic Review* 89: 473–500.
- Kantor, L. and M. Caglayan. 2002. "Using Equities to Trade FX: Introducing the LCVI." J.P. Morgan Global Foreign Exchange Research, Investment Strategies: No. 7.
- McClellan, M. 2001. Managing editor of the *U.S. Fixed Income Monthly* published by BCA Research. E-mail correspondence.