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Articles

Cover

Chinese Coin Charms

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The belief that fate or some supernatural power can affect one's life, often for the worse, is prevalent around the world. People use charms to ward off evil or to encourage good fortune. The charms may be written, spoken, or physical in nature. Saying "gesundheit" to one who sneezes, avoiding black cats, or carrying a lucky rabbit's foot or four-leaf clover are examples of superstitious beliefs in Western culture. In China, coin charms used as talismans to ward off evil or to encourage good fortune have a long history.

For over 1,000 years before the establishment of the Chinese Republic in 1911, the Chinese conducted transactions using round, base-metal cast coins called "cash." These small coins featured a square or round hole in the centre and characters on one or both sides identifying the period of issue. For almost as long, private citizens and, to some extent, government bureaus, produced coin-like charms that were similar in form and material to circulating coinage. Ranging from one inch to about four inches in diameter, these pieces served as gifts or as personal talismans worn close to the body. Coin charms are rarely linked to a particular period because popular types were recast year after year well into the twentieth century.

Designs might be entirely textual and included expressions such as "Happiness and long life," "May all calamities be eradicated forever," and "A whole family, pure and happy." Animal and human motifs also figured prominently. The dragon, representing the emperor, was the ultimate symbol of good, while the phoenix and dragon symbolized matrimonial bliss. Some charms showing humans embracing are believed to have been used to encourage fruitful unions.

A particularly decorative charm incorporates the 12 animals of the Chinese calendar with the Chinese characters representing them on one side and the eight trigrams from the I Ching (*The Book of Changes*) on the other. The trigrams are regarded as magical symbols said to reflect the forces of nature and were attributed to the legendary emperor Fu Hui.

The charms on the cover are part of the National Currency Collection of the Bank of Canada.

Photography by Gord Carter.

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The Canadian Debt-Strategy Model

David Jamieson Bolder, Financial Markets Department

- *The government's objective in the management of its domestic debt portfolio is to raise stable, low-cost funding for its operational needs. The Bank of Canada provides analysis and advice to the government regarding the management of this portfolio.*
- *To assist in this challenging task, a mathematical model was constructed by Bank staff for the consideration and comparison of alternative choices for financing this debt portfolio.*
- *A debt strategy depends on several factors, many of them unknown to, or not under the control of, the debt manager. Examples include the future behaviour of interest rates, the macroeconomy, and the government's fiscal policy.*
- *This article describes the basic features of the model and provides a detailed example of its key inputs and outputs.*

In its role as fiscal agent to the government, the Bank of Canada provides analysis and advice on decisions about the government's domestic debt portfolio. Debt-management decisions depend on assumptions about future interest rates, macroeconomic outcomes, and fiscal policy, yet when a debt-strategy decision is taken, none of these factors can be known with certainty. Moreover, the government has various financing options (i.e., treasury bills, nominal bonds, and inflation-linked bonds) to meet its objectives of minimizing debt-service charges while simultaneously ensuring a prudent risk profile and well-functioning government securities markets. Bank of Canada staff have therefore developed a mathematical model to assist in the decision-making process. This article describes the key aspects of the debt manager's challenge and the principal assumptions incorporated in the debt-strategy model, illustrated with specific results.

The Debt Manager's Challenge

The debt managers who are responsible for the government's financing strategy have the complex task of choosing a strategy that minimizes the cost of the debt portfolio within certain risk limits.[1] In any given year, a government must borrow to finance any excess of government expenditures over revenues as well as any maturing debt issued in previous periods. This borrowing requirement thus depends on past decisions regarding debt issuance and on the government's current surplus or deficit position. The government's position, in turn, depends on the general performance of the macroeconomy and on fiscal policy. The debt manager's challenge is to select a strategy for financing this borrowing requirement that meets the government's policy objectives.

1. In the Canadian context, this means that they determine the relative mix of nominal versus inflation-linked debt and the maturity composition of the debt stock.

This is not unlike the challenge faced by households, which must determine the proportion of mortgage, credit-card, and vendor-based debt to use in financing their borrowing needs stemming from any consumption or investment that exceeds income. The relative proportion of each type of debt should be selected to ensure the lowest possible financing costs, yet cost minimization is not the sole objective of the household. For example, the household may decide to lock in its mortgage for a lengthy (10-year) time horizon at an interest rate above that immediately offered by a floating-rate mortgage to ensure greater certainty in its financing costs. Elimination of uncertainty is essentially reducing risk. Thus, we can see that borrowing objectives, even for a household, relate to both cost and risk. Indeed, a tenet of financial economics is that there is invariably a cost associated with reducing risk.[2]

The debt manager's challenge is to select a strategy for financing this borrowing requirement that meets the government's policy objectives.

Practically speaking, the situation is more complicated for a government than it is for a household. The incremental complexities include:

- The amount of borrowing required by a government is enormous. This implies that substantial changes in the amount borrowed in different financing options can affect market conditions and thus debt-service charges.
- The financing options available to the government are broader and more complex than those faced by a household, implying exposure to a range of interest rates.
- The interaction between government revenues and expenditures—the government's fiscal policy—is also more involved. Unlike a household, whose income typically stems from salary, government income is a complicated function of various taxation policies and macroeconomic conditions, while its expenditure programs also depend importantly on macroeconomic conditions.
- Another difference is that government borrowing is a repeated activity. It is consequently advantageous for the government to nurture deep and liquid markets for its debt in order to lower its costs over time rather than exploiting temporary market movements to minimize short-term costs.

Describing the Model

Models, which are essentially mathematical representations of real-world phenomena, are frequently constructed in both the physical and social sciences. They help to understand and solve practical challenges by permitting the consideration and comparison of alternative choices. For the debt manager, this is the comparison of the cost and risk characteristics of alternative financing strategies. Although the comparisons provided by the model are quite valuable, they are not a replacement for judgment in decision making. An experienced debt manager has accumulated general situational knowledge, intuition, and judgment regarding alternative financing strategies and combines these qualitative factors with the model's quantitative output to select a debt-management strategy.

Although the comparisons provided by the model are quite valuable, they are not a replacement for judgment in decision making.

The construction of any model requires an explicit description of the principal elements of the challenge. Often there are multiple ways to describe a given element, requiring the use of assumptions. It is important to understand that all models require assumptions. Moreover, in any model, the tension between complication and simplification must be addressed. The debt-strategy model attempts to

2. In finance, the typical trade-off is between risk and return. These concepts apply equally to risk and cost. An increase in cost, for example, is equivalent to a lower return.

balance these challenges in describing the following four aspects of the debt-manager's challenge:

(i) the financing strategy

(ii) uncertainty about the future

(iii) debt and fiscal mechanics, and

(iv) the set of policy objectives.

The remainder of this section addresses each of these aspects in turn to provide an overview of the general approach.

The financing strategy

The central component of the debt-strategy model is the financing strategy. Mathematically, a financing strategy is defined as a set of weights, summing to one, that describe the proportion of new issuance in each of the government's financing options, which currently include 3-, 6-, and 12-month treasury bills; 2-, 5-, 10-, and 30-year nominal coupon bonds; and 30-year inflation-linked bonds.[3] The model therefore includes eight separate weights or financing options, and the quantitative descriptions of the allocations to each permit an understanding of how different decisions affect the risk and cost characteristics of the portfolio. The financing strategy is also assumed to be constant through time, i.e., the allocations do not vary from year to year in search of short-term cost reductions. This foundation of the model permits a mathematically precise and succinct definition of a government financing strategy.[4] It also reflects the reality that the Canadian government does not typically alter its financing strategy dramatically from one year to the next.

Introducing uncertainty

If the debt manager knew the future path of the Canadian economy and interest rates with complete certainty, it would be relatively straightforward to determine the most advantageous financing strategy for the government. An absence of uncertainty implies an absence of risk; without risk, one would merely select the least-expensive financing strategy. Since this is not the case, the debt manager needs an approach that incorporates future macroeconomic and interest rate uncertainty in an organized manner. The debt-strategy model therefore assumes that the random evolution of the Canadian macroeconomy and interest rates can be summarized by a reduced-form statistical model whose parameters are estimated from historical data.[5]

The statistical model is not a single model, but rather a collection of approaches, since reliance on a single description of future uncertainty exposes the analysis to a misspecification of this statistical component.[6] Therefore, a wide range of alternative statistical models that each summarize the uncertainty policy-makers face in a slightly different manner have been implemented and evaluated. In each case, the macroeconomy is described by the output gap, inflation, and a monetary policy interest rate. Interest rates are assumed to depend on these macroeconomic quantities and a collection of term-structure-related variables. Differences in the models stem from alternative descriptions of the interaction between the key macroeconomic variables and interest rates, as well as the basic structure of the interest rate aspect of the statistical model.

Chart 1 summarizes the average evolution of inflation, the output gap, the monetary policy rate, and interest rates associated with 10,000 simulations from one of the statistical models estimated with monthly data from January 1994 to August 2007.[7] The solid line in each quadrant denotes the average outcome, while the dashed lines build a 95 per cent confidence interval around this average value. In short, our statistical model describes how key aspects of the debt-manager's challenge move randomly, and thus uncertainly, forward.

Debt and fiscal mechanics

The third component of the debt-management model uses these statistical inputs to illustrate the effect of a given financing strategy on key indicators. This requires a description of the mechanics of government debt and fiscal management. A large part of the debt-strategy model consists of mathematical expressions

3. See Boisvert and Harvey (1998) for more information on Canadian treasury bills; Côté et al. (1996) for more information on Canadian inflation-linked bonds; and Branion (1995) for a more detailed discussion of Canadian nominal coupon bonds.

4. More detail on this aspect of the model is found in Bolder (2003).

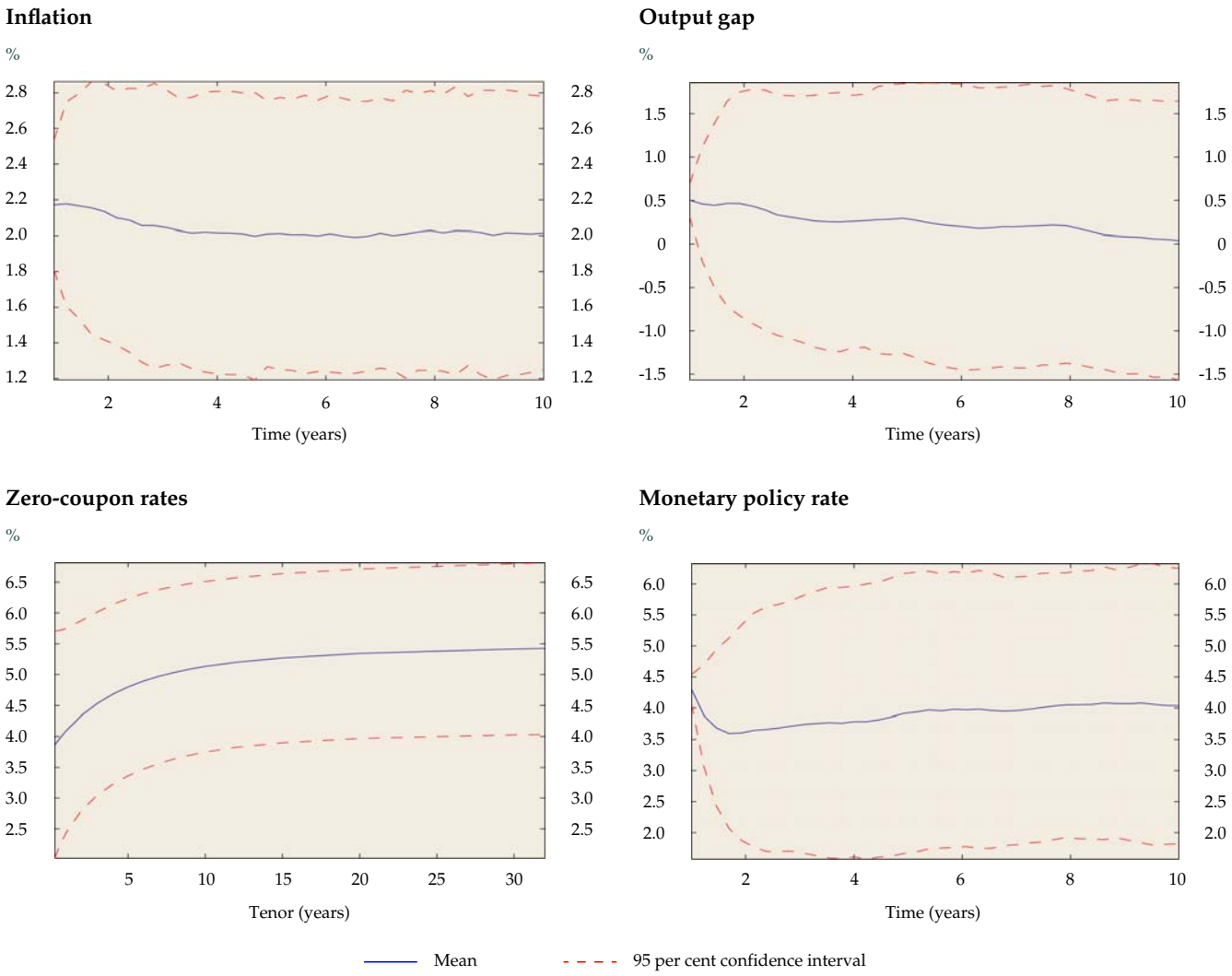
5. A sequence of Bank of Canada working papers describe the structure of the statistical model in substantial detail. See, for example, Bolder (2001, 2002, 2006) and Bolder and Liu (2007).

6. More formally, the ability to use alternative approaches helps to guard against what is termed "model risk" in our policy recommendations. Recent work–see Bolder and Romanyuk (2008)–also considers alternative statistical techniques for combining these various models into a single approach.

7. None of the charts in this article represent the actual data used in debt-strategy analysis, but illustrate a stylized analysis to describe the government's basic approach. The zero-coupon rates in the bottom left-hand quadrant of Chart 1 represent average borrowing rates for different terms to maturity (i.e., tenors) across the simulation horizon. This relationship is often referred to as the "term structure of interest rates."

Chart 1

The Debt-Strategy Model: Critical Inputs



that describe how the debt stock matures, how the government's annual borrowing requirement is computed, how the maturing debt and new borrowing requirement are financed, how debt charges are computed, and how these outcomes affect the size and composition of the debt stock. For a given financing strategy and a single realization of future macroeconomic and interest rate outcomes, each of these quantities can be computed.

Since this is the heart of the model, it merits a bit more description. We need three basic inputs to run the model. First, we require the existing federal debt stock: the amount of treasury bills, nominal bonds, and inflation-linked bonds.[8] Second, we need a sequence of future macroeconomic and interest rate outcomes from the statistical model. Finally, we need a financing strategy. From the debt stock, we determine a sequence of known maturities into the future.

8. Retail debt, non-market debt, and foreign-denominated debt are also included in the model, but only in a deterministic manner. The incremental complexity of modelling these relatively small parts of the government's debt stock is not offset by the incremental benefit of including them. Note that a separate modelling framework is used for decisions on the government's foreign exchange reserves, which is the source of the Canadian government's foreign-denominated debt stock.

In the first period, we compute the government's funding requirement (i.e., surplus or deficit), which will depend on the state of the macroeconomy in that period. Adding in the maturing debt from previous periods provides us with the amount of debt that must be issued in the first period. The financing strategy determines how this amount will be issued and the implications for the debt stock. Once the amount and composition of issuance is determined, we compute the debt-service charges for the first period, which will depend on current and past interest rates. This sequence of steps is repeated for the second period, although it is slightly more complicated, since the outcome of the second period will depend on that of the first period. The sequence is repeated iteratively for each period across the time horizon. Chart 2 provides a schematic overview of the algorithm.

These repeated calculations assess the performance of a given financing strategy under an enormous number of possible macroeconomic and interest rate outcomes.

Thus far, we have only described the computation of debt quantities for a single realization of the statistical model. This provides little or no insight into the uncertainty faced by the debt manager. The solution is to repeat the previous analysis, for the same fixed financing strategy, many thousands of times to construct a statistical distribution of debt quantities associated with a given financing strategy. Conceptually, these repeated calculations (known as stochastic, or Monte Carlo simulations) assess the performance of a given financing strategy under an enormous number of possible future macroeconomic and interest rate outcomes, which are consistent within specific models. Comparisons among different financing strategies are essentially comparisons between different aspects of these distributions. To illustrate, we provide a simple example of the debt-strategy stochastic-simulation model. We took a recent actual debt portfolio and applied a financing strategy composed of equal amounts in each of the available financing instruments.[9] Chart 3 provides an overview—across the 10,000 simulations summarized in Chart 1—of the debt-service charges, the government's surplus or deficit position, the size of the debt stock, and government revenues less expenditures over the course of a 10-year

9. This is the so-called 1/N approach.

Chart 2

The Debt-Strategy Model: Stochastic-Simulation Algorithm

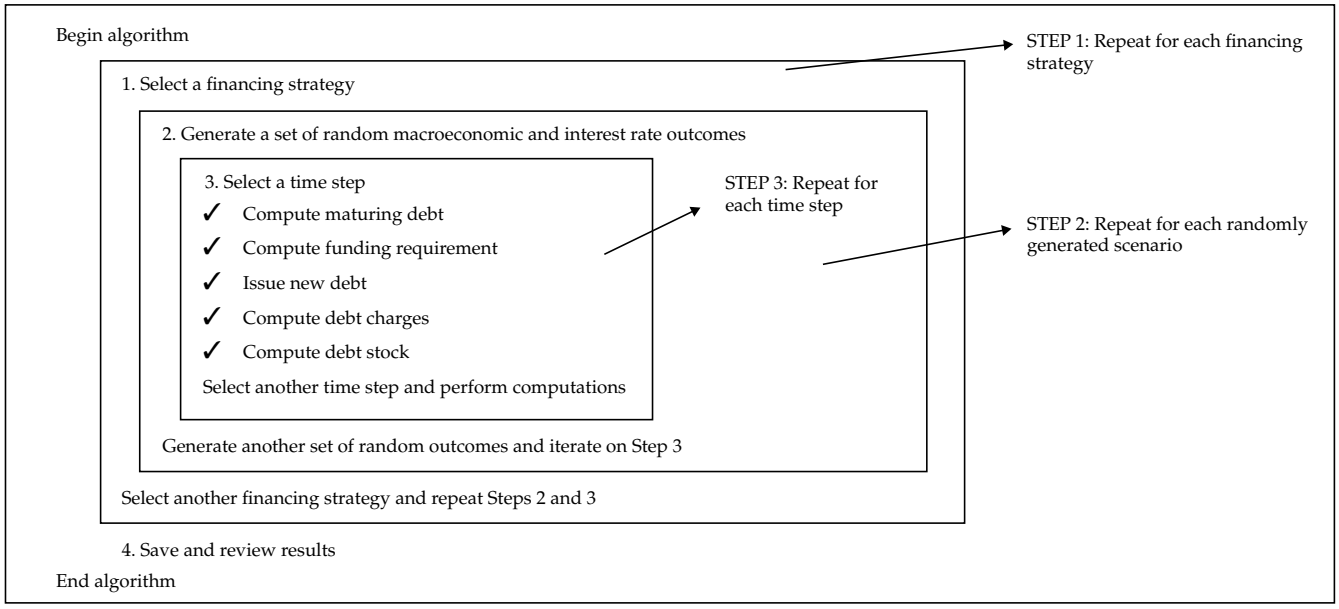
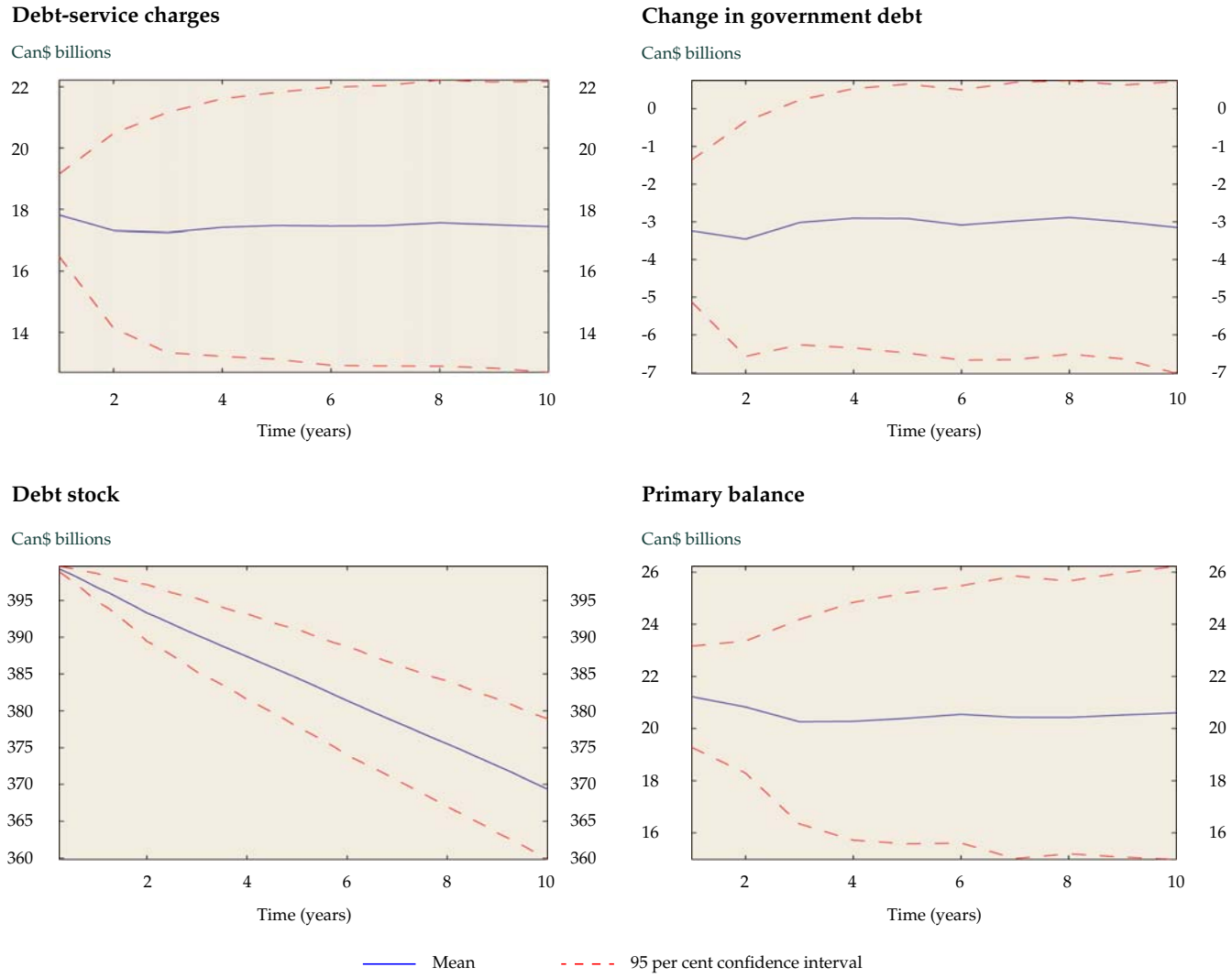


Chart 3

The Debt-Strategy Model: Critical Outputs



time horizon. Observe that each quantity is surrounded by a 95 per cent confidence interval that describes the uncertainty about their future evolution. The model can provide much more detailed information about these specific aspects of the debt manager's challenge, but Chart 3 simply provides a general sense of the model's principal outputs to illustrate how, for any choice of financing strategy, it supplies a rich description of the key elements of the government's debt strategy and a quantification of their relative uncertainty.[10]

The government's deficit or surplus position, what might be termed "fiscal mechanics," depends on a

10. In particular, the model computes portfolio summary measures such as the fixed-debt ratio, the average-term-to-maturity, and the duration, as well as issuance amounts in each financing option. The model also includes a number of different measures of cost and risk associated with a given strategy.

number of elements: the government's fiscal policy, its financing strategy, and the evolution of the macroeconomy. In the model, we ignore the non-cash items that generally contribute to a difference between the cash-based borrowing requirement and the government's budgetary position so that the change in the government's debt stock equals the government's annual deficit for that year. We assume a specific relationship between government revenues and non-interest expenditures (often referred to as the government's "primary balance") and the macroeconomy. Using this relationship, government requirements are computed as debt-service charges minus the primary balance.

The model also permits the government to target its annual debt paydown, implying that it will usually generate a surplus sufficient to meet the target. Chart 3 demonstrates surplus and deficit results for an assumed Can$3 billion debt paydown. On average, the Can$3 billion paydown is met, but the actual paydown is sometimes greater or less than this amount. A final assumption regarding debt and fiscal mechanics is that we do not place *a priori* bounds on the financing strategies; the evolution of the macroeconomy does not depend on the government's financing strategy.[11] We could, for example, consider an extreme financing strategy composed entirely of 3-month treasury bills. With a debt stock of Can$400 billion, this would amount to approximately Can$1.2 trillion of annual treasury bill issuance. To avoid such extreme outcomes, which may be hard for the market to digest, the model includes a price adjustment for excessively large or small issuance. We assume that if issuance falls within the benchmark target ranges defined by the government, it can be issued at prevailing market prices described by the statistical model. If issuance falls below or rises above these target ranges, then the financing cost generally increases in a non-linear fashion.[12] This is essentially a function that penalizes excessively small or large issuance in a given financing instrument and therefore more realistically characterizes the potential cost associated with extreme financing strategies.[13]

Policy objectives

The final aspect of the debt model relates to the government's policy objectives. Operationally, this refers to how we define risk. Debt management has traditionally attempted to evaluate the trade-off between the levels of, and the uncertainty about, debt-service charges.[14] Uncertainty about future financing costs is therefore how we typically define risk in this setting. We can also define risk in another way. The selection of a portfolio that minimizes budgetary uncertainty while also considering the level and volatility of debt costs is useful in considering debt management in the context of fiscal policy. Greater budgetary certainty would allow for a smoother tax profile and a larger proportion of permanent, as opposed to temporary, expenditure initiatives. Both notions of risk are factors in the government decision-making process.

Uncertainty about future financing costs is how we typically define risk in this setting.

Policy objectives are incorporated into the analysis in three steps. First, we define a set of policy objectives for the debt-strategy decision. Second, we determine what measure, from the debt-management model, best describes the attainment of each objective. Finally, we consider a wide range of financing strategies and select the one that best achieves the measures related to the policy objectives. In a simple example where the government wishes only to minimize the cost of debt

11. The financing strategy is assumed to depend on the macroeconomy, but we make the simplifying assumption that the macroeconomy does not depend on the financing strategy.

12. For some instruments, such as 3-month treasury bills and inflation-linked bonds, the borrowing costs could actually fall as issuance decreases because of inelastic demand for these instruments and the lack of acceptable substitutes.

13. Determining the parameters for this penalty function is far from obvious. The idea is not to be precisely correct, but rather, generally reasonable. We currently use conservative values determined through consensus discussion, examination of past experiences where applicable, and consideration of government securities markets in other countries.

14. The generally upward-sloping nature of the yield curve implies that, on average, nominal short-term debt is less expensive. Since nominal short-term interest rates are more volatile than their long-term counterparts, we typically have to be prepared to accept higher uncertainty for lower nominal debt charges. This relationship is less obvious when considering inflation-linked debt.

issuance, a reasonable measure of the policy objective would be the average debt charges over the simulation horizon. We could then examine a large set of financing strategies and select the one with the smallest average debt charges over the simulation horizon. Since the government's actual policy objectives are much richer than suggested by this, finding the specific strategy that best meets a set of policy objectives can be considerably more complicated. For this reason, an optimization module was developed that provides significant flexibility in defining the government policy objectives in various forms.[15] For example, we might want to minimize the cost of the debt portfolio with constraints on the volatility of debt-service charges and the amount issued in various financing options. While it is possible to use the debt-strategy model without the optimization module, the module is a useful tool, given the complexity of the challenge.

In the next section, we will examine how we use the debt-strategy model in conjunction with the optimization module to provide insight into the debt manager's challenge of minimizing cost with some restriction, or constraint, on the amount of portfolio risk.

Using the Model

The main objectives of the Canadian government with respect to the domestic-debt portfolio "is to raise stable and low-cost funding to meet the operational needs of the government. An associated objective is to maintain a well-functioning Government of Canada securities market" (Department of Finance Canada 2007).

Risk is the mirror image of stability. Requiring the level of risk to be *less* than some amount is equivalent to requiring the level of stability to be *greater* than some amount. The concepts of cost and risk are therefore clear from this quotation, but they need to be made operational for modelling purposes. Given that cost and risk have a variety of dimensions, there are several possible specifications for the government's operational objectives for debt management.

Defining cost and risk

Dealing with portfolio cost is relatively straightforward. In this analysis, we use as our measure of cost the average annual debt-service charges as a percentage of the total debt stock over the 10-year simulation horizon. A key advantage of expressing cost as a percentage is that it remains stable even when the size of the debt changes over the period of analysis.[16] Cost can be represented in other ways, but the model results are generally robust to the choice of measure. The definition of risk, however, is somewhat more complex. Two issues must be addressed. First, as previously discussed, it depends on the policy objectives of the government. In particular, how is risk defined—in terms of the volatility of the debt-service charge or of budgetary outcomes? Because of the impact of debt-service charges on the government's budget, these perspectives are related. Second, it is necessary to consider what type of risk most concerns the debt manager: the average volatility of the debt-service-charges, or a more extreme notion of debt-service-charge uncertainty.

It is necessary to consider what type of risk most concerns the debt manager.

These are not easy questions. We will not attempt to answer them here, but instead will provide results representing each of four different possibilities. We will examine the differences in optimal portfolios where the government seeks to minimize debt-service charges with constraints on average and extreme debt-service charges and budgetary risk. These average and extreme risk measures are different aspects of the statistical distributions generated by the debt-strategy model. In this analysis, the average measure of the debt-service charge and of budgetary risk is the conditional standard deviation of the debt-service charge and budgetary distributions outlined in Chart 3. The conditional standard deviation (often called conditional volatility) summarizes the average 1-year uncertainty regarding the debt-service charge and budgetary risk over the entire 10-year horizon, i.e., the average risk characteristics of a financing strategy

15. The optimization module is mathematically involved and beyond the scope of this article. Interested readers are directed to Bolder and Rubin (2007).

16. Given that we assume a positive debt paydown each year, the domestic-debt stock is decreasing, on average.

under normal circumstances.[17] Thus, this analysis defines average debt-service charge and budgetary risk as the conditional debt-service charge and budgetary volatility over the 10-year horizon, respectively.

Extreme outcomes are also of interest to debt managers. To understand them, we must examine the tails of the previously illustrated distributions.[18] The principal measure we use is Cost-at-Risk (CaR). There are two different types of CaR: absolute and relative. Absolute CaR is the worst-case debt-service charge expected with a certain degree of probability. Or, as a percentile measure, a 95 per cent CaR indicates that, for 95 per cent of the time, the government will not pay more than this amount in debt-service charges. Relative CaR, the measure we will use in our extreme analysis, is the difference between absolute CaR and the mean of the distribution. If we use the mean of the debt-service charge (or budgetary) distribution for planning, then relative CaR tells you that with, for example, 95 per cent probability, your worst-case outcome will not exceed your planned outcome by more than this amount. We use the same concepts for Budget-at-Risk (BaR). Thus, a 95 per cent absolute BaR indicates that, for 95 per cent of the time, the government's actual deficit or surplus position will not be worse than this amount. We thus define extreme debt-service charge and budgetary risk as the average relative CaR and relative BaR over the 10-year time horizon, respectively.

Optimal portfolios

We can now illustrate the results of using the optimization module to identify optimal portfolios. In this analysis, we define optimal by assuming that the government wishes to minimize the percentage cost of the debt over the next 10 years—already defined as *low cost*—subject to a single risk constraint. We explore four risk constraints: average debt-service-charge and budgetary risk and extreme debt-service charge and budgetary risk. We also examine constraint levels for each of these risk definitions and compare the results.

Before presenting the results, some clarification is necessary. First, there are a variety of stochastic models from which to choose. In this analysis, we use the Diebold and Li (2003) approach applied to the Nelson and Siegel (1987) model, as described in Bolder (2006). We have forced the long-term inflationary mean to be 2 per cent and the long-term output gap to be zero. Second, the financing strategies include 3-, 6-, and 12-month treasury bills, 2-, 5-, 10-, and 30-year nominal bonds, and 30-year inflation-linked bonds. Finally, we assume an annual debt-paydown target of Can$3 billion.

Each quadrant in Chart 4 represents one of our definitions of risk. Conceptually, the optimizer identifies the portfolio weights that provide the lowest possible debt-service charges while respecting the risk constraint. In each quadrant, the horizontal axis represents the resulting levels of risk; the further to the left we move, the lower the risk. The vertical axis denotes the proportion of the portfolio allocated to each of the eight financing options; these portfolio weights denote the financing strategy that produces a given level of risk. In all cases, the weights sum to one. The focus of this analysis is to understand how the composition of the portfolio changes as we relax the risk constraint.

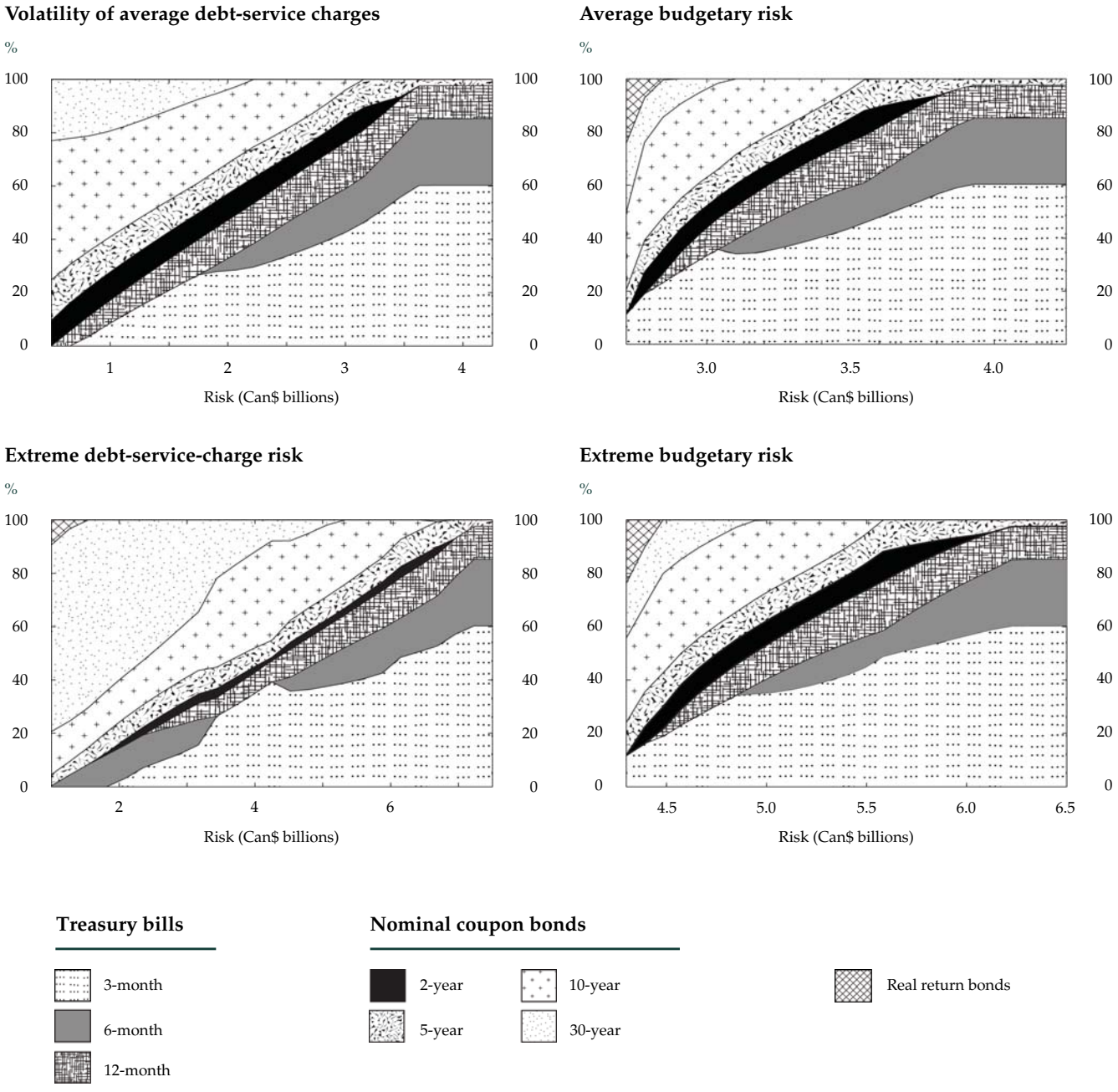
The top left-hand quadrant in Chart 4 provides the optimal financing strategies for the volatility of the average debt-service charge, ranging from Can$500 million to Can$4.25 billion. The easiest way to read this quadrant is from left to right on the horizontal axis. To achieve the lowest level of the average debt-service-charge risk (i.e., a constraint of Can$500 million), the portfolio weights require the following allocations to nominal bonds: about 23 per cent 30-year, 52 per cent 10-year, 15 per cent 5-year, and 10 per cent 2-year. As the risk constraint is relaxed, however, the 30- and 10-year bonds are replaced with 2-year bonds and treasury bills. Beyond a risk level of approximately Can$3.5 billion, the portfolio weights settle down at about 90 per cent treasury bills, with the majority allocated to 3- and 6-month tenors, as well as a small allocation to 5-year bonds. This trend reflects two empirical facts: Long-term debt is refinanced much less frequently than short-term debt; and short-term interest rates are generally more volatile than long-term rates. More frequent refinancing of short-term debt therefore exposes the government to greater variability in their debt-service charges. Consequently, financing strategies with larger proportions of long-term debt are typically more stable.

17. A formal definition of conditional volatility and how it is computed is found in Bolder (2003).

18. The tail of a distribution describes those outcomes that are far from the mean and generally occur with low probability.

Chart 4

Optimization Module: Optimal Portfolio Weights



The bottom left-hand quadrant in Chart 4 provides the same analysis for extreme debt-service-charge volatility. The trend, whereby lower levels of risk include larger proportions of longer-term debt, is also evident. Nevertheless, the proportion of long-term debt required to attain the lowest extreme risk level is substantially higher. To obtain Can$1 billion in extreme debt-service-charge risk, approximately 70 per cent of the portfolio must be allocated to 30-year nominal bonds, 16 per cent to 10-year nominal bonds, and the remainder to 30-year inflation-linked bonds and 5-year nominal bonds. This suggests that the optimal debt portfolio can vary significantly, depending on whether we attempt to avoid average or extreme definitions of risk. The remaining quadrants in Chart 4 illustrate the optimal portfolio allocations for average and extreme budgetary risk. These results are, again, quite different from those found when focusing on debt-service-charge notions of risk. The top right-hand quadrant addresses the average budgetary definition of risk. The lowest risk portfolio, with a risk of Can$2.7 billion, allocates approximately 75 per cent of the portfolio more or less equally among 10-year nominal, 30-year inflation-linked, and 30-year nominal debt, with the remainder approximately evenly split between 3-month treasury bills and 5-year nominal bonds.

The optimal debt portfolio can vary significantly, depending on whether we attempt to avoid average or extreme definitions of risk.

As the risk constraint is relaxed, the optimal portfolio weights shift to include significant proportions of 10-year bonds and treasury bills. Beyond approximately Can$3.75 billion, however, the portfolio requires 5 per cent in 5-year bonds, with the remaining 95 per cent in treasury bills—most of this, about 60 per cent, is allocated to 3-month treasury bills. Interestingly, the portfolio allocations are essentially the same for both the average and extreme definitions of budgetary risk.

It is evident from this analysis that alternative definitions of risk lead to alternative portfolio allocations. A focus on budgetary risk, for example, involves substantially larger allocations to inflation-linked bonds and treasury bills relative to the definition of debt-service-charge risk. This difference relates to the relationship among government revenues, expenditures, and debt-service charges. Remember that the government's budgetary position is defined as the government's primary balance less debt-service charges. The uncertainty of the government's budgetary balance depends upon the variability of its fiscal policy (i.e., revenues less expenditures), the variability of debt-service charges, and the interaction between these two quantities. Clearly, the notion of budgetary risk simultaneously subsumes and is more complicated than that of debt-service-charge risk.

Inflation-linked bonds and treasury bills play a larger role in controlling budgetary risk because they generate debt-service charges with the necessary interaction between the government's fiscal policy and the financing strategy to obtain the lowest level of budgetary risk.[19] Note, however, that the debt manager's capacity to influence budgetary risk is significantly less than their ability to affect debt-service charges. This is evident when we examine the relative minimum levels of risk attainable in the definitions of debt-service charge and budgetary risk. This should not be surprising, since, as previously mentioned, budgetary volatility depends on uncertainty in government revenues and expenditures, which are largely beyond the debt manager's control.

Risk and cost trade-offs

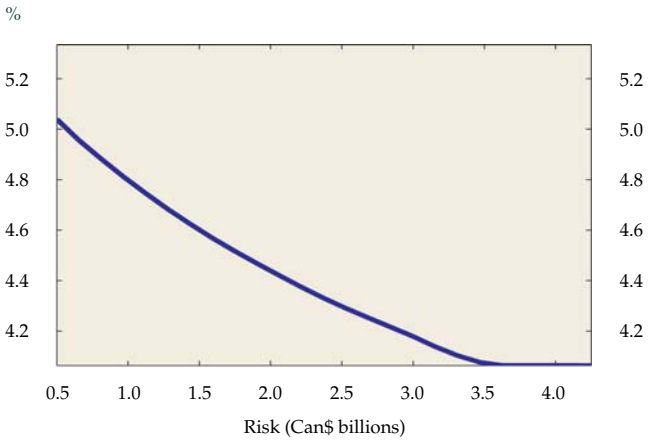
In addition to the portfolio composition for different definitions and levels of risk, we also need to know the cost characteristics associated with each (Chart 5). Each quadrant in Chart 5 corresponds to one in Chart 4, and the horizontal axis is identical for each quadrant in the two charts. In Chart 5 however, the vertical axis represents the expected cost of the portfolio, in percentage terms, relative to the level of risk. The stylized results in Chart 5 depend importantly on the assumptions made about the average shape of the term structure of interest rates over the analysis horizon.

19. The idea is that portfolios with larger proportions of treasury bills and inflation-linked debt have debt-service charges that are typically larger (smaller) when the primary balance is also large (small) and acts like a partial hedge to offset budgetary uncertainty. This situation arises from the (typically) positive relationship between short-term interest rates, inflation, and output.

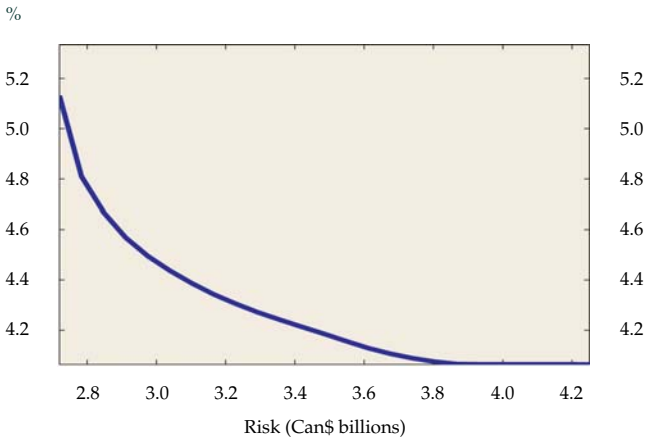
Chart 5

Optimization Module: Risk-Cost Trade-Offs

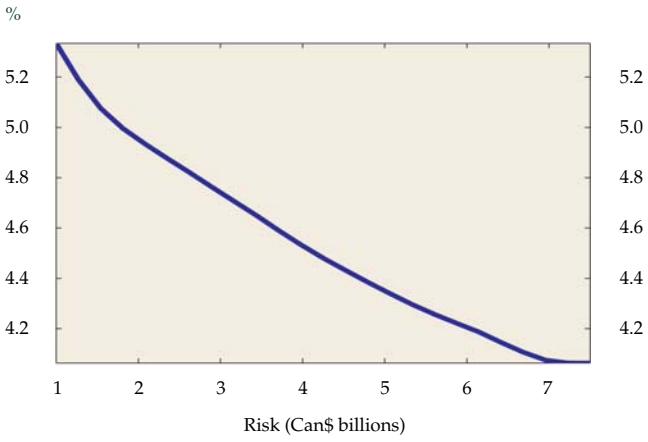
Volatility of average debt-service charges



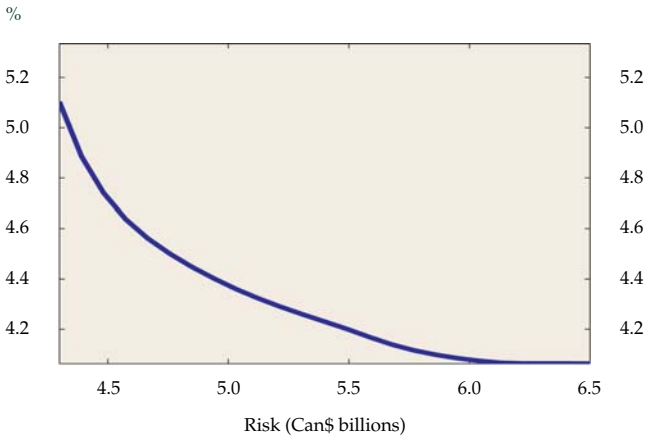
Average budgetary risk



Extreme debt-service-charge risk



Extreme budgetary risk



The shape of the curves in Chart 5 is consistent with what is predicted in finance theory; i.e., the reduction of risk in the government's debt portfolio is not free. It comes at the price of increased debt-service charges. These are merely illustrative results, however. While the basic results remain the same, the slope of the curves will vary, depending on which statistical model is selected and the time period used to estimate the model's parameters.

We can still draw some basic conclusions from these risk-cost trade-offs. In the top left-hand quadrant of Chart 5, as the risk constraint for the average debt-service charge is eased—from Can$500 million to Can$4.25 billion—the expected cost falls by approximately 100 basis points.[20] A similar pattern is found for each of the four alternative definitions of risk, with a few differences. First, the differential between the cost of the lowest and highest risk portfolio is approximately 100 basis points for all of the risk definitions except extreme debt-charge risk, where the differential is almost 130 basis points. This suggests that eliminating extreme debt-service-charge risk is relatively expensive. Second, the shape of the risk-cost trade-off is relatively linear for average and extreme debt-service-charge risk, whereas the curve displays substantially more curvature for average and extreme budgetary risk. It appears, therefore, that once budgetary risk falls below a certain threshold, small risk reductions are achieved with substantial increases in cost.

In summary, Charts 4 and 5 illustrate how the optimal portfolio weights and expected costs evolve for different definitions of risk at alternative constraint levels. While the results vary as the constraint changes, there is a trend towards an increase in the amount of longer-tenure instruments to reduce risk. Moreover, in all cases, this reduction in risk is accompanied by a commensurate increase in expected debt-service charges.

20. For a debt stock of Can$400 billion, this represents approximately Can$4 billion of annual cost reduction.

There is a trend towards an increase in the amount of longer-tenure instruments to reduce risk.

Conclusion

To meet the government's financing needs, including its objectives of ensuring low-cost and stable financing, the debt manager must select a financing strategy in the face of substantial uncertainty about the future. Given the complexity of this task, a mathematical model was developed to help debt managers better understand the implications of various financing choices. This article provides a brief overview of the structure of Canada's debt-strategy model and demonstrates how it is actually used. In particular, the optimal portfolio weights and the risk-cost trade-offs are identified for alternative definitions and levels of risk. Different definitions of risk generate different results. This is an important result and should underscore the role of the debt-strategy model: It is not a substitute for intuition, experience, and judgment but is a tool to assist in understanding and organizing this multi-faceted decision.

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China's Integration into the Global Financial System

*Paul Masson, Wendy Dobson, and Robert Lafrance**

- *Despite its importance as an investment destination and major exporting country, China is considerably less integrated into the global financial system than might be expected.*
- *The lack of integration stems in part from China's focus on its domestic goals of balancing growth and stability while it transforms and modernizes its economy.*
- *Substantially more financial integration can be expected in coming decades, however, as China invests more abroad, develops its domestic financial system, makes its exchange rate more flexible, and further relaxes its capital controls.*

China's global economic significance is growing. Its gross domestic product (GDP) is the world's second largest when measured in terms of purchasing-power parities, and its share in world exports is exceeded only by Germany's and that of the United States. China is Canada's second-largest trading partner, and trade between the two countries is continuing to grow rapidly. China's foreign exchange reserves, now totalling US$1.8 trillion, are the world's largest. Yet China has only a minor role in the global financial system. Its banks, some of which are the largest in the world by market capitalization and the size of their balance sheets, have only a modest international presence. China's currency, the renminbi (RMB), also known as the yuan, is virtually not used outside the country and, with a few exceptions, Chinese capital markets are not a source of financing for foreign borrowers.

China's lack of integration into the global financial system needs to be understood primarily in the context of China's own interests and domestic policy priorities. The central economic goal of the Chinese authorities has been to achieve growth with stability while radically restructuring the industrial sector and creating enough jobs each year to absorb layoffs and large numbers of new entrants into the labour force. China has been generally successful in meeting these challenges, and during the past 30 years economic growth has averaged nearly 10 per cent annually. Structural and institutional reforms to free up market forces and promote efficiency are introduced gradually, with initial experimentation followed by adoption on a national scale. Industrial enterprise reforms in the late 1990s were initially experimental, followed by radical nationwide restructuring and privatization.

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Modernizing the state-owned banking system that dominates China's financial system began gradually in the late 1990s as a first step along the path towards a sound and diverse set of intermediaries and capital market institutions.

Thus, opening financial markets and integrating China's economy into the global financial system has not been a high priority in the past. As the Chinese economy matures, however, and as reforms strengthen the domestic financial system, China will become more important in global financial markets. Changes are already occurring as China's financial might is being channelled towards overseas investments and as popular pressures develop for a loosening of capital controls. The authorities have committed themselves to greater exchange rate flexibility, and this would also facilitate integration into the global financial system, while allowing continued policy focus on domestic priorities.

Our purpose here is to review the ways in which China is, and is not, integrated into the global financial system. We begin by describing the current situation and the forces that are leading to a more important role for China in world finance. This is followed by a review of China's financial system, its linkages abroad, and its current exchange rate regime. We conclude with observations on China's future direction.

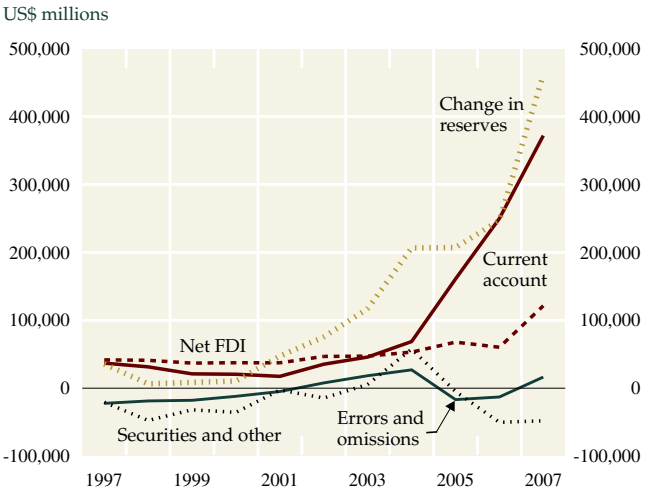
China's Capital Account

Since its accession to the World Trade Organization (WTO) in 2001, China has become one of the world's principal destinations for foreign direct investment (FDI); inflows have almost doubled since then, reaching nearly US$80 billion in recent years.[1] China's capital account is indicative of its links with the rest of the world. FDI is thus the major channel by which China accesses international capital markets. As shown in Chart 1, net FDI inflows have been relatively stable around an increasing trend over at least the past decade. In contrast, securities investments and other forms of capital flows have, until recently, been relatively small on a net basis, and have not been consistently positive or negative.

FDI inflows result from a deliberate policy to modernize Chinese industry by encouraging overseas Chinese and others to invest in China, first in the Special

Chart 1

China's Balance of Payments



Source: China, SAFE = State Administration of Foreign Exchange, downloaded from CEIC Data

Economic Zones (SEZs) and then extending to the rest of the country. The first SEZ was established in Guangdong in 1979.[2] SEZs, like export-processing zones in other countries, allow duty-free imports of inputs, and freedom from export or sales taxes; moreover, they typically provide infrastructure for enterprises to operate and lower tax rates, thus offering incentives for new investment, whether domestic or foreign. In addition, as enclaves within the still centrally planned economy, SEZs served as "laboratories" for experiments with economic reforms where the Chinese authorities could adopt more market-based regulations and use profit as an incentive without completely overhauling the economy and exposing it to world competition.

FDI inflows result from a deliberate policy to modernize Chinese industry by encouraging overseas Chinese and others to invest in China.

Guangdong, as the initial beneficiary, also benefitted from its proximity to Hong Kong. Strong production links have since developed between Hong Kong and

1. Note that Chinese figures for direct investment are higher than those produced by the United Nations Conference on Trade and Development (UNCTAD), and that different Chinese sources have differing estimates of the extent of FDI. See UNCTAD (2007).

2. SEZs, and a variant known as Economic and Technological Development Zones, now number over a hundred. See Naughton (2007).

the entire Pearl River Delta as the SEZs were extended throughout the Delta region. Over time, and with further liberalization and the creation of new investment zones, multinational companies from North America, Europe, and elsewhere in Asia became substantial investors, attracted by the size of China's domestic market and the cost savings from moving manufacturing and assembly to a low-wage country with a vast pool of labour. As a result, the investment zones have industrialized quickly and have attracted substantial numbers of migrants from other parts of China.

China has benefitted from the expertise and technology associated with foreign investment, while the SEZs have provided a model for the more gradual liberalization of the rest of the Chinese economy. A less important advantage has been access to foreign financial resources per se, since China's domestic saving rate has been very high (over 50 per cent at present), and China has been running a substantial current account surplus, not a deficit, with huge reserves accumulating. To try to moderate the future trend in the balance-of-payments surplus, the Chinese government has encouraged Chinese investment abroad. Thus, outward FDI rose from US$6.3 billion in 2002 to US$27 billion in 2006. Nevertheless, China's net FDI liabilities are still far in excess of its foreign assets, while net stocks of securities and other asset categories are much smaller (Table 1). All are dwarfed, however, by China's massive official reserves, which by mid-2008 exceeded US$1.8 trillion.

Chinese investment links with Hong Kong, Korea, and its other Asian neighbours are of prime importance.

China accounted for 5.3 per cent of world FDI inflows in 2006, roughly equal to the share of Belgium, Canada, or France, and far higher than that of Germany, Italy, India, or Singapore. In contrast, its outward investment accounts for only 0.6 per cent of the world total. The destinations of those outflows also differ markedly from the world average. Most global FDI flows (84 per cent) go to developed countries, with the balance (16 per cent) going to developing countries.[3] China's outward FDI, however, is channelled overwhelmingly to developing countries (all but 6 per cent, with 2 per cent each accounted for by North America and Europe), and most going to Hong Kong and the Cayman Islands, which each receive about 35 per cent of the total. While the role of the latter as an offshore financial centre makes it likely that the FDI is destined for other countries, it is nevertheless notable that, for all the publicity given to China's investments in North America, Europe, and Africa, these destinations account for only a modest amount of Chinese investments. Instead, Chinese investment links with Hong Kong, Korea, and its other Asian neighbours are of prime importance.

Table 1

China's Foreign Assets and Liabilities

	FDI assets	FDI liabilities	Net FDI stock	Net securities	Other net	Official reserves	Overall net foreign assets
2004	52,700	369,000	-316,300	35,400	-44,900	618,600	292,800
2005	64,500	471,500	-407,000	40,100	-36,200	825,700	422,600
2006	90,600	612,500	-521,900	108,500	-48,100	1,072,900	611,400
2007	107,600	742,400	-634,800	96,900	25,100	1,534,900	1,022,100

Source: China, State Administration of Foreign Exchange, downloaded from CEIC Data

Despite its relatively modest size, Chinese FDI outside of Asia has attracted considerable media and governmental attention, which can be traced to at least three principal concerns. First, because the purchases of foreign assets are by Chinese state-owned enterprises or agencies charged with investing official reserves, there is a fear that non-commercial motives may drive investment decisions. For instance, stakes in natural resource companies may be acquired, in part to allow China to gain access to resources for geo-strategic reasons. Second, Chinese investments in Africa, in particular, are seen as undercutting conditions of good governance generally imposed by Western governments and international financial institutions, thus propping up corrupt and undemocratic regimes. Third, given the size of the economy and its massive financial resources, the potential size of future Chinese acquisitions, rather than their current importance, seems to fan public concern. The Chinese government could afford to acquire some of the world's largest multinational corporations if it chose to use even a portion of its US$1.8 trillion in reserves in this way.

Another area of interest is recent investments by Chinese financial institutions in listed foreign

3. See UNCTAD (2007). Developing countries include Eastern Europe and the Commonwealth of Independent States (CIS).

companies.[4] To date, these purchases have usually involved minority stakes (except for the investments in Asia), and in several cases (like Blackstone), the Chinese acquirer has explicitly stated that the acquisition was made for investment purposes and that it would not attempt to influence company policy. But a precedent of sorts exists. The Industrial and Commercial Bank of China's purchase of a 20 per cent stake in Standard Bank of South Africa, Africa's largest bank, is intended to serve as foundation for ICBC to become a global bank, according to its chairman. The strategy of passive investing in European and American companies may have been influenced by the unsuccessful attempt by China National Offshore Oil Company (CNOOC) to acquire outright the U.S. petroleum company Unocal in 2005 for US$18.5 billion. Congressional scrutiny and the threat that the takeover would be blocked by the Bush administration led CNOOC to withdraw its offer.

In Africa, Chinese investments have often involved government-to-government deals, with China typically acquiring rights to exploit natural resources in exchange for concessional loans and Chinese assistance in building infrastructure or providing social services (Alden 2007). Thus, China has provided financial assistance to the Sudanese government and is the country's largest investor, while the China National Petroleum Corporation (CNPC) owns the biggest share of Sudan's largest oil venture—a share giving it 150,000 barrels per day—in the southern part of the country. CNPC has helped to construct a pipeline to the Red Sea and an oil refinery in Khartoum. Similarly, China has accessed oil reserves in Nigeria and Angola, and mineral deposits in the Democratic Republic of the Congo and Zambia. In these deals, the aid and commercial elements of financing are difficult to distinguish. When projects are financed in "Angola mode," funds are not directly loaned to the recipient country; instead, the Chinese government will mandate a Chinese construction company to carry out a project, often with assistance from the Export-Import Bank of China. In exchange, a Chinese natural resources company will receive oil or mineral rights (Reisen and Ndoye 2008).

When it is making investments in mineral-rich African countries, China seems to deal primarily with regimes having governance problems, for at least two reasons. The "curse of oil" often produces governments where rent-seeking and corruption are rampant, and China, as a latecomer in the acquisition of sources of supply, most easily finds opportunities with pariah states with which Western governments discourage contact. Its dealings with these states have been facilitated by its doctrine of non-interference in other countries' sovereignty—a policy that resonates with African countries that have suffered from colonialism. China has not escaped blame from Africans themselves, however, because China's actions undercut efforts to improve governance, for instance, in the context of NEPAD.[5] China's continuing involvement with African countries has led it to modify its indifference towards governance failures and civil rights abuses. After years of unqualified support, the Chinese government recently condemned the actions of the Sudanese government with respect to the country's rebels in Darfur and has made contributions to the African Union's peacekeeping force there. Chinese officials are also increasingly distancing themselves from the government of Robert Mugabe in Zimbabwe (Alden 2007). Available data are mixed on whether Chinese involvement has reduced corruption, or instead, added to governance problems (Reisen and Ndoye 2008, 30).

Portfolio capital flows are subject to various restrictions, but there has been a trend towards their liberalization. They are still largely channelled through large institutional investors using the QFII and QDII programs.[6] When China joined the WTO, the government committed to opening its securities markets to foreign investors.[7] In December 2002, the Qualified Foreign Institutional Investor (QFII) program was introduced. Firms that meet the requirements can invest in various domestic financial instruments in China, such as treasuries, convertible bonds, corporate bonds, and A shares, which are common shares registered in Mainland China and denominated in yuan.[8] The program offers many benefits by introducing additional competition

4. Some of these investments will figure in portfolio outflows, rather than direct investment, since the latter includes only stakes that exceed a threshold percentage of an existing company or allow the investor an effective voice in its management. Chinese data are based on a 25 per cent threshold, not the 10 per cent that is the international standard.

5. The New Partnership for African Development, an initiative of the presidents of Nigeria, Senegal, and South Africa, attempts to exert peer pressure to improve governance and economic policies.

6. Qualified Foreign Institutional Investors and Qualified Domestic Institutional Investors, respectively.

7. Foreign security firms were to be permitted to engage directly in trading B shares, and foreigners were to be permitted to establish joint-venture security and funds-management companies. B shares trade and are settled in foreign currencies (in U.S. dollars on the Shanghai market, and in Hong Kong dollars on the Shenzen market) but are otherwise identical to A shares.

8. Neftci and Ménager-Xu (2007) provide a fuller description of China's financial markets.

in China's securities markets, enabling the transfer of foreign expertise, promoting a more effective allocation of Chinese savings, and increasing the attractiveness of Chinese securities for foreign investors.[9]

The QFII program is restricted to funds-management and securities companies with at least US$10 billion under management, and to the world's top 100 commercial banks.[10] As well, the securities regulator of their home country must have signed a Memorandum of Understanding and maintained a good relationship with the China Securities Regulatory Commission (CSRC).[11]

China has also moderately eased its controls on capital outflows.

China has also moderately eased its controls on capital outflows. In August 2004, the CSRC certified its initial Qualified Domestic Institutional Investors (QDIIs). Chinese insurance companies with assets of over five billion RMB are now permitted to invest up to 80 per cent of their foreign exchange funds in overseas capital markets, with some limitations. Individuals have been unable to purchase assets abroad, but the State Administration of Foreign Exchange announced in August 2007 that domestic investors would be permitted to open accounts with the Tianjin branch of the Bank of China to trade securities listed on the Hong Kong market, with extension to other banks to follow.[12] This decision was later reversed by Premier Wen, on two grounds: first, that the anticipated flows of funds might swamp the Hong Kong financial market, and second, that the proposal needed to be restructured.[13] Despite the strict controls, there is some evidence that investors are evading them. In particular, capital has at times flowed in to take advantage of expected renminbi appreciation,[14] leading to a large figure for errors and omissions in the 2003–04 balance of payments (Chart 1). On the other side, Chinese companies and individuals have transferred capital, especially to Hong Kong, in part to buy Chinese shares listed there, which trade at lower prices than in Shanghai.

China's Financial System and Its Linkages Abroad

As the foregoing discussion indicates, China is awash in capital. Households, firms, and governments are prodigious savers. Seventy per cent of Chinese savings are held in banks, compared with 20 per cent in the United States (Farrell and Lund 2006).

The financial system is bank dominated, and nearly all banks are majority government owned. The banking system includes five large state-owned commercial banks (SOCBs), a dozen joint stock commercial banks, more than 100 city commercial banks owned by municipal governments, and more than 30,000 rural and urban co-operatives (Table 2). SOCBs dominate the system, accounting for more than half of banking assets, thousands of branches, and hundreds of thousands of employees located throughout the country,

Table 2

China's Banking System, 2007

Billions of RMB

	Assets (share)		Liabilities (share)	
State-owned commercial banks[a]	28,007	(53.2)	26,433	(53.3)
Joint stock commercial banks[b]	7,249	(13.8)	6,911	(13.9)
City commercial banks	3,340	(6.4)	3,152	(6.4)
Other banking institutions[c]	14,001	(26.6)	13,072	(26.4)
Total	52,598	(100.0)	49,568	(100.0)

Source: China Banking Regulatory Commission, "Total Assets and Total Liabilities of the Banking Institutions as of end–2007." Available at <http: //www.cbrc.gov.cn>.

a. Includes the Industrial and Commercial Bank, the Agricultural Bank of China, the Bank of China, the China Construction Bank, and the Bank of Communications.

b. Includes CITIC Industrial Bank, China Everbright Bank, Huaxia Bank, Guangdong Development Bank, China Merchants Bank, Shanghai Pudong Development Bank, Industrial Bank, China Minsheng Banking Corp., Evergrowing Bank, China Zheshang Bank, and China Bohai Bank.

c. Includes policy banks, rural commercial banks, foreign banks, UCCs, RCCs, finance companies affiliated with enterprise groups, trust and investment companies, financial leasing companies, auto financing companies, money brokers, and postal savings banks.

9. The opening of China's capital markets to foreign investors has followed China's traditionally cautious approach to reform, what Deng Xiaoping termed "crossing the river by feeling the stones."

10. As of the summer of 2007, 52 foreign institutions and four foreign banks had been licensed as custodian banks. See the CSRC website at <http: //211.154.210.238/en/homepage/index_en.jsp>.

11. The CSRC is the executive arm of the State Council Securities Committee, which was established in 1992 to regulate China's securities and futures markets.

12. "China Allows Direct Offshore Investments," *Financial Times*, 21 August 2007, p. 3.

13. One of its alleged flaws was that it amounted to "one bank, one city, one market," raising bureaucratic and jurisdictional objections ("Chinese Plan to Allow Purchase of Hong Kong Shares Put on Ice," *Financial Times*, 5 November 2007).

14. "World News: China Vows to Crimp 'Hot Money,' Inflows," *Wall Street Journal*, 10 March 2007.

but they are slower growing (15 per cent annually) than the joint stock banks (33 per cent) and city commercial banks (29 per cent). Privatization is gradually occurring as equity becomes more widely held by private investors and foreign strategic investors. In experimental cases in rural areas, strategic private investors are being allowed 100 per cent ownership.

China's capital markets are among the smallest in the world relative to the size of the domestic economy. There are two stock exchanges: Shanghai, established in 1990, and Shenzhen, in 1991.[15] Most of the available listings are those of the public shares of China's largest state-owned enterprises (SOEs). High levels of government ownership in these companies and segmentation of the market have limited market liquidity. The QFII program, which allows foreign investors to trade in the domestic market subject to certain restrictions that include a maximum 10 per cent equity stake in any domestic company and prohibitions on acquisitions of non-tradable state-owned shares, is aimed at partially addressing these problems.

China's bond market is at an even earlier stage of development, serving mainly as a channel for government finance, owing to the highly restrictive regime faced by corporate issuers. Although both the central bank and the Securities Regulatory Commission are the regulators, the National Development Research Council, secretariat to the policy-making State Council, until recently approved quota allocations and the issuance of corporate bonds. Banks continue to supply most debt finance. By September 2006, corporate bonds accounted for only 3 per cent of outstanding bonds, compared with the 68 per cent combined shares of government and central bank bonds (UBS 2006). Corporate issuers, especially those listed on the Hong Kong Stock Exchange, are instead tapping into overseas debt markets.

The government has worked intensively since 1998 to modernize the banking system. In 2000, the China Banking Regulatory Commission (CBRC) was created to oversee retail and wholesale banks.[16] As part of the 2001 WTO accession agreement, China agreed to open the domestic banking sector to foreigners by 2007. To ensure that banks would be competitive by then, the government took three steps. The first encouraged restructuring and recapitalization, beginning with the five large state banks. By 2005, an estimated half a trillion dollars had been spent to remove bad loans from banks throughout the system (the Agricultural Bank of China, still a work in progress, was not included in this estimate) and to inject fresh capital to bring them to Basel I levels of capital adequacy (Ma 2006). The second step encouraged participation of strategic foreign investors, not for their capital, but for their expertise and assistance in modernizing the banks. By mid-2007, some US$20 billion had been invested (Table 3). The third step, permitting these banks to list some of their shares on the stock exchanges in Hong Kong and Shanghai, was intended to encourage transparency and greater management focus on efficiency and profitability. These offerings attracted huge investor interest. The Bank of Communications, which listed in 2005, raised US$2 billion, followed by the Bank of China and the China Construction Bank, each of which raised US$9 billion. When ICBC listed late in 2006, it raised an astounding US$19 billion. By one estimate, these listings, along with domestic listings in China's A share market, have raised more than US$50 billion since 2005 (Anderson 2006).

The government has worked intensively since 1998 to modernize the banking system.

These measures are having an impact on bank management. Non-performing loans (NPLs) as an indicator of efficiency have improved. Among the Big Five state-owned commercial banks, NPLs dropped from 28.6 per cent (for the original Big Four) in 2000 to 8.05 per cent for the five in 2007 (CBRC 2007). The banks have yet to be tested by adverse economic conditions, however.

Banking-system efficiency and competitiveness are also inhibited by certain institutional features of the financial system.[17] China's investment-led export-oriented growth strategy relies on the stability of key prices, like the exchange rate and interest rates. Since the 1997–98 East Asian financial crisis, the exchange rate has fluctuated in a very narrow range. It has been stabilized by the central bank acquiring large foreign

15. In 1990, 10 companies had listed on the Shanghai Exchange; by the end of 2006, the number listed on both exchanges had grown to 1,500.

16. The CSRC oversees investment banks. Since the 17th People's Congress in October 2007, the formation of a single regulator has been under discussion ("China Considers Financial Superministry," *Wall Street Journal*, 10 January 2008).

17. These interconnections are traced in detail in Prasad (2007).

Table 3

Foreign Investments in Chinese Banks

Date	Chinese bank	Foreign investor	Equity share (%)	US$ millions
2002	Shanghai Pudong Dev Bank	Citigroup	15	73
2002	Bank of Shanghai	IFC/HSBC	15	145
2002	China Everbright Bank	IFC	5	19
2002–05	Bank of Nanjing	IFC/BNP Paribas	25	114
2004	Industrial Bank	Hang Seng/ IFC/GIC	25	326
2004	China Minsheng Banking Corp.	IFC/Temasek	6	125
2004	Shenzhen Development Bank	Newbridge	18	150
2004	Xi'an City Commercial Bank	IFC/Scotiabank	25	40
2005	Jinan City Commercial Bank	Commonwealth Bank	11	17
2005	Bank of Beijing	IFC/ING	25	270
2005	Hangzhou City Commercial Bank	Commonwealth Bank/ADB	25	110
2005	Huaxia Bank	Deutsche/ Sal Oppenheim	13	325
2005	Bohai Bank	Standard Chartered	20	125
2005	Bank of Communications	HSBC	20	1,750
2005	China Construction Bank	Bank of America/ Temasek	14	4,000
2005	Bank of China	RBS/UBS/ Temasek/ADB	17	5,175
2005	Tianjin City Commercial Bank	ANZ	20	110
2005	Industrial and Commercial Bank of China	Goldman/ Allianz	10	3,700
2006	Ningbo Commercial Bank	OCBC	12	70
2006	Shanghai Rural Commercial Bank	ANZ	20	252
2006	United Rural Cooperative Bank of Hangzhou	Rabobank/IFC	15	30
2006	Chongquing City Commercial Bank	Dah Sing/ Carlyle	25	130
2006	Guangdong Development Bank	Citigroup/IBM	25	760
2007	CITIC Industrial Bank	BBVA	5	650
2007	Dalian City Commercial Bank	Scotiabank/IFC	25	320
Total				18,786

Source: Ma (2006), IMF, Xinhua, *China Daily*, UBS estimates

exchange earnings from exports and FDI inflows and sterilizing the resulting liquidity. These practices have reduced the independence of monetary policy. Rather than allowing banks' loan and deposit interest rates to be market determined, the central bank must administer them, offering savers low returns and allowing the banks healthy spreads by setting higher lending rates. Allowing market-determined rates would be risky, since the fixed exchange rate is vulnerable to speculative capital inflows, which would put upward pressure on the exchange rate and require more sterilization. Administered interest rates were ineffective in slowing growth in 2007, but an outright prohibition on new lending towards the end of the year did slow credit expansion.[18] Administered interest rates also reduce commercial banks' appetite for risky credits because these banks can rely for a good part of their income on large well-known borrowers with government connections and on the generous administered spreads between deposit and lending rates.[19]

Banking-system efficiency is also influenced by continued government ownership. Since 2004, prudential standards and oversight have been strengthened and incentive structures for bank managers have been modernized. But incentive structures have not changed sufficiently to make the banks' overlending (mainly to state-owned enterprises) a thing of the past. The large banks continue to rely on traditional mainstay borrowers, which are firms, many of them owned or controlled by the government. According to the large banks' own published financial statements, corporate customers still account for between 70 and 80 per cent of their loans (Dobson and Kashyap 2006). The implication is that banks are exposed, not to firms with burgeoning profitability, but to tens of thousands of government-owned or -controlled firms whose profits are likely to be less certain in an economic downturn.

All of this means that governance in China's majority government-owned banks is a work in progress that affects incentive frameworks. Steps have been taken to increase representation by independent directors on boards, but the involvement of Communist Party officials, while declining, continues to be pervasive. Bank

18. By August 2007, the People's Bank of China had raised interest rates four times in its attempt to curb price increases, rising asset values, and overcapacity in manufacturing, yet the economy expanded nearly 12 per cent in 2007Q2, the strongest growth in 12 years (Zhang Tao, "Deal with Inflation, Currency Threats, Chinese Central Banker Warns," *National Post*, 29 August 2007, p. FP18).

19. Dobson and Kashyap (2006) illustrate the size of the spread and discuss its impact on bank business plans.

heads are members of the Central Committee (Naughton 2003); the CEO is often also the party secretary; and bank performance is discussed at party meetings.

Short-term profitability masks the problems that lie ahead.

The management, ownership, and governance weaknesses mentioned above co-exist with the belief among investors, depositors, and customers that China's government-owned banks are "too big to fail." The increasing numbers of banks listed on stock exchanges are subject to more external monitoring, but continued political pressures undermine their efficiency. Indeed, the economic and credit booms since 2002 have tested their ability to evaluate and monitor new loans; bank loans have soared (reducing ratios of NPLs) in response to robust demand in expanding industries. Short-term profitability masks the problems that lie ahead. Such indicators suggest that banks are also making commercial decisions, but it takes time for these loans to mature, and should China experience slower growth, as is increasingly likely in the next few years, nonperforming loans are likely to increase and to create stress on the banks. Yet depositors believe they have blanket protection of their deposits, even if the rate of return is low. The People's Bank of China is not independent, so there is widespread confidence in it as a lender of last resort.

Once all of the major banks have been restructured, market forces are likely to be freed up, borrowing and lending rates deregulated, interest spreads will shrink, investor and depositor monitoring will intensify as the implicit blanket guarantee is modified or removed, and banks will face stiffer competition from the developing capital market institutions. As margins shrink and balance sheet growth declines, pressures to consolidate the banking sector are likely to follow.

In the meantime, banks are flush with cash. The Industrial and Commercial Bank of China (ICBC) and the Bank of China have joined the world's top 10 banks, as measured by tier one capital,[20] and the government is encouraging banks to "go abroad" to develop global capabilities. In September 2007, central bank governor Zhou Xiaochuan outlined the government's supportive policy framework. It includes fostering the development of the foreign exchange market to help enterprises manage interest rate and exchange rate risk; reduced controls on foreign exchange transactions; assistance to qualifying financial enterprises to establish overseas operations; and development of "regional financial platforms" through co-operation with regional development banks (Zhou 2006).

In the past year, financial enterprises have used three channels for their investments (Table 4). One is to follow their customers into developing countries. In Asia, which is familiar territory, Chinese banks have taken large stakes. ICBC has a majority stake in Bank Halim Indonesia and Macau Seng Hang Bank; Bank of China owns Singapore Aircraft Leasing outright. ICBC is following its corporate customers into Africa and, along with China Development Bank's China-

Table 4

Foreign Investments Announced by Chinese Financial Institutions

Date	Chinese bank	Target	Equity stake (%)	Estimated value (US$ millions)
December 2006	Bank of China	Singapore Aircraft Leasing	100.0	965
December 2006	Industrial and Commercial Bank of China	Bank Halim Indonesia	90.0	10
May 2007	China Investment Corporation	Blackstone	9.9	3,000
May 2007	CDB	China-Africa Development Fund	100.0	1,000
July 2007	China Development Bank	Barclays	3.1	3,100
August 2007	Industrial and Commercial Bank of China	Seng Hang Bank (Macau)	79.9	583
October 2007	CITIC Securities	Bear Stearns*	6.0	1,000
October 2007	China Minsheng Banking Corp.	UCBH (San Francisco)	9.9	317
October 2007	Industrial and Commercial Bank of China	Standard Bank of South Africa	20.0	5,600

* Transaction was cancelled because of the takeover of Bear Stearns by JPMorgan Chase & Co. in March 2008.
Source: Reuters, *Financial Times, China Daily*

20. "Top 1000 World Banks" (annual), *The Banker*, July 2007.

Africa Development Fund, is financing infrastructure and building ties with African governments and enterprises in China's search for natural resources and new markets. ICBC's investment in Standard Bank of South Africa, Africa's largest bank, gives it a platform with an experienced partner to assist its penetration of an unfamiliar geography.

The second channel is to take stakes in more sophisticated banks in the United Kingdom and the United States to increase international competitiveness by learning advanced banking technologies and products. In these cases, the stakes are small, in part to avoid political friction. The fates of the first four investments are mixed and suggest that there is still much to learn. In October 2007, CITIC Securities agreed to acquire 6 per cent of Bear Stearns, the U.S. investment bank struggling with its mortgage business, which would provide a 2 per cent stake in CITIC in return. When Bear Stearns became insolvent in March 2008 and JPMorgan Chase stepped in as its acquirer, CITIC Securities cancelled its deal. China Investment Corporation (CIC) took a stake in the IPO of Blackstone, the U.S. private equity firm, in May 2007. CIC was widely criticized in Beijing for having paid too much when the share price dropped following the IPO. China Development Bank's July 2007 investment in Barclays included an agreement to invest further if Barclays' bid for ABN-Amro succeeded (it did not). The one investment that appears to be structured for successful learning and partnership is China Minsheng Bank's stake in UCBH Holdings (a San Francisco-based bank that focuses on the ethnic Chinese population in the United States and abroad), acquired in October 2007. Each party acquires the right to board representation in the other, and Minsheng can increase its investment in the future if it receives U.S. regulatory approval.

The third channel for foreign investment is market entry through a banking licence. Both ICBC and China Merchants Bank have applied to the Federal Reserve for U.S. banking licences but have been met with caution, reportedly because of concerns about governance, transparency, and the absence of a legal framework to deal with money laundering. The CBRC has indicated a linkage between the Chinese government's stance on opening wider the door to foreign investors in China's banks and the willingness of other governments to grant banking licences to Chinese applicants.[21]

21. "Beijing in Call for US Banking Licenses," *Financial Times*, 24 September 2007.

In summary, with variable success, Chinese financial institutions have used their growing foreign linkages primarily as a means to increase their efficiency and competitiveness. As China's financial system is further modernized, the banks will face stiffer domestic competition, which will reduce margins and shrink balance sheets, likely resulting in domestic consolidation in the years ahead. It is reasonable to expect, therefore, that only the strongest "brand" candidates will likely be permitted to participate in China's "go abroad" drive. Even then, the available evidence suggests that there is still much to be learned about operating outside of East Asia. Initial investments are still small in financial terms, but they incur reputational risks and add operational complexity. As the domestic environment becomes more competitive, even adverse, banks' abilities to manage these international investments will be tested.

China's Exchange Rate Regime

Most large economies have flexible exchange rates, which free up the central bank to pursue domestic objectives. Pegged exchange rates in a context of highly mobile capital can be fragile, because they can be subject at times to strong speculative pressures for a devaluation or revaluation. The crises in the European Monetary System and in Mexico and East Asia in the 1990s have led most of the larger emerging-market economies to abandon exchange rate pegs and embrace exchange rate flexibility—if not complete flexibility in all cases. China retains extensive capital controls and has a managed exchange rate, but has embraced the principle of greater exchange rate flexibility.

The evolution of China's exchange rate regime has been gradual. In 1994, the official and parallel[22] exchange markets were unified, and the official RMB–dollar exchange rate was devalued sharply following a period of sustained inflation and loss of international competitiveness. The exchange rate has been stable since then, particularly during the turbulent period of the Asian crises in 1997–98.[23] On 21 July 2005, a managed floating exchange rate regime was introduced, and the RMB was allowed to move within a narrow range in reference to an unspecified basket of currencies. Recognizing that Chinese enterprises

22. Applying to non-trade transactions not officially encouraged, and taking place at a more depreciated exchange rate.

23. China's decision not to engage in competitive devaluation to match those of its regional trading partners was widely appreciated in the region, earning China political dividends.

would have to learn to manage associated exchange rate risks, new instruments were introduced to enhance the operations of the foreign exchange market, including an over-the-counter market and foreign exchange and interest rate swaps. From that date until the end of May 2008, the RMB has appreciated by 14.4 per cent in terms of the U.S. dollar, but much less in real effective terms (since most other major currencies have appreciated against the dollar) despite China's large and growing trade surpluses and substantial capital inflows (Chart 2).

Since 1992, China has increasingly become a magnet for foreign investors attracted to its large domestic market and abundant supplies of low-cost, educated labour. China is now the world's third-largest trading nation, exporting labour-intensive manufactures assembled there and importing natural resources, manufactured components, and capital-intensive goods. The speed and magnitude of China's export growth has contributed to a large trade surplus, averaging about 9 per cent of GDP in 2006 and 2007 (Chart 3).

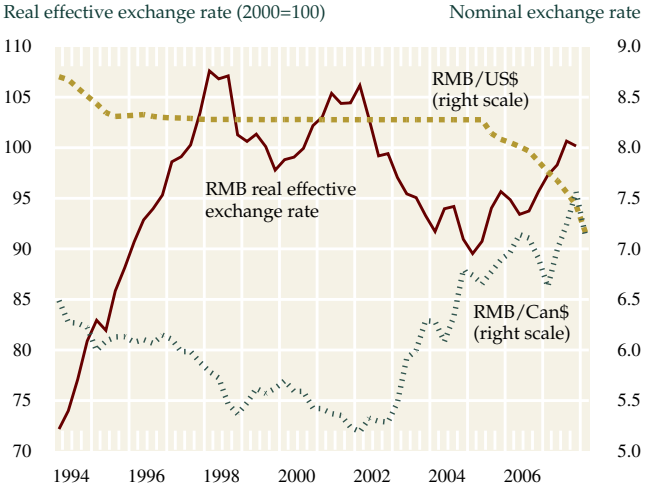
Chinese government concerns about the domestic consequences of large or rapid revaluation are paramount.

In this context, China's stable exchange rate is the subject of prolonged international debate. Some call for greater exchange rate flexibility (Eichengreen 2005), while others call for a one-time revaluation (Goldstein and Lardy 2006). China's trade gains, which have not been reflected in a substantial appreciation of its currency, have come from its comparative abundance of low-cost labour whose productivity is growing. To the Chinese government, concerns about the domestic consequences of large or rapid revaluation are paramount; namely, fear of disruptive adjustment for exporters of labour-intensive manufactures and risks to the low-productivity agricultural sector (on which large numbers of Chinese still depend for employment) from increased import competition.

Large Chinese surpluses need to be seen in the context of global imbalances and, in particular, large U.S. current account deficits.[24] As many have pointed out, including central bank governor Zhou Xiaochuan, balancing China's trade will not by itself resolve the problem of the U.S. current account deficit, which reflects a fundamental savings-investment imbalance. In an attempt to coordinate a solution to the problem of global imbalances, the International Monetary

Chart 2

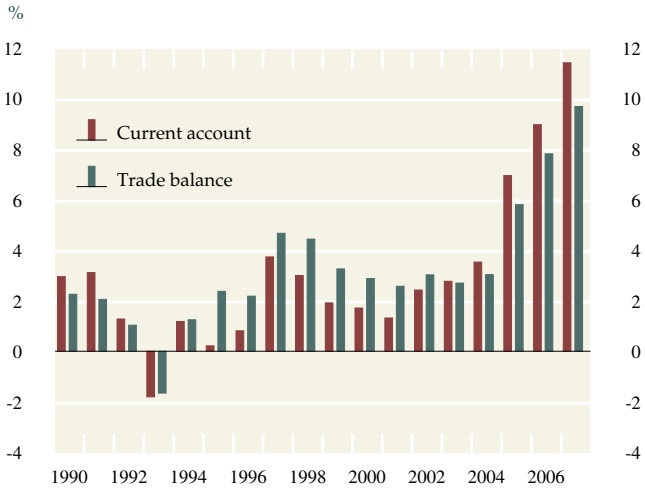
China's Real Effective Exchange Rate and Bilateral Rates with Canada and the United States



Source: IMF *International Financial Statistics*

Chart 3

China's Trade and Current Account Balance as a Percentage of GDP



Source: IMF *International Financial Statistics* (1990–2006), China, SAFE, downloaded from CEIC data (2007)

24. IMF (2007a). For additional insights on why global imbalances are a source of concern, see Dodge (2006a, b) and Little and Lafrance (2006).

Fund has begun multilateral discussions with key players (IMF 2007b). For their part, high-level U.S. and Chinese officials have met many times to try to resolve their differences with respect to trade imbalances and the RMB-dollar exchange rate but, to date, agreement on specific measures has been limited.

China's emphasis on exchange rate stability in the face of rising current account surpluses has forced the central bank to accumulate massive foreign exchange reserves, producing unfavourable domestic consequences as well as generating protectionist pressures abroad.

The accumulation of international reserves on a central bank's balance sheet typically finds its counterpart in monetary expansion, unless these reserves are sterilized, i.e., are not allowed to affect the domestic economy.[25] Sterilization may levy a heavy fiscal cost and introduce distortions into domestic financial systems (Mohanty and Turner 2005). The fiscal costs stem from the fact that the yields on sterilization bonds are typically higher than the returns earned on foreign reserves. While this has not been a problem for China, the recent fall in short-term U.S. Treasury rates has increased the financial burden on the central bank. Moreover, China is exposed to large capital losses on its foreign reserve holdings (which are believed to be largely held in U.S. dollars) as the RMB appreciates.

For these reasons, a key issue for China, given its current level of integration into the international financial system, is when and how to change the exchange rate regime. Eichengreen et al. (1999) argue that international experience shows that the best time to exit from a fixed exchange rate is while capital is flowing into a country. By adopting a *de facto* (as well as a *de jure*) flexible exchange rate, China would gain greater leverage to limit deviations of inflation and growth from chosen targets by means of a monetary policy geared to domestic objectives. An independent monetary policy would allow interest rates to be market determined, which would help in modernizing the banking system, as discussed above. Such a policy does not imply neglecting the exchange rate; it may involve intervening in the exchange market to limit short-run currency fluctuations, but not to resist longer-term trends.

25. There are two main ways to sterilize foreign reserves: either by reinvesting the funds directly abroad, which is basically what a sovereign wealth fund does; or by draining funds from the national banking system by forcing them to hold either government or central bank bonds. So far, China has mainly relied on the latter method, although it has recently created a special fund for foreign investments, the China Investment Corporation, with an initial endowment of US$200 billion.

Eichengreen (2005) points out that a rapid transition to a more flexible exchange rate is not an argument for rapid capital account liberalization. History is replete with examples of countries that have operated managed floats while retaining capital controls (e.g., Europe in the 1930s, Japan in the 1970s, Chile in the 1990s, Brazil and India today).

A key issue for China is when and how to change the exchange rate regime.

Greater exchange rate flexibility would facilitate the liberalization of the capital account by better preparing the economy to deal with the impact of increased volatility associated with freer capital flows. One of the main lessons China drew from the Asian financial crisis is that financial system development and capital account liberalization should be carefully sequenced to allow for the institutional development necessary to manage the additional risks. Studies of countries' experiences have demonstrated that capital account liberalization has to be supported by a combination of sound macroeconomic policies to contain aggregate financial imbalances and sound prudential policies, backed by adequate supervision of the financial system, to ensure proper incentives for risk management (Eichengreen et al. 1998). In summary, the adoption of a monetary policy aimed at domestic objectives would facilitate various reforms that would contribute to China's central domestic goals, a sound and diverse financial system, and greater transparency and effectiveness of monetary policy in its pursuit of low inflation.

Conclusions

China is considerably less integrated into the global financial system than its importance as an investment destination and major exporting country might suggest. These features are best understood in the context of China's overarching domestic priorities to create sufficient modern-sector jobs as it restructures the economy and moves people out of low-productivity agriculture while maintaining political and social stability. China's rapid economic development is likely to lead to substantially more financial integration in coming decades, however, as China invests more

abroad, develops its domestic financial system, and relaxes further its capital controls.

The question of the proper sequencing of domestic financial reforms, exchange rate flexibility, and capital account liberalization naturally arises. Capital controls protect Chinese banks from the risks of foreign currency mismatches that were so harmful to the financial systems of the countries affected by the Asian crisis during the late 1990s.[26] Outward FDI by Chinese banks and SOEs will require further capital account liberalization, however, as Chinese banks also increase their foreign currency business with Chinese companies.

A stable RMB has helped to further the development of China's industrial base, but the managed exchange rate regime has constrained monetary policy, a problem that still needs to be addressed. Greater exchange rate flexibility, allowing a faster appreciation and reducing currency undervaluation, will be necessary to encourage Chinese enterprises to rely more on productivity than on price competitiveness in international markets, to prevent further accumulation of reserves, and to defuse growing protectionist pressures, particularly in the United States and Europe.

While capital account liberalization is likely to continue, leading to greater integration with the global financial system, some elements should be postponed until domestic institutions have further developed their abilities to assess and mitigate risks; supervision and regulation are strengthened; and domestic financial markets develop further.

Much will depend on whether the Chinese authorities are interested in seeing the currency in wide international use.

A more distant issue is when and whether the Chinese currency will play a role on the world stage that is comparable to the size and rate of growth of China's trade (Dobson and Masson 2008). At present, the RMB is not used outside of China except for a modest amount of renminbi balances held at Hong Kong banks. The first step towards more international use of the currency can be expected in East Asia, where it is likely to be used for invoicing and settlement of trade. As capital controls are gradually liberalized, the next step might be the growth in foreign holdings of RMB-denominated assets, followed by RMB borrowing by foreigners in China's capital markets. In the long run, however, much will depend on whether the Chinese authorities are interested in seeing the currency in wide international use. This is still an open question, but it can be argued that, even if the authorities were interested, the RMB will not gain international importance until China has a sophisticated and sound domestic financial system buttressed by an independent central bank, a flexible exchange rate, and open capital markets.

26. Principally Thailand, Malaysia, Indonesia, and Korea.

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House Prices and Consumer Spending

Kimberly Flood and Sylvie Morin, International Department, and Ilan Kolet, Research Department

- *The apparent overvaluation of house prices in several advanced economies is an ongoing concern for policy-makers, since a significant downturn in prices would have adverse effects for consumer spending and the aggregate economy.*
- *House prices influence consumer spending through two main channels: a direct housing wealth effect and a collateral effect.*
- *The evidence cited in this article suggests that the link between house prices and consumer spending is stronger in countries with more-developed mortgage markets characterized by lower down payment ratios, increased availability of home-equity borrowing products, longer average mortgage terms, and a higher degree of mortgage securitization.*
- *The liberalization of mortgage markets since the early 1980s has resulted in a stronger link between house prices and consumer spending.*

The most recent increase in real house prices around the globe, which for some countries now appears to be over, has significantly outpaced previous episodes. Although some studies (e.g., IMF 2008c) suggest that the rapid rise in house prices was not in line with economic fundamentals, the extent of this overvaluation is highly uncertain. Moreover, the impact on global economic growth of a broadly based correction in house prices is not clear. Although some advanced economies have already begun to experience declines in real house prices, consumption expenditures and other measures of demand have not yet fallen appreciably. Nevertheless, the likely adverse effects on consumer spending and the aggregate economy of a significant downturn in house prices are an ongoing concern for policy-makers.

Movements in house prices can affect consumer spending in two ways: through a direct wealth effect implied by the life-cycle and permanent-income theories, or through a collateral effect, by allowing greater access to credit. Under the permanent-income theory, households perceive their houses as wealth, and base their spending decisions in part on movements in net wealth positions. As well, if access to credit for some consumers is contingent on their housing wealth or equity, these credit-constrained households will be able to borrow and spend more, based on an increase in the collateral value of their homes.

The purpose of this article is to examine estimates of the effect of housing wealth on consumer spending in a group of advanced countries, and how institutional differences in national mortgage markets lead to different effects on consumption. The article is organized as follows. The next section contains a brief review of

recent developments in house prices in advanced economies and a discussion of whether, at current prices, houses are overvalued. Next, we summarize the key reasons why house prices might enter into household consumption decisions and explain the role of institutional differences in mortgage markets in the link between house prices and consumer spending. We then discuss how the effect of housing wealth on consumer spending may have changed as mortgage markets in advanced economies have undergone significant deregulation. We conclude with our views on the potential impact on consumer spending of a global slowdown in house price appreciation.

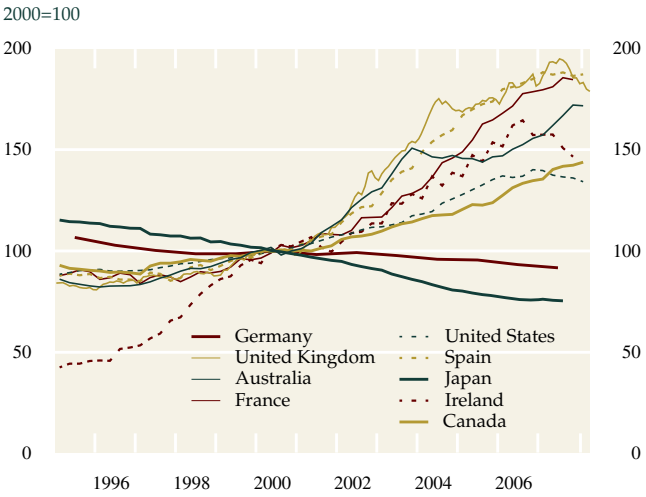
Housing Prices in Advanced Economies

The recent boom in house prices across advanced economies is unprecedented in its size and duration and appears to have been more synchronized across advanced countries than in the past. In a study of 16 countries belonging to the Organisation for Economic Co-operation and Development (OECD), Girouard et al. (2006) find that, since 2000, 13 countries experienced a real increase in house prices that exceeded 25 per cent. Substantial increases in existing house prices occurred in Ireland, the United Kingdom, Spain, France, Australia, the United States, and Canada (Chart 1).[1] In contrast, some countries, such as Germany and, more importantly, Japan, have experienced declines in real house prices over the past 10 years. In Germany, the weakness of the housing sector followed the unification boom and is also related to the withdrawal of tax subsidies in the late 1990s; while in Japan, house prices have been stagnant since the collapse of the housing bubble in the early 1990s. Notably, the countries recently experiencing strong appreciation in house prices have also experienced robust growth in consumer spending, raising the possibility that higher home equity is a key channel stimulating consumer spending (Chart 2).[2]

More recently, the global pace of appreciation in existing house prices has slowed, or reversed (Charts 3 and 4).

Chart 1

Real Residential Property Prices

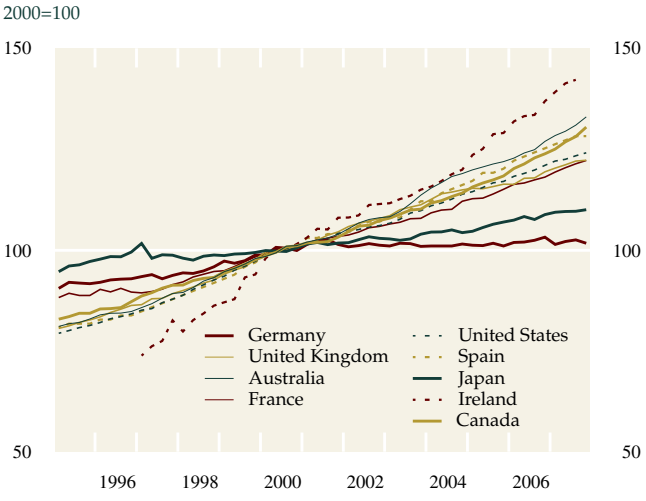


Note: Prices for Japan include land only.
Source: BIS + Datastream

In the United States, the slowdown began in mid-2005, and real house prices have fallen since mid-2007.[3] Signs are also emerging of a cooling in European housing markets, with growth in prices moderating in most countries. In Ireland and, more recently, the

Chart 2

Real Household Consumption



Source: BIS

1. Unlike earlier episodes, where housing booms have been limited to a few regions, for many countries, including the United States, the most recent boom was nationwide (Shiller 2007).

2. The comovement between house prices and consumer spending may also reflect the influence of common factors, such as an improvement in income expectations that will increase demand for consumer spending and housing. This article considers the literature that examines a causal link between consumer spending and house prices and does not examine common factors driving both house prices and consumer spending.

3. Real house prices in the United States are measured using the Office of Federal Housing Enterprise Oversight (OFHEO) index deflated using total consumer price inflation.

United Kingdom and Spain, prices have begun to fall; the International Monetary Fund (IMF 2008a) expects further declines in house prices in these countries over 2008–2009. In Canada, the growth in house prices is expected to moderate, since affordability has deteriorated and economic growth is expected to slow. With few signs of excess supply at the national level, the growth in prices is expected to remain positive (Bank of Canada 2008).

Assessing Global Overvaluation in House Prices

Whether, and to what extent, house prices are likely to experience a pronounced correction is hard to determine. To address this issue, it is necessary to examine prices in light of their underlying fundamentals (or determinants). Typically, these can be decomposed into demand factors (affordability, real disposable income growth, real interest rates, household formation rates) and supply factors (housing stock, land scarcity, and the availability of skilled labour). Countries that have experienced the greatest run-up in house prices, and for which a large share of the increase cannot be explained by fundamentals, are likely to be the most at risk of experiencing a severe correction.

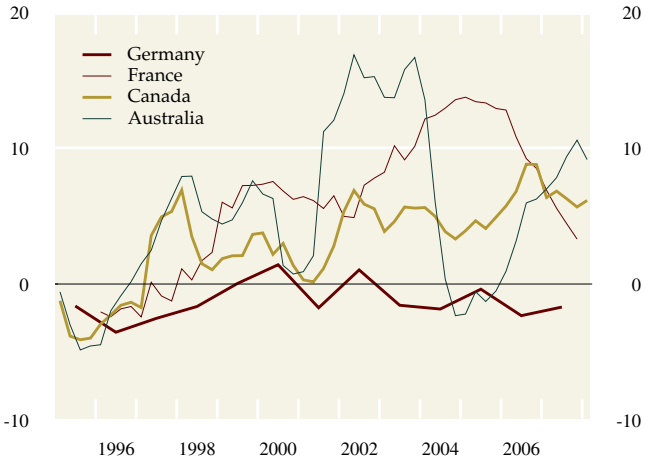
In many advanced countries, a large proportion of the house price increases over 1997 to 2007 does not seem to be accounted for by changes in fundamentals.

A recent IMF study (2008c) finds that, in many advanced countries, a large proportion of the house price increases over 1997 to 2007 does not seem to be accounted for by changes in fundamentals, such as affordability, growth in real disposable income, and real interest rates.[4, 5] Housing prices appear to be most overvalued in Ireland and the United Kingdom, where they are estimated to be about 30 per cent higher than can be justified by fundamentals (Chart 5).[6] The second group of countries where roughly 20 per cent of house prices cannot be explained by fundamentals includes France, Australia, and Spain. The

Chart 3

Real Residential Property Prices

Year-over-year percentage change

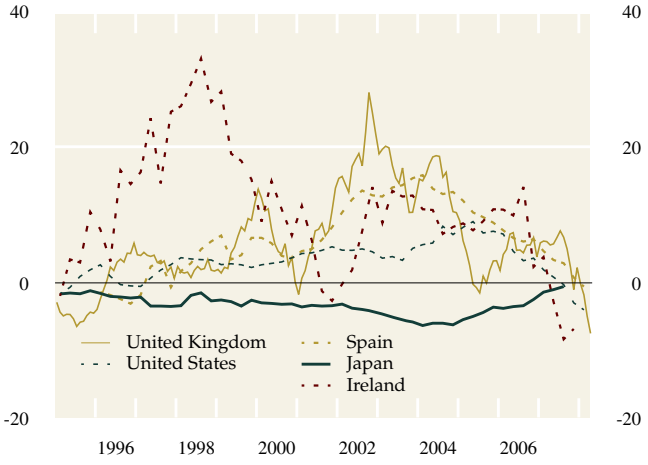


Source: BIS + Datastream

Chart 4

Real Residential Property Prices

Year-over-year percentage change



Note: Prices for Japan include land only.
Source: BIS + Datastream

4. See the IMF's *World Economic Outlook*, April 2008, Box 3.1 "Assessing Vulnerabilities to Housing Market Corrections." Growth in house prices is modelled as a function of an affordability ratio, growth in disposable income per capita, short-term interest rates, long-term interest rates, credit growth, and changes in equity prices and working-age population.

5. Several criticisms can be made of this study; e.g., credit growth is not part of fundamentals, it is a facilitator at best, and it can be an amplifier of house prices.

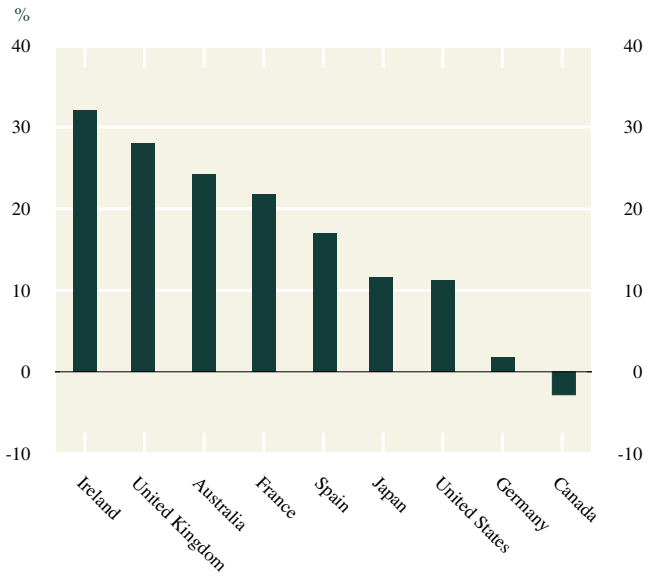
6. The IMF study does not include supply factors. The overvaluation in countries with land scarcity (e.g., the United Kingdom) may therefore be overestimated.

overvaluation appears to be more limited in the United States (about 10 per cent), where a decline in house prices has already begun.[7] In Germany and Canada, recent price levels appear to be roughly in line with fundamentals. Consistent with the IMF's findings, the OECD (2008) finds that prices in the United States, the United Kingdom, Ireland, and Spain are overvalued relative to fundamentals.

Considerable uncertainty surrounds these estimates, however, since house prices can be affected by specific features of national housing markets that are not captured by the IMF's model. In the United Kingdom and Ireland, for example, homebuilders' ability to respond to higher house prices is constrained by complex zoning rules and slow administrative procedures.[8] Fiscal incentives in some countries, such as the Netherlands, have also played a role by creating favourable conditions for those choosing to invest in housing. Nevertheless, given the risk that housing may be overvalued in many advanced economies, it is important to evaluate the effect of house prices on consumer spending.

Chart 5

House Price Gaps



Note: Gaps are the percentage of increases in house prices that cannot be explained by fundamentals.
Source: IMF staff calculations

The Effect of Housing Wealth on Consumer Spending

A well-developed literature based on the permanent-income hypothesis or the life-cycle model has established a link between consumption and wealth (Friedman 1957; Ando and Modigliani 1963). According to the permanent-income hypothesis, a household's consumption in any given period is equal to its permanent income, defined as the annuity value of household wealth.[9] The current value of household wealth is the sum of human wealth and non-human wealth. Non-human wealth includes both financial and housing wealth, with housing wealth often forming the largest component of household assets.[10]

Housing wealth may have a larger effect on consumption than changes in financial wealth, since it is spread more evenly across the population.

Unexpected wealth shocks change the permanent income of households and thereby affect the life-cycle pattern of saving and consumption which, in its most basic form, implies that the marginal propensity to consume (MPC) out of wealth should be the same across different categories of wealth, including financial, housing, and human wealth.[11] A companion literature has argued, however, that shocks to different forms of wealth can elicit varying consumption responses. For example, the effect of housing wealth on consumption may be larger than the effect from other forms of wealth. First, households may view some forms of wealth as more uncertain (Lettau and Ludvigson 2004; Case, Quigley, and Shiller 2005), and since house prices are typically less volatile than stock

7. Real house prices as measured by the OFHEO index have already declined by 4 per cent since 2006Q4. Other measures, such as the Case-Shiller index, suggest that much larger declines have taken place.

8. The United Kingdom has also experienced a less-pronounced increase in residential investment, which may indicate that recent price appreciation has been driven by supply shortages.

9. Assuming that older generations do not plan to leave money behind to younger generations (i.e., a bequest motive).

10. In Canada and the United States, housing wealth accounts for approximately 20 and 30 per cent, respectively, of total gross household assets, while in most major European countries it accounts for between 30 and 40 per cent of household assets. In Japan, housing wealth represents only about 10 per cent of household assets.

11. The MPC is the ratio of a change in consumer expenditure to a change in either disposable income or in any measure of wealth.

prices, households may view gains in housing wealth as more permanent. Second, these differences in cross-asset wealth effects may be related to distributional effects. Empirical evidence suggests that the MPC out of wealth is lower for higher-income households (Souleles 1999), suggesting that housing wealth may have a larger effect on consumption than changes in financial wealth, since it is spread more evenly across the population.

There are also reasons why the effect of housing wealth on consumption may be smaller than that from other forms of wealth. First, for homeowners, an increase in the value of their housing wealth will be matched by an increase in their implicit rental cost and should not raise the volume of their spending.[12] Second, for households saving to buy a house, higher house prices could reduce consumption, since these households must increase their savings to finance the more expensive purchase. Third, unlike increases in financial wealth, increases in housing wealth may reflect supply constraints rather than an increase in the productive potential of an economy or an improvement in economic conditions. Finally, housing wealth may be less liquid than other types of wealth because of high transactions costs (e.g., refinancing fees) when borrowing against home equity to finance consumption.

The effect of house prices on consumer spending may also reflect the important role played by housing wealth as collateral for borrowing. In many countries, it is common for households to finance their spending through debt, which is often obtained through secured consumer loans that require the borrower to put up collateral.[13] The primary form of collateral available to most households is their housing equity, so that the borrowing capacity of some households may be tied to the value of their homes.[14] An increase in the value of their homes thus increases the amount of collateral available, which can increase the quantity and improve the price of credit available to these households (Mishkin 2007). Rising house prices may therefore encourage consumers to borrow more, causing an increase in consumer spending.

Overall, several factors suggest not only that the effect of housing wealth on consumption is likely to differ from that of other forms of wealth but, like other wealth effects, it is uncertain. Moreover, even if households view an increase in house prices as an increase in their wealth, they may not adjust current spending because of financial constraints. In particular, consumers may be precluded from consuming their housing wealth if they cannot draw on other liquid assets or borrow to finance their consumption of housing wealth.

Empirically, estimates of the effect of housing wealth on consumption vary across countries (see Table 1). The housing wealth effect is estimated to be the strongest in Japan, the Netherlands, the United States, Australia, the United Kingdom, and Canada. Spain and France, however, have relatively low MPCs out of housing wealth. This may be related to the less-developed mortgage markets in the latter countries, which constrain the ability of consumers to borrow against their housing wealth.

Some studies also examine whether consumers' responses to changes in housing wealth are asymmetric. Case, Quigley, and Shiller (2005), using a panel of U.S. states, find that increases in housing wealth have positive and significant effects on consumption, but that declines in housing wealth have no effect. In contrast, Skinner (1996) and Engelhardt (1996) find that declines in housing wealth have a larger effect on consumption (2.5 times stronger, by Skinner estimates) than increases in housing wealth. Although most of these studies use U.S. data, there is also some international evidence. For example, Disney, Gathergood, and Henley (2007), using U.K. data, find no evidence

Table 1

Estimated MPCs out of Housing Wealth across Advanced Economies

	Marginal propensity to consume (MPC) (%)
Australia	7 (Catte et al. 2004)
Canada	5.7 (Pichette and Tremblay 2003)
France	4 (Catte et al. 2004)
Japan	between 12 (Ogawa et al. 1996) and 20 (Girouard and Blöndal 2001)
Netherlands	8 (Catte et al. 2004)
Spain	2 (Catte et al. 2004)
United Kingdom	7 (Catte et al. 2004)
United States	between 2 (Girouard and Blöndal 2001) and 11.3 (Palumbo, Rudd, and Whelan 2002)

12. Since consumer spending includes imputed rent, higher housing wealth automatically increases consumer spending. However, this would be reflected in the deflator, rather than in the volume of consumer expenditures.

13. Secured loans are often preferred to unsecured loans, since collateral reduces the agency costs associated with borrowing and reduces the price of credit for borrowers.

14. The fact that most secured borrowing is based on housing equity helps to explain why housing wealth has a bigger effect on spending than other types of wealth in some countries.

of significant asymmetry in response to unanticipated changes in house prices, but find that the response of households with negative equity is five times stronger than the response of those with positive equity. This finding likely reflects the impact of credit constraints on these households. The authors therefore conclude that an increase in prices that lifts households out of negative equity induces a disproportionately large consumption response.

Other authors examine the effect of house prices on consumer spending through the collateral channel. Most economic models for households that include an explicit role for collateral or credit-market effects on consumption do so by adapting for households the financial-accelerator model of Bernanke and Gertler (1995) and Bernanke, Gertler, and Gilchrist (1999), where endogenous developments in credit markets modelled as variations in net worth or collateral amplify and propagate shocks to the macroeconomy. In the context of housing wealth, fluctuations in house prices significantly alter the value of houses as collateral, influencing the borrowing capacity of credit-constrained households. In one of these studies, Iacoviello and Neri (2008) find that housing collateral effects increase the reduced-form elasticity of aggregate consumption to housing wealth in the United States by around 2 basis points, from 0.10 to 0.12.[15] Results from Aoki, Proudman, and Vlieghe (2002) suggest that, in the United Kingdom, the collateral channel also increases the sensitivity of consumption to changes in house prices. Overall, it is likely that the increased use of houses as collateral has strengthened the feedback effect of rising house prices on consumption via increased household borrowing (IMF 2008b).

The effect of housing collateral on consumer spending has often been analyzed by taking into consideration home-equity borrowing, which is a particular type of collateralized borrowing. Home-equity borrowing occurs when homeowners extract equity from their homes by increasing their mortgage debt, thus transforming an illiquid asset (housing) into a liquid asset (cash).[16] This transformation of wealth can occur through the refinancing of property with a larger mortgage, by obtaining a home equity loan, or through housing turnover. Housing turnover can result in a reduction of home equity because consumers might make a down payment on the new home that is smaller than the equity accumulated in the old property and obtain a new larger mortgage to finance the difference.

Whether home-equity borrowing boosts consumption spending or is used to acquire financial assets or to finance investment is an important issue, since house prices are widely considered to be the main determinant of home-equity borrowing. This implies that, as house prices decelerate among the major advanced economies, home-equity borrowing will also fall, potentially depressing consumption expenditures by more than the amount suggested by the traditional wealth effect.[17] On the other hand, home-equity borrowing can be seen as a new source of financing that merely operationalizes the wealth effect. In this case, consumers' use of home-equity borrowing implies that they were previously constrained in their ability to consume their wealth or that home-equity borrowing represents a lower-cost means of financing the consumption of housing wealth. Finally, home-equity borrowing may also be used by households as a means to rebalance their portfolios by diversifying away from housing wealth.

Evidence on the effect of home-equity borrowing on global consumption expenditures is mixed.

Empirical evidence on the effect of home-equity borrowing on global consumption expenditures is mixed. In the United States, although most research finds that home-equity borrowing does not play a significant role beyond that of the traditional housing wealth effect, other analysts find the reverse. Belsky and Prakken (2004) note, however, that when a significant effect on consumer spending from home-equity borrowing is found in the United States, the coefficients are very sensitive to the sample period and to the equation specification. Furthermore, studies citing

15. This difference is found to be statistically significant.

16. Home-equity borrowing can be divided into "active" and "passive" types. Active home-equity borrowing is the reduction in home equity on a current property and is so termed because the homeowner intends to use the cash generated from the additional debt for consumption or investment purposes or to pay down other debt. Home-equity borrowing resulting from housing turnover is referred to as passive because relocation provides homeowners with the opportunity to reduce home equity, which might not have been their original intention.

17. Importantly, home-equity borrowing may also provide financing for other types of spending such as spending on home renovations. Therefore, the studies that examine only the effect of home-equity borrowing on consumer spending would not capture the complete effect on aggregate spending.

survey evidence suggesting that homeowners spend the funds they receive through home-equity borrowing (e.g., Canner, Dynan, and Passmore 2002) often ignore whether consumers used the funds to finance purchases they otherwise would not have made or to finance investment and diversify portfolios.

Not surprisingly, the international evidence suggests that the effect of home-equity borrowing differs across countries. In two cross-country OECD studies (Boone, Girouard, and Wanner 2001; Catte et al. 2004), home-equity borrowing is found to be strongly associated with a high estimated marginal propensity to consume from housing wealth. Indeed, Catte et al. (2004) find that 89 per cent of home-equity borrowing is spent in the United Kingdom, 63 per cent in Canada and Australia, and 20 per cent in the United States. For Canada, these results are consistent with evidence from the Bank of Canada (2007) that suggests that home-equity borrowing has been an important contributor to growth in consumer spending since 2001. Catte et al. (2004) conclude that households use the equity extracted through home-equity borrowing primarily to acquire financial assets or to repay other debts. Spending intentions were focused principally on home improvements, with less than 20 per cent of home-equity borrowing generally used to finance consumption. Hence, although some home-equity borrowing is consumed, it appears to be used primarily as a tool for acquiring financial assets, repaying more expensive debts, improving the housing stock, or financing unincorporated businesses.

The Role of Institutional Differences in Mortgage Markets

The deregulation of housing finance systems (see Box) has led to significant heterogeneity in the institutional characteristics of national mortgage markets across advanced economies that could affect the magnitude of the observed housing wealth and collateral effects. Such institutional characteristics include the typical duration of mortgage contracts, the required levels of down payment, the existence of equity-release products such as home-equity lines of credit, and the interest rate structure of mortgage contracts (Table 2).

Across countries, there is a high degree of dispersion in all the indicators considered in Table 2. The ratio of mortgage debt to gross domestic product (GDP) varies from a low of 32.2 per cent in France and 45.3 per cent in Canada to a high of 98.4 per cent in the Netherlands. Refinancing (fee-free prepayment) is easily available in some countries, but is either unavailable or its availability is limited in others, including Canada. Likewise, in some countries (e.g., Canada, the United States, and the United Kingdom), households can easily access their housing equity through home-equity borrowing products, while in others (e.g., Japan) these products do not exist or have limited availability. There is also a large degree of dispersion across the average term of mortgage loans, which range from 15 years in France to 30 years in the United States.

Despite deregulation, mortgage markets remain primarily domestic in nature.

Significant heterogeneity exists in the interest rate structure of mortgage loans across countries. In the United Kingdom and Spain, variable or adjustable-rate mortgages predominate, while in Canada, France, the Netherlands, and the United States, fixed-rate mortgages are more popular.[18, 19] Finally, the home ownership rate varies, from 43.2 per cent in Germany and 68.4 per cent in Canada, to as high as 86.3 per cent in Spain. Despite deregulation, mortgage markets remain primarily domestic, reflecting national traditions and cultural factors as well as the institutional setting of the local banking sector (Calza, Monacelli, and Stracca 2007).

The characteristics of mortgage markets across countries play an important role in determining the strength of the link between house prices and consumer spending. Calza, Monacelli, and Stracca (2007) find that the correlation between private consumption and house prices in the main industrialized countries is larger in those that feature more-developed mortgage markets with lower down payment ratios, lower rates of repayment, and a greater share of variable-rate mortgages. In a similar vein, the IMF (2008b) has developed a mortgage market index that measures the

18. Heterogeneity also exists across countries in the tax deductibility of mortgage-interest payments; for example, mortgage interest is tax deductible in the United States, while in Canada it is not.

19. In Canada, the popularity of variable-rate mortgages varies with the slope of the yield curve.

Mortgage Market Deregulation

The recent period of rapid appreciation in global house prices has occurred alongside substantial innovations in mortgage markets across advanced economies. Before 1980, mortgage markets were highly regulated by national authorities and were characterized by weak competition among lenders. Mortgage lending was often largely controlled by specialized mortgage lenders that received significant tax or funding subsidies. Although regulations differed across countries, they often included the fixing of lending and deposit interest rates, limited access to consumer loans secured on the value of housing collateral, and restrictions on the quantity of mortgage credit available through ceilings on permissible loan-to-value ratios and limits on mortgage credit extension. In light of these regulations, it was difficult for households to increase consumer spending in response to increases in their housing wealth, since their borrowing capacity was often constrained by credit rationing in the mortgage market (Girouard and Blöndal 2001).

In Canada, mortgage market deregulation began somewhat earlier than in other advanced countries and occurred mainly via the removal, in 1967, of ceilings on lending interest rates and restrictions on the involvement of commercial banks in housing finance. These measures have stood the test of time and have served Canada well. For example, early liberalization in Canada has meant better matching of terms of mortgages and deposits (mostly five years and less); it also helped the Canadian mortgage market to avoid the upheaval when interest rates rose between 1979 and 1981. The legislation also aimed at establishing a level playing field for banks and trust and mortgage loans companies by allowing banks to enter the mortgage lending market.

In the United States, the regulation of mortgage lending largely occurred through restrictions on the activity of the savings and loan associations that monopolized the mortgage market. Before the 1980s, regulation and tax advantages forced these institutions to concentrate their lending operations in long-term, fixed-rate mortgages, which they funded with short-term deposits insured by the Federal Savings and Loan Insurance Corporation (FSLIC). At the same time, the Federal Reserve's Regulation Q set strict interest rate ceilings on their deposits. Savings and loan associations therefore faced a sharp outflow of low-rate deposits when money market rates rose above the ceilings set on deposit interest rates and were forced to restrict lending activity and reduce credit availability to households.

Banks in Australia were required to follow guidelines on the composition of their balance sheets and faced controls on their deposit and lending rates. In the United Kingdom, housing finance was primarily funded by building societies that charged below-market rates on mortgage loans and rationed mortgage debt, partially as a result of explicit government requests to limit its growth. Likewise, in France, the banking system was highly specialized and segmented, limiting the ability of banks and other financial institutions to enter the housing finance market. As well, access to mortgage credit was restricted by the use of credit controls and interest rate ceilings.

Over the 1980s, mortgage markets in most advanced economies were deregulated, increasing competition among lenders and improving households' access to mortgage credit and their ability to borrow against their housing equity. Mortgage market deregulation began in the United States with the gradual phasing out of Regulation Q between 1980 and 1986. At the same time, tax advantages for savings and loan associations and the development of a secondary mortgage market increased competition by encouraging the entry of a broader range of financial institutions. Mortgage market deregulation also occurred relatively rapidly in the United Kingdom and Australia, where credit controls were removed in the early 1980s.

In contrast, in some countries, including Germany, France, and Japan, the reform process was slower and less extensive. Although interest rate restrictions have been removed, competition in the mortgage market remains limited in these countries because public sector financial institutions continue to benefit from substantial advantages. In Japan, interest rate restrictions and credit controls were removed very gradually and were not eliminated completely until the mid-1990s.

Since early 2000, one noticeable innovation in mortgage markets has been the rapid growth of subprime mortgage borrowing. In 2006, the U.S. subprime mortgage market accounted for about 14 per cent of the total mortgage market. Subprime mortgage lending has also grown rapidly in Canada and the United Kingdom, although to a much smaller degree than in the United States. In the United Kingdom, subprime mortgages represent between 3 and 4 per cent of the total mortgage market, while in Canada, they account

Mortgage Market Deregulation (cont'd)

for less than 5 per cent of total mortgages outstanding.[1] A common feature of subprime mortgage lenders is their reliance on securitization as their primary source of funding. More recently, subprime lending, most notably in the United States, has collapsed as declining house prices led to a sharp increase in default rates on subprime mortgages. These developments triggered turmoil in financial markets as investors became concerned about which institutions and investors were exposed to these types of securities. As a result, U.S. subprime mortgages have declined dramatically as a share of total mortgage originations.

1. Moreover, subprime mortgages in Canada are more conservative than in either the United Kingdom or the United States, since lenders in Canada focus more on near-prime and Alt-A customers and offer more conservative mortgage products (Bank of Canada 2007). Near-prime customers are borrowers just outside the comfort zone of major financial institutions. Alt-A customers are borrowers with a good credit history but a lack of income documentation.

Table 2

Characteristics of Mortgage Markets

Country	Ratio of mortgage debt to gross domestic product (2006) (%)	Refinancing (fee-free prepayment)	Home-equity borrowing availability	Average term (years)	Loan-to-value ratios, typical (%)	Interest rate adjustment	Home ownership rate (%)	Mortgage market index
Australia	81.4	Limited	Yes	25	80	Mainly V	70.0	0.69
Canada	45.3	No	Yes	25[a]	80–100	FL and FS (77%) V (23%)	68.4	0.57
France	32.2	No	No	15	73.5	FL/FS/Other (86%) V (14%)	56.5	0.23
Germany	51.3	No	No	25	70	Mainly FL and FS	43.2	0.28
Ireland	70.1	No	Limited	20	70	V (70%) Rest mostly FS	74.5	0.39
Japan	36.5	No	No	25	80	FL (36%) FS and V (64%)	60.9	0.39
Netherlands	98.4	Yes	Yes	30	90	FL (74%) FS (19%) V (7%)	54.2	0.71
Spain	58.6	No	Limited	20	70	V (75%) Rest mainly FS	86.3	0.40
United Kingdom	83.1	Limited	Yes	25	75	FS (28%) V (72%)	70.0	0.58
United States	76.3	Yes	Yes	30	80	FL (85%) FS (15%)	67.8	0.98

a. Recently, however, longer amortization periods (for up to 40 years) have proven successful. These extended amortization periods are available for insured mortgages. Beginning in October 2008, the maximum amortization period on insured mortgages will be 35 years.

Source: Column (2) and part of column (8) are from the European Mortgage Federation (2006) supplemented with data from Statistics Canada, the U.S. Census Bureau, and the Japanese Statistics Bureau. Columns (1), (3), (4), (5), (6), and part of column (8) are from IMF (2008b), and column (7) is from Calza, Monacelli, and Stracca (2007). In column (7), mortgages are classified according to the rate structure, where FL = fixed-rate mortgage, in which interest rate are fixed for more than five years or until expiry; FS = mixed mortgages, in which interest rates are fixed for one to five years; and V = variable mortgages, in which interest rates are renegotiated after one year or are tied to market rates, or are adjustable at the lender's discretion.

degree of mortgage market development in a given country.[20] The IMF (2008b) finds that mortgage markets in the United States and Australia are the most flexible and complete. Canada and the United Kingdom also have well-developed mortgage markets; Canada's solid mortgage market has a variety of terms (mostly five years or less) and conservative lending practices that have stood the test of time. The mortgage market in the United States generally consists of fixed-rate loans with long maturity and prepayment options. These characteristics may lead households to underestimate the long-term risks, resulting in overborrowing. Access to financing is more limited in France and Germany. Moreover, the MPC out of housing wealth is generally found to be higher for countries with more-developed mortgage markets, as measured by higher values of the mortgage market index; Japan, however, is a notable outlier (Chart 6).

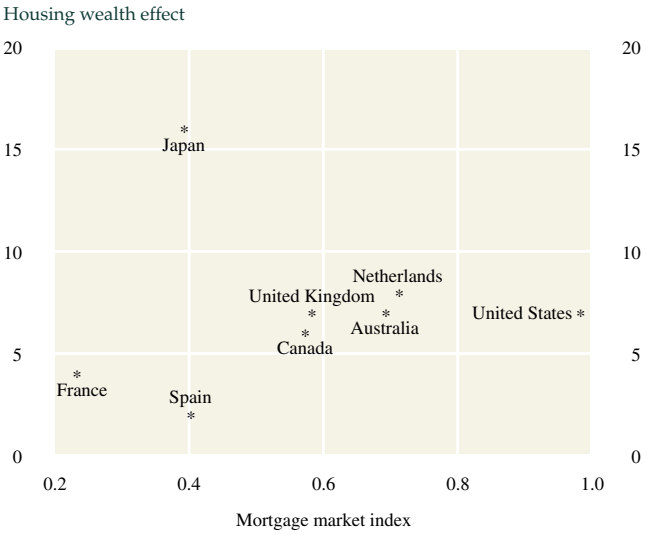
The MPC out of housing wealth is generally found to be higher for countries with more-developed mortgage markets.

Although the level of development in a country's mortgage market is a significant determinant of the strength of the housing wealth effect, it is also important to consider the role played by institutional differences across national mortgage markets. As mentioned previously, home-equity borrowing is used more extensively in the United States, the United Kingdom, and Australia, but its availability is limited in Germany (see Table 2). This country split coincides with that between countries with market and bank-based financial systems and may suggest that the availability of home-equity borrowing products depends, in part, on lenders' ability to raise loanable funds and transfer risk through capital markets. Furthermore, this may be related to the fact that mortgage market liberalization and deregulation generally took place earlier and

20. The index is constructed as a simple average of the availability of home-equity borrowing, refinancing, the typical loan-to-value ratio, the average term of a mortgage contract, covered bond issuance as a per cent of residential loans outstanding, and mortgage-backed securities as a per cent of residential loans outstanding. The index lies between 0 and 1, with higher values indicating easier household access to mortgage credit.

Chart 6

Housing Wealth Effects and the Mortgage Market Index



was more extensive in market-based financial systems. Consequently, the MPC out of housing wealth tends to be higher in countries with access to home-equity borrowing, again with the exception of Japan (see Table 2).

The collateral effect on consumer spending is likely to be the largest in countries with a high loan-to-value (LTV) ratio, such as the United States, which also have more-developed subprime mortgage markets. As suggested by Iacoviello and Neri (2008), a higher LTV ratio increases the maximum borrowing capacity of households (measured by the expected present value of their home multiplied by the LTV ratio). At the same time, a higher LTV ratio has been found to decrease the share of credit-constrained consumers in an economy (Japelli and Pagano 1989). Therefore, the larger the LTV ratio, the higher the liquidity of housing wealth and the larger the effect of housing collateral on consumption (Chart 7).

The wealth effect on consumer spending may also be larger in countries with a higher rate of home ownership, since owner-occupiers and renters may react differently to an increase in house prices. A rise in house prices increases the wealth of homeowners and can induce a positive effect on consumer spending. For renters, however, a rise in house prices raises expected future rents and the down payment requirement for

Chart 7

Housing Wealth Effects and the Loan-to-Value Ratio

those saving to purchase a house, which may cause them to reduce their spending.

Other institutional features of mortgage markets, including the degree of securitization, the magnitude of transactions costs, and the use of credit-scoring techniques, also affect the magnitude of the collateral and housing wealth effects on consumer spending. First, the ability of lenders to securitize mortgages and other consumer loans can reduce the cost of mortgages and increase the availability of mortgage credit by providing lenders with access to a wider range of investor capital and increasing their ability to manage their capital (Klyuev and Mills 2006). As well, advances in credit-scoring techniques reduce the problem of asymmetric information and have improved borrowers' access to credit. Such developments are prevalent in the United States, where a large share of mortgages is securitized. Recent events there suggest, however, that securitization can come at the cost of reducing the lender's incentive to practise prudent lending standards, since the originator of mortgages does not hold the securities on its balance sheet. Transactions costs are another important factor governing consumers' ability to spend their housing wealth. When it is costly to withdraw housing equity, more homeowners are likely to face credit constraints. To summarize, in countries with a high degree of securitization, lower transactions costs, and better credit-scoring techniques, such as the United States and the United Kingdom, the collateral and housing wealth effects are likely to be larger.

Overall, based on their mortgage market characteristics, the countries considered can be split into two groups. Countries in group one, including the United States, the United Kingdom, and Canada, have more-developed mortgage markets and tend to have higher ratios of mortgage debt to GDP, higher LTV ratios, and access to home-equity products. Countries in group two, including Germany and Italy, have less-developed mortgage markets. The effect of housing wealth on consumer spending is generally estimated to be larger in the group of countries with more-developed mortgage markets. Japan is a notable exception, with a relatively high MPC and a relatively less-developed mortgage market.

Has the Link between House Prices and Consumer Spending Changed?

The link between housing wealth and consumer spending has evolved in parallel with the deregulation of mortgage markets (see Box), which has been achieved through changes in prudential and wider capital market regulations, improvements in technology and reductions in its cost, developments in the sharing of information on credit histories, and the deepening of markets for securitized contracts and derivatives (Muellbauer 2007). As a result, households have gained greater access to unsecured and secured credit, reducing the number of credit-constrained consumers (Dynan, Elmendorf, and Sichel 2006; Iacoviello and Neri 2008). These developments have also significantly reduced the costs associated with accessing home equity (Bennett, Peach, and Peristiani 2001). Furthermore, household debt levels have increased as households have taken advantage of their greater ability to borrow against their home equity, resulting in a stronger link between house prices and consumer spending.

Mortgage market deregulation may have also increased the responsiveness of consumption to a given change in house prices by increasing the average LTV ratio across countries. Campbell and Hercowitz (2005), for example, argue that by reducing the equity requirements associated with collateralized borrowing, the recent changes in housing finance systems may have enhanced the ability of households to borrow as well as strengthening the collateral effect on consumer

spending. In addition, as LTV ratios have increased, it is likely that younger households saving to buy their first home have reacted by lowering their savings as the amount needed for their initial down payment has declined. It is possible that this has reduced the negative impact of house prices on the consumption of this demographic group (Muellbauer 2007).

The link between housing wealth and consumer spending has evolved in parallel with the deregulation of mortgage markets.

The empirical evidence across countries confirms that financial deregulation has likely strengthened the wealth effect of rising house prices on consumption.[21] For the United States and the United Kingdom, Boone, Girouard, and Wanner (2001) find that, beginning in the 1980s, financial deregulation strengthened the effect of house prices on consumer spending. In continental Europe, where financial reforms were implemented later, they find that the same effects did not begin until the early 1990s. This is consistent with evidence from Case, Quigley, and Shiller (2005), who find that the effect of housing wealth on consumption in the United States has increased with the greater availability of home-equity loans. Overall, evidence from Bayoumi and Edison (2003), who examine a panel of 16 advanced countries, suggests that the size of the housing wealth effect has risen as financial deregulation has taken place, from an MPC of 4 cents per dollar between 1970 and 2000 to an MPC of 7 cents per dollar between 1984 and 2000.

Conclusion

Over the past 10 years, many advanced economies have experienced a tremendous increase in house prices and, not surprisingly, a concomitant increase in consumption expenditures. While some of this increase is likely related to fundamentals, including low borrowing rates, increased incomes, and financial innovation, at times the increases have been outside of the range suggested by these fundamentals. The recent decline in house prices in some major economies, most notably in the United States, has raised concerns about potential spillover effects on consumption and growth. From reviewing a broad spectrum of literature, we find that house prices play an important role in household spending decisions for several countries. This link is stronger in countries like Australia, Canada, the United States, and the United Kingdom, which have more-developed mortgage markets, than it is in countries like Spain and France, which have less-developed mortgage markets. These results suggest that, in the event of a major global correction in house prices, the link between house prices and consumer spending can pose serious challenges for policy-makers. In particular, rapid decreases in the price of housing can have serious implications for aggregate output and should help to contain inflation, particularly if a house price correction is followed by a significant downturn in consumption expenditures. Furthermore, the negative consequences associated with a general decline in global house prices would be expected to be greatest for those countries where house prices are seriously overvalued and where consumption expenditures and house prices are closely linked (e.g., the United States, the United Kingdom, the Netherlands, and Australia).

21. Although not examined in this article, it is also likely that financial deregulation has had a direct effect on house prices, contributing to the recent global increases.

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A Tool for Assessing Financial Vulnerabilities in the Household Sector

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- *An environment of low interest rates, coupled with the rapid pace of innovation in the financial sector, has contributed to a significant increase in the indebtedness of Canadian households.*
- *Data showing the indebtedness of individual households are useful for assessing how the proportion of households with high debt burdens is changing.*
- *This article presents an innovative framework that uses household-level microdata to simulate changes in the distribution of the debt-service ratio under various stress scenarios. This tool will enable researchers to refine their analyses of current risks to the financial health of Canadian households.*

In recent years, an environment of low interest rates, combined with a rapid pace of innovation in the financial sector, has contributed to a significant increase in the indebtedness of Canadian households. In the short run, this increase has boosted consumer spending and economic growth; it has also led to increased debt-payment obligations for Canadian households. These obligations are measured by the debt-service ratio (DSR), which represents the portion of their income that households devote to servicing their debt obligations. A rising DSR could cause a steady deterioration of household financial health.

The Bank of Canada regularly assesses the potential financial risks related to household indebtedness in its *Financial System Review*.[1] Some of this analysis is based on aggregate data for the household sector. These data have limitations, however, since they do not contain information on changes in the distribution of indebtedness across different households and, in particular, on how the proportion of households with potentially high debt burdens evolves. Thus, research published in the *Financial System Review* has increasingly used household microdata to assess current risks in the household sector and to conduct simulations of changes in the distribution of the DSR under various stress scenarios.

This article presents a detailed account of the Bank's method of analyzing the impact of economic shocks on the household sector through the use of microdata. We begin with a discussion of the microdata and a critical DSR threshold of financial vulnerability.

1. See, for example, Bank of Canada (2007) and Djoudad and Traclet (2007).

We then describe a new framework to simulate the impact of various economic shocks on the household balance sheet and perform several simulation exercises to illustrate the range of applications that can be produced using this tool. We conclude with comments on future directions for refining the Bank's household sector risk analyses.

A Comparison of the Microdata Sets

The Bank's DSR simulations use the Ipsos Reid Canadian Financial Monitor (CFM) household microdata because they are available on a regular basis. Statistics Canada's Survey of Financial Security (SFS) also provides household microdata, so it is useful to examine whether the two sources are broadly similar. We describe key features of these data sets and compare their descriptive statistics.

Description of the data sets

Like the SFS, the CFM contains Canadian household balance-sheet information. The data sets differ, however, in important ways. First, survey frequency and sample size differ. The CFM has conducted a monthly survey of approximately 1,000 households (for an annual total of 12,000) since 1999. The SFS surveys are less frequent, with the last two waves taking place in 1999 and 2005. As well, the SFS sample size varies between waves: about 16,000 households were surveyed in 1999 compared with 5,000 in 2005. The regular and timely updates of the CFM data are important factors that allow us to analyze changes over time in household financial conditions.

Second, the CFM provides superior coverage of debt payments, with details on credit cards, bank loans, and mortgages in every survey year. The SFS provides information on mortgage payments for 1999 and 2005 and only began to include data on non-mortgage payments in 2005. This is also an important difference, because the analyses of changes in the DSR over time require detailed information for both mortgage and non-mortgage debt over extended periods.

Third, the methods of collecting the data are different. Although both surveys aim to capture data on Canada's major demographic and geographical subgroups, the CFM conducts mail surveys, while SFS data are gathered via telephone and personal interviews. One important concern of a household financial survey is to capture the distribution of income and wealth across households. Since income and wealth are highly concentrated within a few "rich" households, both the CFM and the SFS oversample high-income households in order to collect reliable information for this group. The methodology used for the CFM makes it less likely to capture detailed information on very wealthy households.[2]

Finally, the presentation of variables differs. In the CFM, quantitative information on debts, assets, income, and payments is coded in ranges, while the SFS provides dollar values exactly as reported by respondents.[3]

Definition of variables

To facilitate the comparison, the main variables used in the analysis were constructed to be as consistent as possible over the two data sets. Our key variables are defined as follows:

(i) total household debt: the sum of balances outstanding on all forms of debt, including credit cards, mortgages, personal loans, and personal lines of credit (PLC)

(ii) total assets: liquid assets plus registered savings plans, registered pension plans, real estate, and vehicles

(iii) total household income: the sum of all income of household members.

The debt-service ratio (DSR) is as follows:

$$DSR = \frac{payments}{income} \text{x} 100 ,$$

where payments (both principal and interest) include those on credit cards, auto leases, personal loans, personal lines of credit, and mortgages, while income is that of the household.

Results of the comparison

We compared the contents of the CFM and SFS data sets for 2005 under several categories: debt, assets, and income (Table 1).[4] The results are reported in average dollar values for households belonging to each of five quintiles. In terms of debt, the numbers

2. In the CFM, half of the sample is reserved for households with an annual income above $60,000 and the other half for those with income less than $60,000. In the SFS, 10–15 per cent of the sample is for households with total income above $200,000 or with investment income exceeding $50,000.

3. The CFM numbers used in this article represent the midpoints of the ranges. For the highest range, which is unbounded at the upper end, the lowest value of the range is assigned. For example, the highest range for income is $150,000 and over, and a value of $150,000 is assumed for each household in this upper range. This feature means that CFM averages for the highest income group in Table 1 will be biased downwards relative to SFS averages.

4. Information from 2005 is used because it is the most recent year for which both surveys are available.

Table 1

The Data Sets Compared

2005 averages

		Income quintiles				
		1st	2nd	3rd	4th	5th
Debt	CFM	$12,779	$28,293	$51,267	$78,497	$106,283
	SFS	$12,860	$26,941	$49,961	$76,347	$118,803
Income	CFM	$19,852	$37,138	$57,481	$85,000	$132,036
	SFS	$11,500	$28,202	$45,296	$71,417	$140,851
Assets	CFM	$88,314	$189,292	$277,762	$375,646	$615,503
	SFS	$107,319	$200,191	$375,801	$503,376	$937,791

Note: CFM=Canadian Financial Monitor; SFS=Survey of Financial Security

are comparable. Under income, although the SFS numbers are lower than those of the CFM for the first four quintiles (the differences range from $8,000 to $14,000), they are also broadly comparable. The differences are likely caused by using the midpoint of the range of income reported by CFM respondents. Under assets, however, we observe a large discrepancy in the highest quintile, with an average asset value of $615,503 reported for the CFM and $937,791 for the SFS. Again, this is because the highest range in the CFM is open ended, and our calculations use the lowest value in this range.[5]

It is evident that the two data sets are broadly comparable in reporting debt and income, which are necessary for DSR calculations. We primarily use the CFM data set for our risk analysis, because it provides detailed information on debt payments, as well as more regular and timely updates. Since the SFS data provides information on mortgage delinquencies, we use it to identify a DSR threshold (see Box).

Characteristics of Financially Vulnerable Households

The financial services industry considers that households that devote more than 40 per cent of their income to service their debt are financially vulnerable. Over the 1999–2007 period, among households with positive debt, the fraction with a DSR higher than 40 per cent fluctuated between 2.8 per cent and 4.1 per cent and stood at 3.2 per cent in 2007.[6] Although this is a relatively small number of households, the share of debt they hold is much larger, representing about 6.5 per cent of total household debt in 2007. We group these households by several characteristics, including: income, education, and work status, using data reported in the CFM for 2007. Table 2 shows the results for the income classifications. We observe a negative relationship between income class and the measure of vulnerability: As income goes up, households become less vulnerable, with the poorest 20 per cent of households approximately 3.5 times more likely to be vulnerable than the richest 20 per cent. Under education, among households whose heads have a college diploma, those with a high school diploma, and those without a high school diploma, we find the greatest vulnerability among households with lower education. Work status also matters. Comparing households headed by full-time workers with self-employed and non-working households, self-employed households were about 1.96 times more likely to be vulnerable than full-time workers and 1.89 times more likely than non-working households.

Table 2

Households with Debt-Service Ratio Higher than 40 Per Cent: 2007

	Income quintiles				
	1st	2nd	3rd	4th	5th
Households (%)	5.61	3.95	3.76	1.74	1.60

DSR Simulations: Methodology and Assumptions

For our simulations, we create scenarios that demonstrate how the financial situation of households (i.e., their DSR) reacts to various economic shocks. Since movements in the DSR correspond to movements in both the debt-to-income ratio and interest rates, we assess the effect of different economic scenarios on each of the three components of the DSR (debt, income, and interest rates) separately and then combine these elements to estimate how the DSR is affected overall.

Changes in the ratio of debt to income

To simulate the effect of shocks on the distribution of debt payments, we need to determine the ways in which debt responds to movements in various economic variables. Since the available microdata are

5. See footnote 3.

6. We exclude households with a measured DSR equal to or above 50 per cent, given the possibility that some of these very high debt burdens may reflect reporting errors. The role of reporting errors is being examined further, but it is important to note that, over time, the proportion of households above the 40 per cent vulnerability threshold is virtually unaffected by the exclusion of these households.

Identifying Financially Vulnerable Households

Establishing a DSR threshold

A growing literature is attempting to quantify the effects of household bankruptcy and delinquency on the lending decisions of financial institutions.[1] In these studies, household income and debt payments are significant factors influencing credit-granting decisions. These two important variables are summarized in one statistic: the debt-service ratio (DSR). Currently, the industry standard for identifying financially vulnerable households is often based on a DSR number of 40 per cent.[2] Research reported in the Bank's *Financial System Review* has also used this threshold value of 40 per cent to group vulnerable households.

As a guideline for evaluating household vulnerability, we examine the relationship between the mortgage-delinquency rates of households and their DSR and confirm whether the critical DSR threshold we calculate from this examination is broadly consistent with the industry benchmark of 40 per cent. To obtain mortgage delinquency rates for our calculations, it is necessary to combine the information provided in two separate data sets: the Ipsos Reid Canadian Financial Monitor (CFM) and Statistics Canada's Survey of Financial Security (SFS). The CFM data set provides information that allows us to calculate the DSR and uses household characteristics similar to the ones we use but does not report mortgage delinquencies. We therefore use SFS data on mortgage delinquencies to estimate an equation that relates mortgage-debt delinquency to the DSR and other household characteristics[3] (see the Technical Appendix for details on the estimation methodology and results). Using this equation and a common set of regressors, we are able to evaluate how mortgage-debt delinquency varies with the DSR[4] for the years 1999 to 2006 of the CFM sample.

Based on this information, we identify a critical DSR threshold of 35 per cent, above which there is a significant increase in households' propensity to be delinquent on their mortgages (see the Technical Appendix for details). Given that the industry standard is based on a broader definition of financial obligations than just mortgage debt, our DSR threshold appears to be broadly consistent with the financial services industry benchmark of 40 per cent.

1. See, for example, Chatterjee et al. (2007); Livshits, MacGee, and Tertilt (2007); and Meh and Terajima (2008).

2. Note that the industry standard is often determined on the basis of financial obligations beyond just debt.

3. See Domowitz and Sartain (1999); Stavins (2000); Fay, Hurst, and White (2002); Gross and Souleles (2002); Pyper (2002); and Dey and Traclet (2008) for a list of household characteristics used in the literature.

4. Mortgage-debt delinquency for the 2007 CFM survey was not generated because of some irreconcilable data issues.

cross-sectional survey data that do not necessarily track the same households, we cannot calculate the growth in credit and income levels between two periods for the same households.

We can, however, construct growth rates for a cluster of households having similar characteristics, such as employment status, level of education, and place of residence.[7] To construct the data set and estimate the determinants of credit growth, we use annual observations over 64 categories. Our criteria are as follows:

(i) age: groups from 18–24 years, 25–34 years, 35–49 years, and 50 years and over

(ii) employment status: households that receive income from an economic activity, and those that derive income from other sources, e.g., students, retirees, and the unemployed

(iii) education: those that have completed up to 13 years of schooling and those whose education includes grade 13 up to a university degree

(iv) status as a homeowner or a tenant.

Finally, given that the economy of Alberta has developed differently from the economies of the other provinces in recent years in terms of growth in incomes, wages, investment, property values,

7. This approach (i.e., creating pseudo panel data) is relatively new. According to Biao (2007), the first to use it were Dargay and Vythoulkas (1999). It was subsequently adopted by Dargay (2002); Bourguignon, Goh, and Kim (2004); Navarro (2006); and Biao (2007), among others. This approach raises a number of questions and challenges, e.g., the choice of characteristics to delineate the groups of consumers.

consumer spending, etc., we differentiate between households residing in Alberta and those living elsewhere.

As noted above, most financial institutions consider a DSR of 40 per cent to be the threshold above which a household could begin to struggle to meet its repayment commitments. It also becomes more difficult for these households to obtain loans, because financial institutions scrutinize their credit requests more closely and, as a result, such households may become constrained. Our methodology takes this institutional feature into account and groups households according to this criterion as well. Thus, we created a total of 128 household groups for each year.

For every household group, we compute average debt for each category of borrowing (credit cards, secured and unsecured personal lines of credit, car loans, other loans, and mortgages), income, the DSR and house values.[8] In addition, for each household, we include the interest rate (proxied by the value of the overnight interest rate on the day the survey questionnaire was completed).

Using the household groups described above, we estimate equations that determine the amount of credit available, based on the following variables: income, house prices, net housing wealth, and the overnight interest rate. We also include in our equations a parameter that captures the difference in credit growth for households with a DSR above 40 per cent. Since, as noted above, the banking industry's credit-granting decisions are influenced by the household's current level of DSR, we expect, all else being equal, that credit growth rates will typically be weaker for households with a DSR above 40 per cent.

The results of the estimations indicate a negative and significant relationship between credit growth and changes in interest rates.[9] The relationship is positive and significant for income and housing equity. Although some preliminary results indicate that substitutions have occurred among consumer-credit instruments (between personal lines of credit and other type of loans) because of changes in housing prices, for this article, the shares of consumer-credit components are kept constant over the simulation horizons.[10] Future work will consider a less restrictive approach, however. The results also confirm our hypothesis that growth of credit for households with a DSR above 40 per cent will, on average, be lower than growth of credit for those with a DSR below 40 per cent.

For the scenarios in our simulations, we construct the distribution of credit growth across households using a macroeconomic outlook that includes assumptions about the average aggregate growth rates for income, house prices, and interest rates. We then evaluate how debt responds to changes in interest rates, income, house prices, and housing wealth by applying the estimated relationships to each household.

Because we assume that households are heterogeneous in regard to income, we use the simulated distributions of income (described in the next section) with a mean that is consistent with aggregate growth.

Changes in household income

To simulate the second element of the DSR, household income, households are categorized according to four income classes. Since households are heterogeneous, we allow for the fact that the average income growth (and the variance) may vary across income groups. Income growth also varies across households within each income group. The advantage of this approach is that it can accommodate alternative risk scenarios. Following a negative shock to the labour market, for example, it is possible that the average income growth of households belonging to the lowest-income groups (as shown in Table 2) will be affected more than that of households belonging to the other groups.[11] Alternatively, we could assume that average growth rates across all income groups are the same. In the stress scenarios presented in this article, we exploit some heterogeneity by assuming the same mean level of income growth for each of the four income groups but allow for variances to differ across these classes.[12]

8. Housing wealth is the difference between the current market value of the house and the amount of mortgage credit house outstanding. Since the end of the 1990s, innovations in the financial sector have provided households with more ready access to their housing wealth, through either mortgage refinancing or personal lines of credit. For this reason, we view housing wealth as a potential determinant of the demand for mortgages and personal lines of credit.

9. For our estimations, we use weighted least squares with a corrected covariance matrix.

10. For further details, see Djoudad (2008).

11. Table 2 indicates that vulnerable households are not evenly represented in different income groups.

12. Empirical evidence provided from our panel data suggest that the variance of income growth for the households in the lower-income group is higher than for those in the higher-income group.

Given these assumptions, we combine the distributions of credit and income growth to construct the distribution of debt over income across all households. The debt-to-income distribution is then combined with interest rate information (discussed next) to simulate the distribution of the DSR across households.

Effect of changing interest rates on debt payments

The third element that will affect our simulations is interest rates. We make the following assumptions regarding the effects of changing interest rates on debt payments. First, shocks to interest rates will affect only the amount of interest paid, not the principal. Thus, from the CFM data set, we must estimate how much of the payment is applied to the interest and how much to the principal. Payments will depend on the path taken by interest rates and on the growth of indebtedness.

Second, we consider that payments made on credit cards equal 2 per cent of the current outstanding balance, the minimum required by the credit card companies. The household must therefore repay an amount corresponding to 24 per cent of the annual balance each year, regardless of the interest rate. Since all other categories of consumer lending (personal loans, personal lines of credit, and car loans) are held at variable rates, the assumed profile for interest rates has an immediate effect on these debt payments. This assumption over (under) estimates debt payments for variable-rate mortgages as interest rates increase (decrease).[13]

We also make assumptions about mortgage renewals. Since the CFM survey data do not indicate the date on which mortgages mature, for fixed-rate mortgages, we need to make assumptions on how many households must renew their mortgage each year and will thus be affected by the new interest rates. The CFM data include eight different mortgage terms (1-year, 2-year, 3-year, etc.). We assume that households whose mortgages have terms of one year or less renew their loans every year. For terms exceeding one year, we assume that the proportion of households renewing will be equal to one divided by the term of the mortgage. Thus, for a 5-year mortgage, 20 per cent (1/5 = 20 per cent) of households will renew their mortgages each year. For 10-year terms, 10 per cent (1/10 = 10 per cent) of households will renew each year.

We further assume that the distribution of mortgages by type (fixed vs. variable) will remain stable at its most recent level. Although the proportion of households with a variable-rate mortgage should change gradually, as term and risk premiums vary over the cycle, we use a simplifying assumption for the simulation exercises in this article and maintain these shares constant. Finally, the distribution of mortgage-holders by term among fixed-term mortgages remains constant in our exercises.

Simulation Exercises

The final step in our analysis is to use this framework to simulate how changes in indebtedness and interest rates will affect debt-payment obligations. To illustrate, we present two different scenarios, with each representing a single shock rather than a complete risk analysis. The first evaluates how higher indebtedness levels could affect the distribution of the DSR, and the second assesses the impact of higher risk premiums on this distribution.

In the first scenario (the indebtedness scenario) we assume that the level of interest rates remains unchanged over the simulation horizon. We suppose that growth rates for total credit (8.7 per cent), and income (5 per cent) will be similar to those observed over the 2000–2007 period. We also assume that house prices rise at an annual rate of 5 per cent. To isolate the effect of a rising proportion of debt to income, we assume that monetary policy will not respond, but a more complete risk analysis should incorporate changes in the policy rate.

The second scenario (the risk-premium scenario) assesses the effect of an increase in risk premiums on the distribution of the DSR. We consider a crisis scenario in which the spread between mortgage rates and government bond yields rises immediately to historical highs of 322 basis points and persists at this higher level, which is about 200 basis points higher than the starting point of the simulations. Again, to show the marginal effect of risk-premium shocks, we assume that this shock is not offset by monetary policy actions.[14]

13. We assume that the principal payments, as a share of debt, will remain constant while interest payments will vary with interest rate movements. In practice, for variable-rate mortgages, total payments are constant, while the share of principal and interest payments will change.

14. Other research published in the *Financial System Review* has considered scenarios where the overnight rate increases towards historical norms, and the term premiums rise from their current level to their historical yield. In such scenarios, we can allow risk premiums to adjust relative to the overnight rate as well.

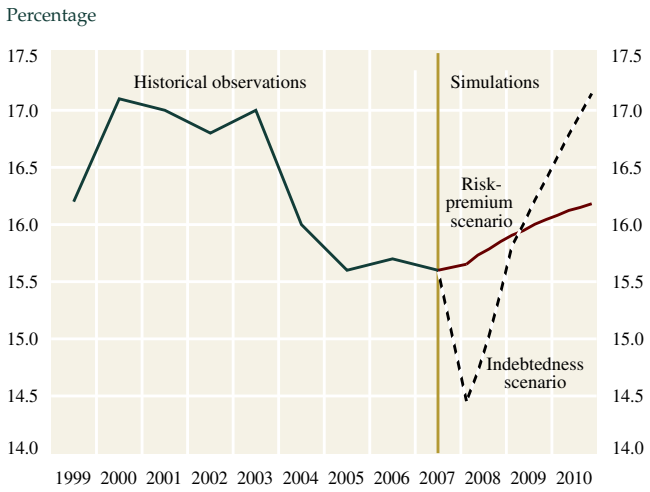
In our scenarios, we assume that increases in house prices will affect all house values similarly. Given that net housing wealth is the difference between house values and mortgages, the distribution of mortgage credit growth will affect the distribution of net housing wealth at every period.

Results

Table 3 and Chart 1 show the evolution of the average DSR and its distribution for different periods. In the first scenario, the increase in debt over income raises the DSR from 15.6 per cent at the starting point to 17.1 per cent 12 quarters later. The proportion of households with a DSR above 40 per cent rises from 3.1 to 6.1 per cent over the same horizon. The proportion of debt carried by these households varies from 6.5 per cent at the beginning of the simulations to 13.6 per cent 12 quarters later. [15]Assuming a constant ratio of debt to income, the assumed increase in the risk premium will, over 12 quarters, increase the average DSR from 15.6 per cent to 16.2 per cent 12 quarters later. The number of vulnerable households and the proportion of debt they carry rise to 4.2 and 9.6 per cent, respectively, from their initial points. Both exercises assume that monetary policy is passive.

Chart 1

Average Debt-Service Ratio



Source: Ipsos Reid, Bank of Canada calculations

15. At the beginning of the simulations, the interest rates are lower than in 2007. This will make the interest payments over the first periods of the simulations lower than they were in 2007, as households will also renew their previous fixed-term mortgages at lower rates, before the indebtedness increases significantly. This causes a relative drop in the DSR over the first quarters.

Table 3

Simulation Results (Per cent)

		Ratio of debt to income (trend)			Risk-premium shock		
Quarter	Initial	Q4	Q8	Q12	Q4	Q8	Q12
Average	15.6	15.4	16.4	17.1	15.8	16.0	16.2
Proportion of households with DSR > 40%	3.1	3.6	4.9	6.1	4.1	4.1	4.2
Proportion of debt held by households with DSR > 40%	6.5	7.5	10.9	13.6	9.2	9.5	9.6

Conclusion

In this article, we build on the framework used in the Bank of Canada's *Financial System Review* to assess the evolution of household indebtedness and financial vulnerabilities in response to changing economic conditions. To achieve this, we first compare the microdata sets generated by the Canadian Financial Monitor (CFM) and Statistics Canada's Survey of Financial Security (SFS). We find that the surveys are broadly comparable, despite methodological differences, which enables us to use their combined information content for the identification of the threshold value of the debt-service ratio (DSR). We then present a framework for simulating the DSR and illustrate how it can be used by analyzing the effects of two different scenarios on the distribution of the DSR and their impact on vulnerable households.

We are working to strengthen the framework with the goal of using it to incorporate a more consistent macroeconomic outlook in our analyses of current risks to the Canadian household sector. In addition, we plan to improve this methodology by allowing the shares of consumer-credit components to vary in relation to house-price movements, since rising housing equity has likely contributed to the significant shift towards secured personal lines of credit. We also plan to relate the proportion of fixed- and variable-rate mortgages to household expectations of the future path of interest rates.

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Technical Appendix: The Relationship between the DSR and the Probability of Mortgage-Debt Delinquency

We use Statistics Canada's Survey of Financial Security (SFS) data set to estimate the probability of mortgage-debt delinquency for Canadian households using explanatory variables identified in the literature and the debt-service ratio (DSR). This information is used to identify the critical DSR threshold used in the article. Here we describe our estimation method.

Estimation methodology

The propensity of household i to be delinquent can be described by

$$d_i^* = X_{ib} + u_i,$$

where d_i^* is the propensity to be delinquent; X_i is a set of regressors; b is a set of parameters; and u_i is an error term.

The delinquency variable represents mortgage payments in arrears for two months or more, i.e., $d_i = 1$, if, in 2004, the household was two months or more behind on its mortgage loan payments, i.e., if $d_i^* = X_{ib} + u_i > 0$, and $d_i = 0$, otherwise.[1]

Note that the delinquency variable is not total debt in arrears, since the SFS questionnaire does not report that variable. A maximum-likelihood probit estimation with X_i as the vector of regressors in the SFS gives us an estimate of the set of parameters (b).

We considered several specifications of the probit model. We kept a minimum set of demographic variables (age, gender, and current marital status); all other demographic and financial variables were included in the model based on their statistical significance.

1. The 2005 SFS survey reports information on mortgage-debt delinquency for 2004.

Estimation results

Following the literature, we chose the variables for our model based on their ability to explain households' ability to repay their debts. Our results indicate that high values of household net worth and the logarithm of the ratio of liquid assets to total assets are associated with a lower likelihood of mortgage delinquency. Since households can easily convert liquid assets into cash to meet their mortgage-debt obligations, the more liquid assets they have relative to their total assets, the less likely they are to be delinquent and, hence, the negative correlation. Various types of scaling of the liquid assets (and their logarithms) were attempted in the model specification, and the logarithm of the ratio of liquid assets to total assets was chosen based on its statistical significance. The logarithm indicates the presence of a high degree of non-linearity in the response of the ratio of liquid assets to total assets—a small fraction of liquid assets relative to total assets is associated with a larger reduction in the probability of mortgage-debt delinquency. Moreover, households with high net worth are likely to have favourable loan terms and will be less likely to fall behind in their mortgage-debt payments, also confirming our intuition.

The DSR, on the other hand, is positively correlated with the incidence of mortgage delinquency. A higher DSR means that households must devote a larger fraction of their income to debt payments. Households are more likely to fall behind on their mortgage-debt payments if their DSR is high; hence the positive correlation. The demographic variables are not statistically significant.

Identifying a DSR Threshold

We use the model of mortgage-debt delinquency estimated with the SFS data set, the standard normal cumulative distribution function, and a common set of regressors to obtain a distribution of the

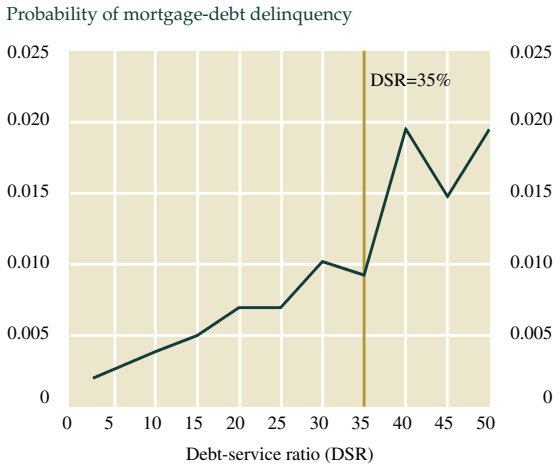
Technical Appendix: The Relationship between the DSR and the Probability of Mortgage-Debt Delinquency (cont'd)

probability of mortgage-debt delinquency for the years 1999 to 2006 of the CFM sample. We first bracket households in DSR groups that increase by increments of 5 per cent, then calculate the average probability of delinquency for households in each grouping. Finally, we identify a DSR threshold as the value of DSR beyond which there is a significant increase in the probability of delinquency.

To illustrate, we plot the probability of mortgage-debt delinquency in 2002 for each of the DSR groups (Chart A1). A critical DSR threshold for 2002 seems to be 35 per cent, since we find a large increase in the probability of mortgage-debt delinquency above this level.

Chart A1

The Debt-Service Ratio and the Probability of Mortgage-Debt Delinquency, 2002



A Money and Credit Real-Time Database for Canada

*Roobina Keshishbanoosy, Pierre St-Amant, Devin Ball, and Ivan Medovikov, Department of Monetary and Financial Analysis**

- *Model-based forecasts of important economic variables are part of the range of information considered for monetary policy decision making. Since some of the data underpinning these forecasts can be revised over time as new information is released, having access to the data available when decisions are made can have a significant impact on assessments of forecasting models.*
- *A database of published information for a set of money and credit variables has been developed at the Bank of Canada. This real-time database, which will make available estimates of money and credit data that have been published at different times, is expected to be of great help to researchers developing models based on money and credit data.*
- *The authors describe the contents of the new database and discuss patterns in data revisions. While they find that most revisions are unbiased, they provide evidence that revisions to some of the money and credit aggregates are biased.*

Money and credit data, such as time-series data on short- and long-term business credit, total residential mortgage credit, and measures of the money supply, are part of the broad information set considered by central banks in their monetary policy decision making and in assessing financial stability risk.[1] Various studies have concluded that these data contain information that is useful for predicting output and inflation in Canada.[2] There is also evidence that credit data, in particular, are useful for predicting financial stress (Borio and Lowe 2002; Misina and Tkacz 2008).

Conclusions about the usefulness of the information contained in the financial variables may depend on whether real-time data were employed.

Time-series data are regularly updated and revised, however, as new information becomes available. As a result, the version of a time series that is used in economic studies may differ from that used by

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1. Recent theoretical advances, such as the development of models with financial-accelerator mechanisms (see Bernanke, Gertler, and Gilchrist 1998; Iacoviello 2005; and Christensen and Dib 2006), have rekindled interest in credit developments. Meanwhile, recent studies with real-time data (e.g., Orphanides and van Norden 2005) have shown that indicators widely used by central banks—in particular, measures of the output gap—include little or no useful information about future inflation. This finding has stimulated research on alternative indicators, such as money and credit aggregates.

2. See, for example, Hostland, Poloz, and Storer (1988); Milton (1988); Muller (1992); Longworth (2003); Chan, Djoudad, and Loi (2005); and Dufour and Tessier (2006).

policy-makers. Conclusions about the usefulness of the information contained in the financial and economic variables may therefore depend on whether real-time data (i.e., the data in the form in which they were available to analysts and researchers at various times in the past) were employed. The importance of this issue has been demonstrated in various economic studies. Amato and Swanson (2001), for example, show that the assessment of the information content of monetary aggregates can change when real-time data are used (aggregates that seem useful with revised data do not perform well with real-time data). Orphanides and van Norden (2005) make the same observation in the case of measures of the output gap.[3] To date, no published study using Canadian money and credit data has factored in revisions, since no real-time version of these data was available. The database described in this article was designed to fill this gap.[4]

This article reports on some Bank of Canada research into possible patterns and biases in the revisions to the data that have been compiled in the database. It begins with a description of the contents of the database and reviews the sources of the revisions. It then examines biases and patterns in data revisions and concludes with a summary of the main findings. In future work, it would be interesting to use this new database to revisit the conclusions of previous studies about the information content of Canadian money and credit aggregates. The database could also be used to study the impact of data uncertainty on policy decisions.

Contents of the Database

The Canadian money and credit real-time database is a collection of monthly data representing selected vintages of various money and credit series. A vintage is the latest estimate of a given series at a particular time (i.e., the full history of total business credit as it was reported in January 1993 is one vintage; that reported in February 2007 is another; see Table 1). In this article, we focus on the following series: gross M1+, gross M2++, short-term business credit, long-term business credit, total business credit, total household credit, total residential mortgage credit, and total consumer credit. We chose these series because they tend to be the ones emphasized by Bank of Canada economists in their analyses. These series, as well as others that will be updated regularly in the real-time database, are defined in the Appendix.[5] They are constructed largely on the basis of information received from banks and other financial institutions, although some are also created using information supplied by Statistics Canada.

Both print and electronic sources were used to construct the database. Print sources include two Bank of Canada publications: the *Weekly Financial Statistics*

Table 1

Real-Time Data: Vintages for Total Business Credit

	Vintage					
Date	January 1993	February . . . 1993	January 1996	February . . . 1996	January 2007	February 2007
Feb. 1969	N/A	N/A	N/A	N/A	6.161	6.161
Mar. 1969	N/A	N/A	N/A	N/A	5.686	5.686
. . .	N/A	N/A	N/A	N/A	. . .	. . .
Jan. 1992	2.884	N/A	N/A	N/A	3.839	3.834
Feb. 1992	4.027	2.774	N/A	N/A	-0.838	-0.886
. . .	. . .	. . .	N/A	N/A	. . .	. . .
Nov. 1992	5.389	5.031	N/A	N/A	1.491	1.493
Dec. 1992	0.152	-0.443	N/A	N/A	-3.092	-3.125
. . .		. . .	N/A	N/A	. . .	. . .
Jan. 1995			3.564	N/A	4.997	5.032
Feb. 1995			10.244	7.196	7.562	7.547
. . .			. . .	. . .	. . .	. . .
Nov. 1995			7.213	4.055	5.627	5.77
Dec. 1995			3.413	3.095	7.719	7.693
. . .				. . .	. . .	. . .
Jan. 2006					7.443	7.313
Feb. 2006					7.817	8.160
. . .					. . .	. . .
Nov. 2006					12.735	12.862
Dec. 2006					11.025	9.559
. . .						. . .

Note: Data for the time series total business credit, expressed as annualized growth rates. Each column represents a vintage. Reading across the rows from left to right shows how the value of the data for the observation date in column 1 were revised over time. N/A refers to data that are not retrievable.

3. See Croushore (2006) for a good discussion about forecasting models and real-time data.

4. The database will be published on the Bank of Canada website by the end of 2008. It is currently available and may be accessed by contacting Roobina Keshishbanoosy (rkeshishbanoosy@bankofcanada.ca).

5. The database also includes gross M1 and net versions of M2+ and M2++. In early 2007, the Bank stopped producing these data based on research by Chan, Djoudad, and Loi (2005). Thus, no new vintages of these series will be added to the database.

(WFS) and the *Bank of Canada Banking and Financial Statistics* (BFS).

For most of our money and credit data, the earliest vintages date from January 1993. There are two exceptions: gross M1+ and gross M2++. Since these monetary aggregates were created in January 1999, vintages of these series are only available from that date.

Chart 1 displays the number of observations available in each vintage of a typical variable (total business credit). Complete sample vintages are available since June 2001, which is when the Bank began electronically archiving vintages. The first observation in each of these complete sample vintages is January 1969, for all series except gross M1+ and gross M2++.[6] Thus, Chart 1 shows 388 observations (January 1969 to June 2001) for the June 2001 vintage; one observation is added for each subsequent month until there are 459 observations for the most recent vintage. Prior to June 2001, when print versions were used, there are fewer observations in the various vintages, with the fewest (12) being recorded from January 1993 to March 1997.[7]

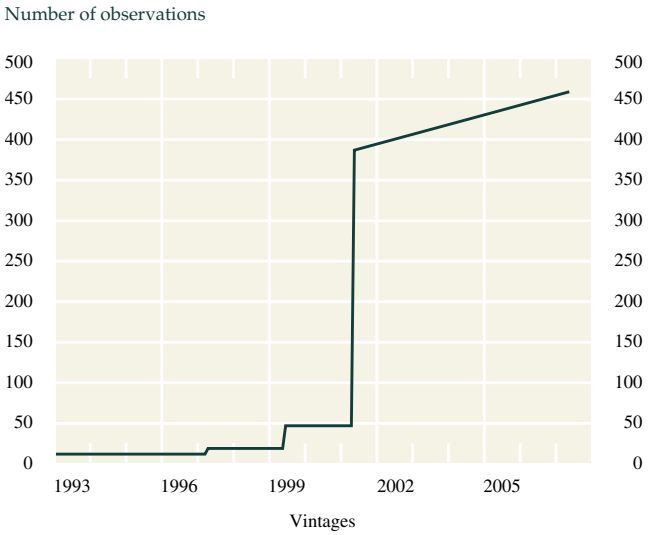
Many vintages were created in the third or fourth week of the month, which corresponds with the first release dates (for instance, total business credit for December is typically published in the third or fourth week of January). An exception is the period during which the BFS was used to build the data (July 1999 to May 2001). Since the *Banking and Financial Statistics* was published two or three weeks after the first release, these vintages may have included more revisions; this is a limitation of the database.[8] Because revisions during those two to three weeks tend to be small, however, we expect the BFS-based vintages to be very close (often identical) to the first-release vintages.

Although each observation in a particular vintage can be expressed either in levels or in growth rates, we use (annualized) month-over-month growth rates in this article. One reason for focusing on growth rates instead of levels is that definitional changes imply that there can be breaks in the data when they are assessed in levels. These breaks would not be reflected in the growth rates because they are calculated within a given vintage.

Most of our real-time data exist only in seasonally adjusted form. The sole exception is long-term business credit, which is not seasonally adjusted, because no stable seasonal factors could be estimated for that series.

Chart 1

Snapshot of the Database: Total Business Credit



Sources of Revision

Revisions to money and credit data are derived from four major sources: continuity adjustments, adjustments to non-bank data, seasonal adjustments, and new instruments.[9] We discuss each of these sources in turn and briefly summarize their effects on the vintages.

Continuity adjustments

Continuity adjustments are required in the monetary aggregates whenever changes in the financial industry, such as mergers and acquisitions, generate structural breaks in the data. Without continuity adjustments, the data would show significant breaks, making them useless for most econometric work. The Bank adjusts

6. The first observations for these series were in January 1975 and February 1968, respectively.

7. The first few vintages in total household credit, total residential credit, and total consumer credit have 11 observations.

8. There was a trade-off to be faced for that period between longer but slightly desynchronized BFS-based vintages and synchronized but much smaller WFS-based vintages.

9. Data are sometimes revised by financial institutions because of reporting errors or misclassifications. Given the many quality checks that are built in at different steps of reporting, these types of revisions are small when compared with other types.

its monetary aggregates each time one of the following four events takes place (Kottaras 2003):

- the acquisition of a trust company by a bank
- the acquisition of an entity in a sector (e.g., investment dealers) that was not previously included in the monetary aggregates
- the formation of a bank from a trust company or companies
- the acquisition of a bank by a trust company.

These discontinuities are documented in the annual *Notes to the Bank of Canada Banking and Financial Statistics* (Tables C1–C2 and D1). All continuity adjustments are made prior to seasonal adjustments.

Mergers and acquisitions do not always lead to a level change, since most of the aggregates in the real-time database include non-bank data. As a result, continuity adjustments are not always necessary.

Adjustments to non-bank data

Non-bank data, most of which are compiled by Statistics Canada, are subject to revisions from two sources. First, since Statistics Canada provides quarterly data two months after the end of a quarter, the Bank of Canada must use estimates based on interpolation and extrapolation techniques and judgment, making the data subject to revisions. Second, Statistics Canada revises the data for the previous quarters when it releases the data for the current quarter.

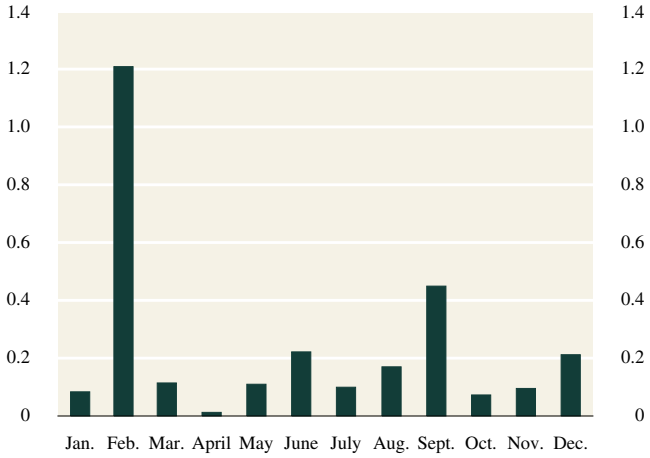
An example will illustrate the process. In late February 2007, the Bank of Canada received non-bank data from Statistics Canada for Q4 of 2006, as well as revisions to Q1, Q2, and Q3 of 2006. The Bank had provided initial estimates of the monthly data in Q4 of 2006. In March 2007, the Bank published revised data for the period January–December 2006. All of our real-time series are subject to this type of revision. Given the lags in receiving the quarterly Statistics Canada data, we may see large revisions in the March, June, September, and December vintages of each year (see Chart 2).

Seasonal adjustments

At the beginning of each year, new factors representing seasonal patterns are applied to the series. These seasonal factors are also adjusted to reflect revisions made to the data during the previous year. Thus, in addition to the original revisions to the unadjusted

Chart 2

Mean Absolute Revisions to Gross M2++ by Month, 1999–2007 Vintages



data, other revisions result from changes in the seasonal factors. The new seasonally adjusted data are published annually in February. Our investigation shows that some data, such as credit card loans, non-bank liquid assets, chartered bank deposits, and commercial paper issued by non-financial institutions, are more prone to seasonality and, hence, have larger seasonal factors. We expect that the corresponding aggregate real-time series, i.e., total consumer credit, short-term business credit, gross M1+, and gross M2++, will show relatively large and frequent revisions because of seasonal adjustments.

Chart 2 shows absolute mean revisions to gross M2++ in each month over the sample period.[10,11] Average revisions in the February vintage are significantly higher than those of the other months, reflecting revisions resulting from seasonal adjustments.

New instruments

Some of the series, especially total business credit and long-term business credit, are subject to revisions because new types of financial instrument are included in the calculations. Flow-through shares, for example, have been traded in the market since they were created; only recently, however, has the Bank decided to

10. Absolute mean revisions are defined in the section on methodology.

11. The results obtained from other aggregates support our discussion on sources of revisions. Because of space limitations, however, we have decided to present only gross M2++ in this article.

include this instrument in the data for long-term business credit, thus expanding the coverage of total business credit.[12] Since the new instruments have been included to improve the information content of the series, any bias in long-term business credit data may not necessarily point to a shortcoming in the revisions process.

Biases and Patterns in Data Revisions

Our methodology is designed to detect possible biases in the revisions to the data and to determine whether there are patterns in the revisions. We expanded our investigation of possible biases by using two definitions of data revisions. We also studied the size of the revisions in real-time data.

Methodology

Revision to observation i in vintage j, compared with vintage k for $j > k$, is defined as $R_i^{j,k} = x_i^j - x_i^k$, where x is the month-over-month annualized growth rate of each observation. For instance, j could be the December 2006 vintage of total business credit, i the March 2006 observation of this series, and k the November 2006 vintage of the same data point. A positive number for $R_i^{j,k}$ indicates upward revision. The mean revision in each vintage is calculated as the sum of all revisions divided by the number of observations in that vintage:

$$\bar{R}^{j,k} = \left(\frac{1}{n_k}\right)\sum_{i=1}^{n_k} R_i^{j,k}. \qquad (1)$$

Mean absolute revisions are calculated as the sum of the absolute values of the revisions divided by the number of observations in the vintage:

$$|\bar{R}|^{j,k} = \left(\frac{1}{n_k}\right)\sum_{i=1}^{n_k} |R_i^{j,k}|. \qquad (2)$$

Equation (1) indicates whether the revisions were biased up or down. When they have a zero mean, they are considered to be unbiased. Equation (2) shows by how much, on average and in absolute terms, data were revised. In gauging the size of revisions, the concept of mean absolute revision in equation (2) is more valuable than that of mean revision in equation (1) because it avoids the offsetting effects of negative and positive revisions.

Data tend to fluctuate and to be more volatile over shorter periods, but more stable over longer horizons. For this reason, we speculate that short-run revisions may not provide a realistic picture of patterns in revisions. We therefore study long-run revisions to capture any revisions stemming from occurrences in the more distant past.

Although the process of data revisions is ongoing, at some point, revisions are fewer and less pronounced.

To help us determine patterns in data revisions, we first look at them for periods of up to 12 months (the maximum size of some of our vintages). Such revisions can also be interpreted as annual revisions, which are particularly important, considering that researchers at the Bank often use year-over-year data (especially for broad-money growth) to conduct their economic analyses.

To determine long-run patterns in the revisions, we compare data in their initial form at first release with the final data. We define "final" in two ways. Although the process of data revisions is ongoing and, in one sense, data are never final, at some point, revisions are fewer and less pronounced. This is illustrated in Chart 3, which covers the period from January 1993 to April 2001, beginning with the June 2001 vintage, and shows that, for the average growth rates for this fixed period, revisions become less frequent and less pronounced after about three years.[13] We thus assume that the data are almost final three years after they were first released. As a robustness check, we also take the most recent vintage as final, which is our second definition. Further details are provided in the section on biases in long-run revisions.

12. Flow-through shares facilitate the ability of exploration companies to raise equity capital, even in the absence of revenue-producing assets. Companies are able to raise this money by flowing through to their investors the tax deductions associated with their exploration expenses.

13. We found an outlier corresponding to the October 2001 vintage of gross M2++. Our investigation shows that, as of that date, data for money market mutual funds and non-money mutual funds were revised back to March 1990, reflecting a new data source. We chose to keep this outlier in the sample despite the minor skewness it creates in the statistics.

Chart 3

Average of Observations

January 1993–April 2001

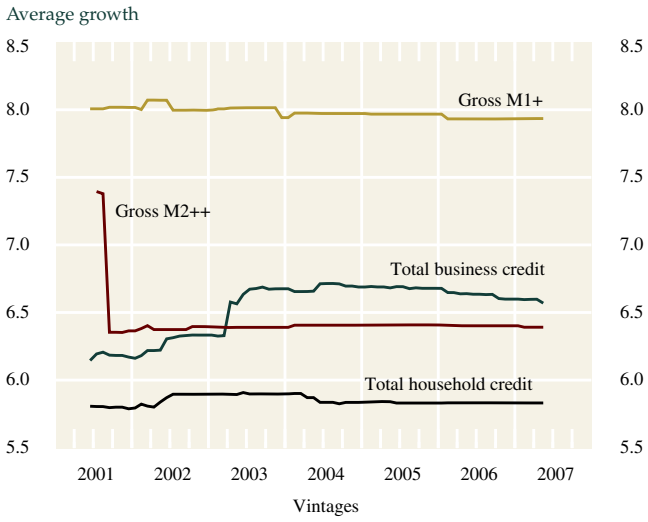
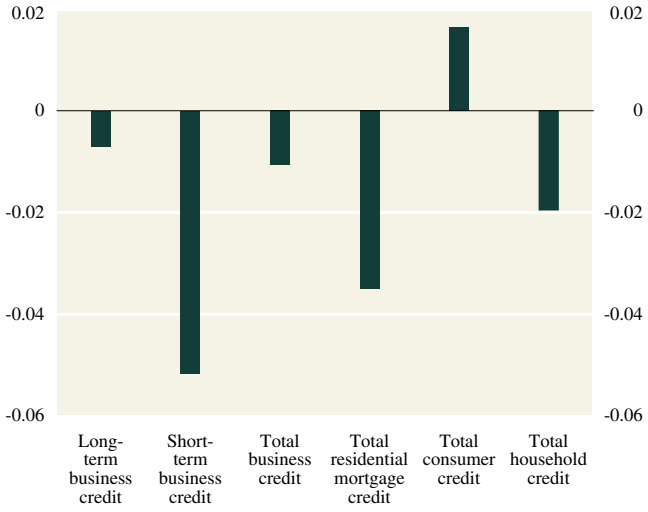


Chart 4

Mean Revisions



In the following sections, we use equation (1) to study biases in revisions and equation (2) to study the magnitude of revisions.

Biases in revisions

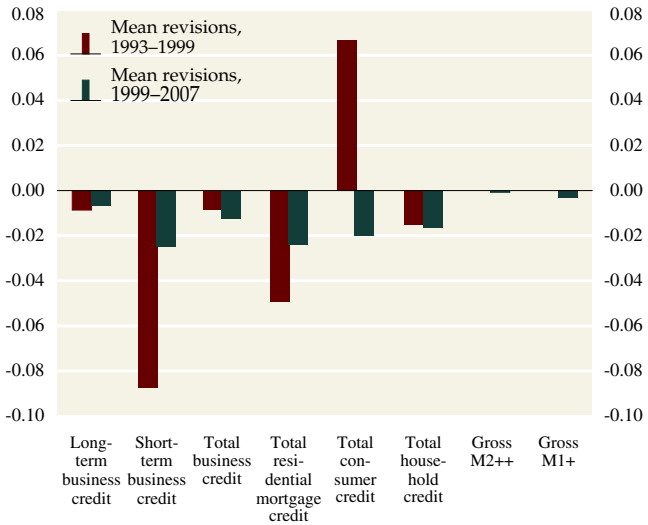
Bias in monthly (short-run) revisions

The mean revisions to monthly annualized growth rates for all of our credit aggregates are shown in Chart 4.[14] To ensure that the statistics we have calculated are comparable, only the final 12 data points in each vintage are considered (remember from Chart 1 that our smallest vintages have 12 data points). Chart 4 indicates that, except for total consumer credit, all variables in our sample have tended to be revised downwards. Short-term business credit shows the highest average monthly revisions. In most cases, these revisions are not significantly different from zero at the 5 per cent level, however, indicating that with this approach we do not find statistically significant evidence of bias in revisions.[15] The only exception is total residential mortgage credit, which shows significant downward revisions. This seems to be a short-run phenomenon, however, because we found that the revisions are not statistically significant when quarterly data are used.

To study whether the pattern of monthly revisions has changed over time, we divided the vintages into two subgroups, 1993–99 and 1999–2007 (Chart 5). Note that the starting date for the second subgroup is 1999, which coincides with the starting date of the first vintages of both gross M1+ and gross M2++. Compared with the other series, both monetary aggregates have low mean revisions. The main difference

Chart 5

Patterns in Monthly Revisions



14. Since 1999 is the first vintage for some of the monetary aggregate series, we do not depict them in this chart.

15. Standard tests are used to check whether revisions are biased. The null hypothesis is that mean revisions are zero. If we do not reject this hypothesis, it means that revisions are not biased.

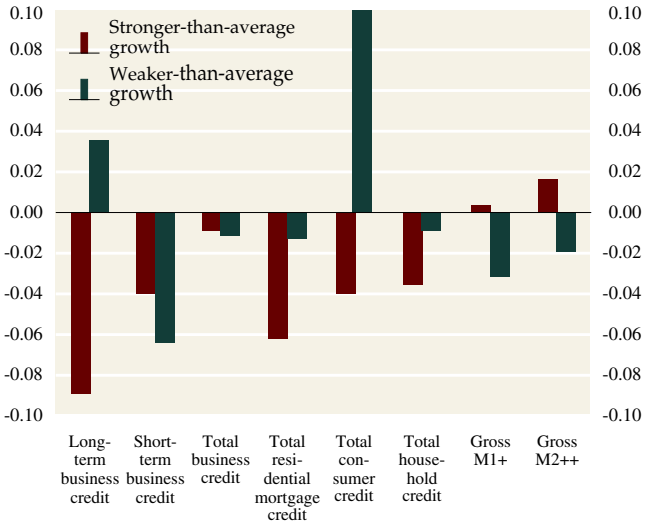
between the two subgroups is that mean revisions to total consumer credit, total residential mortgage credit, and short-term business credit have decreased for the most recent period. Again, most mean revisions are not statistically significant. Downward revisions to total residential mortgage credit are statistically significant in the first subsample, but not in the second.

We would not expect changes to the conclusion that there is no statistically significant systematic bias in mean monthly revisions when revisions to stronger-than-average, or weaker-than-average, growth rates are considered separately. To verify this, we looked at mean revisions to credit aggregates when average growth in a vintage was above the historical average, calculated using data in the most recent vintage, and when it was below average (Chart 6).[16]

Vintages with stronger-than-average growth tend to be revised downwards for all credit aggregates. Total residential mortgage credit, total household credit, total business credit, and short-term business credit tend to be revised down when data releases reflect both stronger- and weaker-than-average growth.

Chart 6

Mean Revisions with Stronger-than-Average and Weaker-than-Average Growth



16. The smaller sample (1999–2007) is again used in the case of monetary aggregates. We confirmed that this conclusion is not qualitatively different when the smaller sample is used for all series.

Vintages with stronger-than-average growth tend to be revised downwards for all credit aggregates.

Formal hypothesis tests cannot reject the null hypothesis that mean revisions are zero to both above- and below-average growth in short-term business credit, total business credit, total consumer credit, and monetary aggregates, even at low levels of significance. On the contrary, when growth is above average, revisions to long-term business credit are biased down at a 1 per cent level of significance and are biased up when growth is below average at the 5 per cent level of significance. Similarly, revisions to above-average growth in total residential mortgage credit are biased down at the 1 per cent significance level.

Biases in long-run revisions

In the previous section, we studied the average revisions for the most recent 12 months. It is useful, however, to examine the size of revisions over longer horizons for evidence of trends that are not identifiable in short-run revisions. As noted, the majority of revisions stabilize after about three years, indicating that most of them probably occurred within three years of the data being released. As a robustness check, however, we calculated revisions based on: (i) final revisions, defined as three years after the first release (Scenario A) and (ii) final revisions as they appear in the most recent vintage (Scenario B). The advantage of Scenario B is that it does not impose an arbitrary cut-off date for revisions, but allows them to occur until the last available vintage.[17] The disadvantage of Scenario B is that the length of time between first-released and final data is not constant. In Tables 2 and 3, we compare the monthly revisions with those of Scenario A and Scenario B, as described above.

Our results indicate that, in the long run (Scenarios A and B), total business credit and long-term business credit show upward biases; while in the monthly revisions there are no biases (Table 2). We speculate that the long-run biases in revisions to business credit may reflect the impact of financial innovations, which

17. In Scenario B (as in Scenario A), we do not include data for the three years preceding the final vintage. Thus, there is a significant period for potential revisions.

Table 2

Mean Revisions Compared

Mean revisions	Monthly revisions	Longer-run revisions: Scenario A	Longer-run revisions: Scenario B
Total business credit	-0.0107	0.78*	0.80*
Short-term business credit	-0.0516	-0.11	-0.66
Long-term business credit	-0.0070	1.24*	1.35*
Gross M1+	-0.0031	0.02	-0.22
Gross M2++	-0.0005	-0.58	-0.57
Total household credit	-0.0195	0.00	-0.12
Total consumer credit	0.0165	0.43	0.42
Total residential mortgage credit	-0.0350**	-0.21	-0.32

* Rejects the null hypothesis of no bias at the 1 per cent significance level.
** Rejects the null hypothesis of no bias at the 5 per cent significance level.
Note: As a robustness check, we calculated these statistics using quarterly data. The results are similar to those shown in this table.

Table 3

Mean Absolute Revisions Compared

Mean absolute revisions	Monthly revisions	Longer-run revisions: Scenario A	Longer-run revisions: Scenario B
Total business credit	0.3964	2.20	2.47
Short-term business credit	0.7756	3.78	4.66
Long-term business credit	0.3060	2.20	2.67
Gross M1+	0.5375	5.15	4.30
Gross M2++	0.2391	2.33	2.20
Total household credit	0.3007	1.85	1.65
Total consumer credit	0.6138	4.21	3.62
Total residential mortgage credit	0.2962	1.68	1.61

tend to appear in the data only after some delay (see the section on new instruments). Given that financial innovations tend to be associated with stronger credit growth, they may well produce this upward bias in the long-run revisions.

Mean Absolute Revisions

The magnitude, or size, of revisions indicates their relative importance. We have defined the size of revisions based on equation (2), which is calculated for short-run (monthly) and long-run revisions of the data on annualized growth rates. Following the methodology used in the previous section, we calculated the size of revisions based on two definitions of final data (i.e., three years after the first release, and the most recent vintage). Again, we call them Scenario A and Scenario B, respectively. Table 3 presents a comparison of the sizes of the revisions for the two scenarios.

Short-term business credit, total consumer credit, and gross M1+ had the largest absolute revisions in both the short and longer run. We speculate that revisions to non-bank data, as well as to their preliminary estimates by the Bank of Canada, are the main sources of the relatively large size of the revisions to these variables.

Note that revisions partly reflect very short-run phenomena. When the data are examined over the long run (i.e., on a lower-frequency basis), revisions are smaller. In Scenario A, for example, mean absolute revisions to annualized quarterly growth rates of gross M1+ are 2.25 per cent, compared with 5.15 per cent when annualized monthly growth rates are considered. The same order of magnitude applies to other series.

Conclusion

This database is a valuable source of information for researchers, since it allows them to use real-time data (the data that are available when policy decisions are made) to assess the information content of money and credit aggregates. In this article, we provided a brief introduction to the database and examined whether biases and patterns exist in the revisions to money and credit data.

Based on our analyses of both short-run and long-run data revisions, our main conclusions are:

(i) Revisions to non-bank data, seasonal-adjustment factors, and financial innovations that are factored into the data after a delay appear to be the major sources of data revisions.

(ii) In most cases, the process of revising the data tends to settle down within three years or less.

(iii) There is no statistically significant evidence, in most cases, of bias in short-run (monthly) revisions. The only exception is total residential mortgage credit, which tended to be revised downwards in the early part of our sample.

(iv) Some variables, however—in particular, long-term business credit and total business credit—tend to show bias over longer periods. We speculate that this is because there tends to be a delay in factoring the effects of financial innovations into time series. Practitioners

should consider this when interpreting long-term business credit growth. It could be misleading, for example, to compare current growth rates with historical averages without making the appropriate adjustments to reflect the likelihood that current growth rates will be revised upwards.

(v) Some data tend to be revised downwards when first-released data are strong (reflecting above-average growth). We have not yet found a good explanation for this.

(vi) Mean absolute revisions are larger for short-term business credit, total consumer credit, and gross M1+.

The work presented in this article stimulated our interest in further investigating the implications of revisions in money and credit data. In particular, we intend to study whether previous conclusions about the information content of money and credit data are robust to the use of real-time data. We would also encourage other researchers to use the new database.

Appendix: Definitions Canadian Financial Variables

Monetary Aggregates

M1+: Currency outside of banks plus bank and non-bank chequable deposits

M1++: Currency outside of banks plus bank and non-bank chequable deposits, plus bank and non-bank non-chequable deposits

M2+: M2 (currency outside banks plus demand deposits at banks plus non-personal notice deposits plus personal savings deposits in the banks) plus deposits in near-banks plus personal deposits at government saving institutions plus money market mutual funds (MMMFs) plus annuities of life insurance companies

M2++: M2+ plus Canada Savings Bonds plus cumulative net contributions to mutual funds other than Canadian-dollar money market mutual funds (which are already included in M2+)

Credit Aggregates

Short-term business credit: Short-term bank and non-bank loans, securitized short-term bank loans, and commercial paper

Long-term business credit: Leasing and non-residential mortgages, long-term bank and non-bank loans, securitized long-term loans, bonds and debentures, equities and warrants, and trust units

Total business credit: Short-term business credit plus long-term business credit

Total household credit: Total consumer credit plus total residential mortgage credit

Total residential mortgage credit: Bank and non-bank mortgage credit, National Housing Act mortgage-backed securities, and secured mortgages

Total consumer credit: Bank and non-bank consumer credit plus securitized consumer credit

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