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Gas Cards

David Bergeron, Curator

Gas cards, or travel cards, have existed for almost a hundred years. They originated in the United States in the wake of World War I and flourished along with the automobile. As people began travelling for longer periods and farther away from home, oil companies realized that their customers could not be expected to maintain loyalty to a particular service station or brand of gasoline. Gas cards, which allowed drivers to buy gasoline at any service centre selling a specific company's product, were therefore a much-needed boost to customer loyalty.

Because fuel could be purchased anywhere in North America, gas cards were the first cards to be issued on a widespread basis. In the mid-1920s, oil companies launched major marketing campaigns. Cards were sent by mail or issued at service centres to almost anyone who owned an automobile. For the issuers, ownership of an automobile ensured that a customer had sufficient collateral to cover charges made on the card. And the low cost of fuel at the time meant that transactions were small and the risk of loss minimal.

Functioning like credit cards, gas cards were based on the principle of "buy now, pay later," permitting customers to make large or frequent purchases. Payment was deferred until the end of the month, when customers received a statement in the mail that had to be paid in full. In addition to the benefit to the oil com-

panies, the system was convenient for customers, who could use the card for a multitude of services, from fuel purchases to oil changes, yet pay only one bill. It was convenient as well for the gas retailers, who were relieved of the burden of maintaining customer accounts.

Gas cards appeared in Canada after the end of World War II, when gas rationing was lifted. To regain the customer base lost during the war, oil companies began a mass distribution of credit cards. The gas cards featured on the cover of this issue are from Canadian oil companies that have long since disappeared. It is interesting to note the variety of substrates used to manufacture the cards. For example, the card supplied by the Canadian Oil Company in 1946 was made of paper. In the mid-1950s, the company switched to an aluminum "charga-plate." By the 1960s, companies such as the Supertest Petroleum Company of London, Ontario; Radio Oil Limited of Winnipeg, Manitoba; Royalite Oil Company of Calgary, Alberta; and national companies such as BP (British Petroleum) had begun to issue plastic cards. Nearly a century after their introduction, gas cards are still issued and continue to allow drivers to enjoy the freedom of the open road.

All gas cards pictured here are part of the National Currency Collection of the Bank of Canada.

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Renewing the International Monetary Fund: A Review of the Issues

*Danielle Lecavalier and Eric Santor, International Department**

- *Given the rapid and ongoing integration of the global economy, the role of the International Monetary Fund (IMF) as the institution charged with promoting global financial stability has never been more relevant.*
- *If the IMF is to be effective in the twenty-first century, there is a need to renew its role, governance structure, and functions.*
- *The IMF has embraced the reform process through the review of its Medium-Term Strategy championed by Managing Director de Rato.*
- *The Bank of Canada has been an active participant in the reform process, with particular emphasis on surveillance and governance reform.*
- *In support of this participation, research at the Bank of Canada has focused on a new framework for IMF surveillance that clarifies the objectives, scope, and conduct of surveillance.*
- *Researchers have also explored how enhancing the IMF's governance structure could further strengthen the Fund's decision-making process.*
- *The ultimate aim of these reform efforts is to enhance the IMF's ability to promote crisis prevention and support a well-functioning international financial system.*

Recent decades have witnessed an unprecedented degree of integration among global financial markets. While globalization has brought tremendous benefits, it has also brought many risks. Ongoing global imbalances, concerns over the extent of global liquidity, and the not-so-distant experience of financial crises in Latin America and East Asia highlight the importance of maintaining a well-functioning and stable international financial system. In particular, the global nature of these issues has prompted policy-makers to advocate for a new, reinvigorated role for the International Monetary Fund (IMF) (King 2006; Dodge 2006).

Clearly, the IMF is still *the* institution charged with maintaining global financial stability, and it has evolved over the past decades to fulfill this role. But concerns remain that its governance structure and policy instruments have not kept up with the changing global economic landscape. Simply put, the world for which the IMF was founded, one characterized by fixed exchange rates, capital controls, and limited international trade, no longer exists. Instead, the IMF must operate in a world of greater exchange rate flexibility, trade liberalization, and capital account openness, and one where emerging-market economies (EMEs) have grown in importance. This has necessitated a reconsideration of the role, governance structure, and functions of the IMF.

To this end, in 2005, the IMF Managing Director (MD) issued a report on the IMF's Medium-Term Strategy (de Rato 2005). Aimed at renewing the IMF's mandate, this initiative offers the opportunity to comprehensively review all aspects of the Fund. How best to renew the IMF for the twenty-first century is currently the subject of an active international discussion, and few aspects of the IMF have been left unexplored.

* We would like to thank Tiff Macklem, Graydon Paulin, Larry Schembri, and our colleagues at the Department of Finance and the Office of the Canadian Executive Director at the International Monetary Fund for helpful comments.

Six main areas of reform are under consideration: (i) quota, voice, and representation; (ii) internal governance; (iii) surveillance; (iv) lending instruments; (v) finances; and (vi) the Fund's role in low-income countries.

Governor David Dodge and Deputy Governor Tiff Macklem have been actively promoting improved surveillance as well as governance reform.

The IMF has an important role to play in the international monetary system. To this end, the Bank is working to facilitate the reform process in many of the areas described above. In particular, Governor David Dodge (2006) and Deputy Governor Tiff Macklem (2006) have been actively promoting improved surveillance as well as governance reform. But it is important to stress that all six elements of the proposed plan for renewal are designed to fit together and reinforce each other. With this in mind, the objective of this article is to examine each of the respective reform issues and explore how they might be resolved. The article also highlights the Bank's research contribution to this

process, which offers perspectives rooted in economic analysis, empirical evidence, and experience.¹

The article is organized as follows: the next section examines governance issues, including quota and how decisions are made. It is followed by a discussion of the reform of the IMF's instruments, namely, surveillance and lending. Issues relating to IMF finances and the role of the Fund in low-income countries are then reviewed, and the article concludes with a brief summary.

Governance

The IMF's governance structure is organized into five broad groups: the Board of Governors, the Board of Executive Directors, the Managing Director (MD) and the staff, the Independent Evaluation Office (IEO), and the International Monetary and Financial Committee (IMFC) (see Chart 1).²

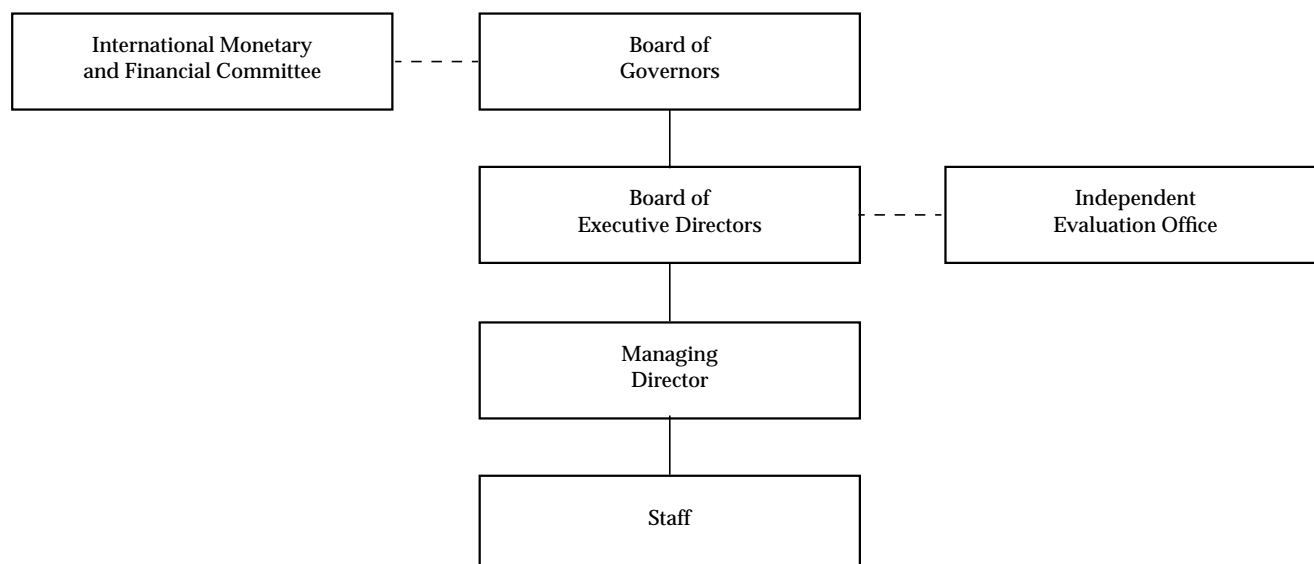
As the highest decision-making body of the IMF, the Board of Governors oversees the Fund's broad policy-formation process and focuses on such issues as quota reviews and accepting new members. Each member of the IMF—there are currently 185 members—has

1. These efforts are not new: the Bank has been involved in IMF reform for many years (Lafrance and Powell 1996; Powell 2001; Haldane and Kruger 2001–2002).

2. See Van Houtven (2002) for detailed information on the IEO and IMFC.

Chart 1

The Governance Structure of the International Monetary Fund



Source: International Monetary Fund

Table 1

Quota Distribution

	Quota share (%)	GDP share (%)*	GDP share (PPP) (%)**
Advanced economies	60.5	79.3	55.1
United States	17.1	29.8	20.5
Major advanced	45.2	64.0	43.0
Developing and transition countries	39.5	20.7	44.9

Source: International Monetary Fund, World Economic Outlook

* Share of world gross domestic product (GDP) based on average GDP, 2002–2004, at market exchange rates

** Share of world GDP based on average GDP, 2002–2004, at purchasing-power parity (PPP) exchange rates

a Governor on the Board. Voting is based on a combination of quota and basic votes.³ The United States accounts for 17.1 per cent of quota, and major advanced countries for 45.2 per cent (Table 1). Overall, developed countries have a majority of IMF quota.

The enormous size of the Board of Governors naturally implies that most decision making is delegated to the Board of Executive Directors, and the Articles of Agreement allocate to the Executive Board all those powers not explicitly reserved for the Board of Governors. The Executive Board consists of 24 directors and the MD. The United States, Japan, Germany, France, the United Kingdom, China, Russia, and Saudi Arabia each have their own director; the remaining directorships are based on country groupings, with the largest country often holding the directorship.⁴ The MD manages the day-to-day operations of the IMF based on recommendations and advice provided by the staff. The MD also plays an important role in guiding the IMF, working closely with the Executive Board, whose meetings he, or his deputies, chairs. There are two distinct aspects to IMF governance: representation and decision making. Each will be considered in turn.

Representation

Quotas are a fundamental issue for the IMF, since they affect many aspects of the Fund's governance and activities, and especially members' voice and representa-

3. Each member receives 250 basic votes plus one vote for each SDR (Special Drawing Right) 100,000 of quota.

4. For example, the constituency that consists of Antigua and Barbuda, the Bahamas, Barbados, Belize, Canada, Dominica, Grenada, Ireland, Jamaica, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines is represented by the Canadian director.

Table 2

Quota Under-Representation

	Actual quota (% of total)	Existing quota formulas (% of total)	Actual quota minus existing quota formulas (% of total)
Singapore	0.40	1.92	-1.52
China	3.72	5.20	-1.48
Korea	1.35	2.51	-1.16
Mexico	1.45	1.93	-0.48
Turkey	0.55	0.74	-0.19

Source: International Monetary Fund

tion. Quotas determine members' (i) voting power at the Board of Governors and the Executive Board (together with the basic votes), (ii) financial contribution, and (iii) access to resources. Members' quotas are based on a combination of five formulas that are determined by four variables: gross domestic product (GDP) at market prices, reserves, openness, and the variability of current receipts.⁵ These variables are a measure of members' ability to contribute to the Fund's finances, as well as their potential demand for Fund resources.

There is currently much dissatisfaction within the IMF's membership with respect to quota and voice. Some countries, especially rapidly growing EMEs, feel that they are under-represented, since their actual quota share is significantly below their "calculated quota," the figure suggested by the five formulas (see column 2, Table 2).⁶ The current formulas are also complex and, in some cases, can produce counterintuitive results. A rise in a member's GDP, for example, can sometimes lead to a decrease in its calculated quota, all else being equal. Moreover, members' views on the nature of the variables that should enter the equations differ. For example, a number of developing countries would prefer that GDP be measured at purchasing-power parity (PPP) exchange rates (see Table 1, columns 2 and 3), while many low-income countries oppose the gradual erosion in their voting power that has occurred because of the decrease in the

5. More information on the formulas can be found in IMF (2006b).

6. Under-representation occurs because quotas are most often adjusted during general quota reviews, which are held every five years and are undertaken to assess the adequacy of the Fund's balance sheet. Moreover, the resulting general quota increases tend to have a large "equiproportional" element, which means that new quotas are distributed, for the most part, in proportion to existing quotas, and disparity is only addressed at the margin.

ratio of basic votes to the membership's total voting power.⁷ The consequence of quota misalignment is that some countries do not feel adequately represented at the IMF, and this lack of appropriate voice and representation impairs their confidence in the IMF and, ultimately, in the legitimacy and effectiveness of the Fund.

In response to these issues, the first step in a two-year reform of quota and voice at the IMF was taken in September 2006.⁸ The objectives of the reform are fourfold: (i) to develop a single quota formula that is simpler and more transparent than the existing ones, (ii) to achieve significant progress in realigning quota shares with countries' relative weight in the global economy, (iii) to make quota and voting shares in the Fund more responsive to future changes in the world economy, and (iv) to enhance the participation and protect the voice of low-income countries.⁹

All members will gain if every one of them is adequately represented, since the IMF's credibility and legitimacy as a truly global institution will be enhanced.

The updating of quota shares means that, for the shares of some members to be increased, other members will have to accept a reduction, since quota shares sum to 100 per cent. Thus, for the reform to be successful, members must co-operate and act in the best interest of the international monetary system. Indeed, all members will gain if every one of them is adequately represented, since the IMF's credibility and legitimacy as a truly global institution will be enhanced. It would also be useful to develop a mechanism to ensure that future quota reviews lead to a regular updating of quota

7. The absolute level of basic votes has not changed from 250 since the IMF was created; the share of basic votes in total voting power has fallen from over 10 per cent in 1945 to 2 per cent at present.

8. Four significantly under-represented members—China, Korea, Mexico, and Turkey—were granted an increase in their respective quota, totalling 1.8 per cent of total quotas.

9. The current reform process takes as given the current roles of quota, but such an approach may be asking too much from a single quota formula, and consideration could be given to separating access from voice.

shares, since the relative positions of countries in the global economy will keep evolving. Ideally, the process for updating quotas should be timely, relatively automatic, and transparent. Lastly, quota review should not be considered in isolation: rather, “with a larger voice comes greater responsibility” (Macklem 2006). All members should be prepared to shoulder their fair share of the responsibility for promoting a well-functioning and stable international monetary system.

Decision making

Although much attention is paid to quota, the issue of how decisions are made at the IMF is also important. The governance structure of the Fund was founded on the notion that IMF decision making would need to command the broad support of its members (Van Houtven 2002). But some members have expressed the view that the IMF's objectives and decisions may, at times, be determined more by political considerations than by sound economic analysis (Cottarelli 2005; Calomiris 2000). Moreover, the role and responsibilities of the Executive Board and the MD can become blurred. The Executive Board sits in almost “continuous session,” working closely with the MD on the day-to-day business of the Fund. This can make it difficult to assign clear accountability for decisions.¹⁰

Governance issues with respect to both private corporations and public institutions have received considerable attention in recent years. And while governance structures should be tailored to the specific circumstances of each institution, there are nevertheless some principles that have emerged as “best practice.” In particular, institutions can benefit, and hence be more effective, from having clearly stated objectives, being transparent in their decision-making process, and possessing the means to hold each level of decision-maker accountable. These principles have also been reflected in recent developments in the governance of central banks. In fact, part of the success of central banks in maintaining low and stable inflation can be attributed to the fact that they too have improved their governance mechanisms along the dimensions described above (Cukierman 1998).

In the same way, the IMF could benefit from considering these best-practice governance mechanisms (Macklem 2006). Simply, the governance of the IMF could be further enhanced by having clearly stated objectives,

10. Santor (2006) provides a discussion of decision making and accountability at the IMF.

greater transparency, and greater accountability. This could be facilitated by a clear separation of the roles of the Executive Board and the MD. As the MD has stressed, the Executive Board should focus more on strategic issues and less on the details of the day-to-day operations of the Fund.¹¹ For instance, more emphasis could be placed on setting the objectives of the Fund and on the design of the policy instruments that are needed to achieve its goals (i.e., the modalities of surveillance). Then, given a set of clearly defined objectives and instruments, the MD would be responsible for the implementation of policy and would be held accountable by the Board. The clarification of the roles and responsibilities of the Executive Board and the MD would increase the transparency of the Fund's decision-making process, leading to greater accountability and, ultimately, a more effective IMF.

The IMF's Instruments

In order to effectively promote a well-functioning international monetary system, good governance is not enough. The IMF must also have the right set of instruments at its disposal. The Fund relies on the use of three main instruments: surveillance, lending, and technical assistance. This section will discuss surveillance and lending. Issues related to technical assistance will be addressed in the section on the role of the IMF in low-income countries.

IMF surveillance

The IMF, under its Articles of Agreement, is charged with maintaining a well-functioning international financial system. The primary means by which the Fund seeks to achieve this goal is bilateral surveillance. Typically conducted through Article IV consultations, bilateral surveillance is the monitoring of members' economies, combined with the timely provision of policy advice principally aimed at crisis prevention (IMF 2006c). The Fund also conducts multilateral surveillance: the examination of economic linkages between countries and international developments, including the global implications of policies pursued by individual members. The findings of multilateral surveillance are typically reported in the IMF's *World Economic Outlook* (WEO) and *Global Financial Stability Report* (GFSR).

The IMF has responded to the challenges of a rapidly changing global environment with professionalism, taking on new responsibilities and developing new

expertise. However, policy-makers, and the IMF, have recognized several concerns. First, the legal basis of surveillance, the 1977 *Decision on Surveillance over Exchange Rate Policies*, is outdated (Lomax 2006). The world for which the 1977 Decision was made no longer exists, since the global economy is increasingly interdependent and market-based, and flexible exchange rates have become more prominent. Moreover, countries have also become more vulnerable to cross-border shocks and policy-spillover effects.

Second, the scope of bilateral surveillance is often very broad, covering issues beyond those directly relevant for countries' external stability (Adams 2005). The IEO (2006) also notes that greater emphasis needs to be placed on the linkages between the financial and real sectors, and that multilateral issues addressed in the WEO and GFSR could be more closely integrated with bilateral surveillance. Lastly, there are also issues regarding the institutional framework that supports Fund surveillance. As the IMF (2005) notes, progress in recent years notwithstanding, some Article IV reviews remain unpublished, and as Dodge (2006) observes, surveillance analysis sometimes lacks candour. Moreover, some members feel that they do not receive equal treatment from the Fund's surveillance process (Akyüz 2005; Lombardi and Woods 2007). With these concerns in mind, policy-makers, and the IMF itself, have begun to tackle the issue of surveillance reform.

Towards a new framework for surveillance

Improved surveillance is in the interest of all members, since it strengthens the Fund's efforts to maintain international financial stability, promote orderly adjustment, and prevent crises. The impetus for surveillance reform has come from several sources, including the Bank of England (King 2006), the United States Treasury (Adams 2005), and the IMFC (2006). The latter, for example, has emphasized the need for greater focus on multilateral issues and consideration of a Surveillance Remit. The Remit would give the IMF a mandate to carry out surveillance, while establishing a mechanism for holding it accountable (Lomax 2006).

At the same time, the IMF's review of its Medium-Term Strategy identified surveillance as a key area of reform (de Rato 2005). With the support of the Executive Board, the IMF staff is exploring the merits of revising the 1977 Decision and the adoption of a Remit (de Rato 2006). These are clearly important steps forward. And to reinforce these efforts, the Bank of Canada has

11. See de Rato (2005).

been actively promoting the discussion on surveillance reform (Dodge 2006).

Research at the Bank of Canada has focused on developing an integrated framework for IMF surveillance (Lavigne, Maier, and Santor forthcoming). The framework consists of two elements: the Guidelines for Economic Policy Frameworks and a renewed institutional framework, consisting of a Remit, a process for communicating surveillance, and a means for ensuring accountability. The Guidelines for Economic Policy Frameworks revise and update the 1977 Decision: in particular, the Guidelines seek to outline the objective and scope of surveillance, as well as delineating the benchmarks against which members' economic policy frameworks will be assessed. To make surveillance more focused, the IMF should assess the overall coherence of a country's exchange rate, monetary, fiscal, and financial policies with a view to analyzing their effects on external stability. The Guidelines also serve to clarify and modernize the principles under which surveillance will be conducted and to reaffirm members' commitment to the surveillance process under their Article IV obligations.

Research at the Bank of Canada has developed an integrated framework for IMF surveillance which consists of two elements: the Guidelines for Economic Policy Frameworks and a renewed institutional framework, consisting of a Remit, a process for communicating surveillance, and a means for ensuring accountability.

The second element of the proposal develops an institutional framework that supports the conduct of surveillance. The key mechanism is a Surveillance Remit, inspired by the work of the Bank of England (King 2006; Lomax 2006). The Surveillance Remit is much like a performance agreement: it defines the aim of bilateral and multilateral surveillance and the obligations of the Fund to pursue this goal and clarifies the means by which the Fund will be held accountable for doing so. In essence, members charge the Fund to conduct surveillance and, in return, agree to recognize its role and the policy advice it generates. Importantly,

with its emphasis on increased accountability, the Remit should heighten the Fund's ability to provide candid and objective surveillance advice.¹²

Taken together, the framework clarifies the roles and responsibilities of the IMF and its member countries in the surveillance process. It also aims to tie together the existing proposals for a revised 1977 Decision, the Remit, and measures for enhancing accountability. These reforms offer a number of benefits for all members. Simply, members can expect to receive focused, high-quality bilateral and multilateral surveillance aimed squarely at crisis prevention. Moreover, surveillance will be applied in an even-handed and symmetric manner, for developed and developing countries alike. In fact, given their dependence on trade and capital flows, effective bilateral and multilateral surveillance would be particularly beneficial for EMEs, since it would help to protect them from being side-swiped by global economic events. It is often the most vulnerable countries that are hardest hit by financial crises, and thus they have the most to gain from a stable international monetary system. Additionally, by focusing clearly on macro policies related to external stability, IMF surveillance will avoid mission creep into structural policies and institutional reform issues. In sum, these surveillance reforms will help to enhance the IMF's ability to promote a well-functioning international financial system.

Lending

Over the years, the IMF has developed various loan facilities to address the individual circumstances of its members (Table 3). These facilities can be grouped into two main categories. The first consists of long-term loans made to low-income countries through the Poverty Reduction and Growth Facility. An evaluation of these loans by the IEO (2004) suggests that they have had limited success. The second category refers to the loans granted to countries experiencing a financial crisis.¹³ These are countries that cannot access sufficient financing on affordable terms to meet their international obligations. This type of IMF lending aims at facilitating the adjustment policies and

12. The Remit is supported by a process for communicating surveillance. Under the framework, the IMF is obligated to communicate its surveillance activities in a complete, timely, and transparent manner. To ensure that the Fund fulfills its surveillance obligations, a Framework for Assessing Surveillance is proposed. The MD and the staff will be assessed on whether they have conducted surveillance in an effective and transparent manner.

13. This category is covered by most of the other facilities and has always represented the largest share of IMF outstanding credit. The IMF also provides emergency assistance to countries that have experienced a natural disaster or are emerging from conflict. We do not discuss these loans.

Table 3
The IMF's Lending Facilities

Facility ¹	Purpose
Stand-by Arrangements	To help countries resolve short-term balance-of-payments problems. This is the main lending facility.
Extended Fund Facility	To help countries address longer-term balance-of-payments problems requiring fundamental economic reforms
Compensatory Financing Facility	To help members experiencing either a sudden shortfall in export earnings or an increase in the cost of cereals imports, often caused by fluctuations in world commodity prices.
Supplemental Reserve Facility	Exceptional access lending, ² introduced in 1997 to address the needs of members who have experienced a loss of market confidence, leading to massive capital outflows
Poverty Reduction and Growth Facility (PRGF) ³	Concessional lending arrangement to assist low-income countries in the development of a long-term strategy for growth and poverty reduction

Source: International Monetary Fund

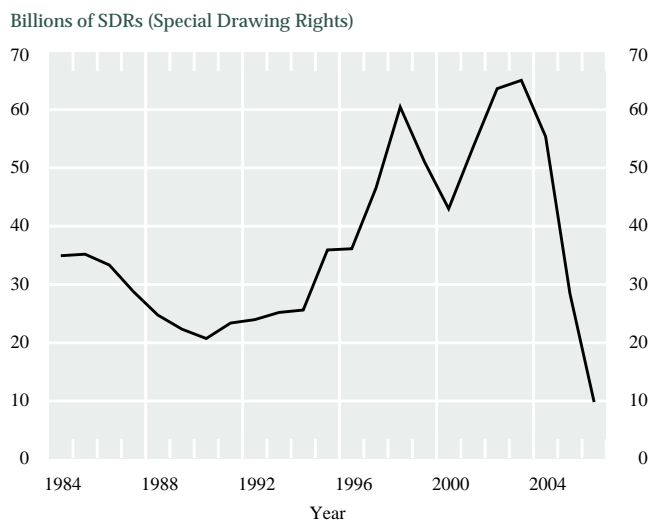
1. The IMF also provides emergency assistance to countries that have experienced a natural disaster or are emerging from conflict.
2. Exceptional access is defined as access by a member to the Fund's general resources (all facilities except the Poverty Reduction and Growth Facility and the Exogenous Shocks Facility) in excess of an annual limit of 100 per cent of the member's quota, or a cumulative limit of 300 per cent of the country's quota.
3. Low-income countries also have access to the Exogenous Shocks Facility when facing shocks such as changes in commodity prices, natural disasters, and conflicts and crises in neighbouring countries that disrupt trade.

reforms that these countries must adopt to resolve their balance-of-payments problems. For instance, in response to crises in Latin America, Asia, and elsewhere, the Fund offered large loans through Stand-by Arrangements and the Supplemental Reserve Facility, resulting in high levels of use of its resources (see Chart 2). Despite this high, and often persistent, level of lending activity, research suggests that, while it led to an improvement in borrowing countries' balance-of-payments position, the impact on other macroeconomic variables was limited (see de Resende 2007 for a survey).¹⁴ At the same time, many borrowers felt that the conditions attached to the IMF lending program were often too onerous and were not applied evenly across countries (Goldstein 2000).

Subsequently, many EMEs have, in recent years, accumulated large foreign exchange reserves, possibly to

14. Some argue that IMF lending can create moral hazard and potentially distort post-crisis restructuring efforts, leading to poorer macroeconomic outcomes.

Chart 2
Total Credit Outstanding in the IMF's General Resources Account



Source: International Monetary Fund

self-insure against capital account crises and to avoid borrowing from the Fund.¹⁵ In this context, it has been suggested that a new precautionary lending instrument is needed at the IMF to support crisis-prevention efforts by EMEs active in capital markets and to reduce the need to accumulate reserves for precautionary purposes.

Reserve Augmentation Line

Work has thus started at the IMF on the development of a high-access financing instrument, called the Reserve Augmentation Line (RAL). This instrument is designed for crisis prevention and would complement the current proposals for surveillance reform. The RAL targets EMEs that have strong macroeconomic policies, sustainable debt, and transparent reporting and are making progress in addressing remaining vulnerabilities.¹⁶ It would provide predictable, imme-

15. Some of these countries also accumulated large holdings of reserves via sterilized intervention in order to resist a real appreciation of their currencies and to stimulate the growth of their exporting sector. This may have contributed to the buildup of global imbalances and led to domestic financial vulnerabilities, especially if carried out using non-market methods.

16. See IMF 2006a and 2007b. A member would pre-qualify for the RAL based on a number of criteria. Then, according to the IMF staff's proposal, the member would have immediate access to 300 per cent of its quota, should a capital account crisis occur. Financing would be limited to a short period (12 months, perhaps up to two years), although the possibility of holding several RALs could exist. It is noteworthy that the views of Executive Directors may differ from those expressed in this proposal. For instance, some Directors consider that access should be between 300 and 500 per cent of quota. Some favour a program of longer duration (two or three years, for example). See IMF 2006d and 2007c for further details. There will be further work and discussion on the proposed new lending instrument.

diate, and large-scale access to Fund resources at the onset of trouble, which would help to maintain market confidence and reduce the likelihood of large and sudden capital outflows that often trigger a full-blown crisis. Moreover, if the RAL is perceived as a close proxy for reserves, it would reduce countries' need to actually accumulate reserves themselves. The instrument could serve as a signalling device to financial markets to help them make appropriate decisions regarding the creditworthiness of a member country if the qualifying criteria adequately measure countries' economic and financial soundness. There are nevertheless some challenges with respect to its design. For example, the appropriate balance between access and Fund risk exposure would need to be achieved.

A need to review the framework for crisis resolution

There is also a need to consider how the RAL fits in with the Fund's lending instruments. More generally, as the joint research by the Bank of Canada and the Bank of England (Haldane and Kruger 2001–2002) has stressed, the IMF's framework for crisis resolution would benefit from clear access rules and limits on IMF lending. This would ensure that no country relies on IMF lending as a means of delaying the policy adjustment required to relieve capital account pressures, or balance-of-payments problems more generally. Ideally, IMF lending should help to maintain stability by providing temporary and limited liquidity to solvent countries in extreme cases. As well, clear constraints on IMF lending would ensure that the private sector plays a crucial part in crisis resolution. Constraints would also align debtors' and creditors' incentives to deal with a crisis and seek co-operative solutions.

There is also a need to consider how the RAL fits in with the Fund's lending instruments.

Other Reform Issues

Principal among the many other aspects of Fund reform that were identified in the IMF's review of its Medium-Term Strategy is the pressing need to exam-

ine the Fund's financing model and its role in low-income countries.

Rethinking the IMF's financing model

A sharp decrease in market borrowing costs and improved fundamentals in many EMEs has led to a relatively rapid reduction in the demand for IMF loans to the lowest level in decades (recall Chart 2). Although this is a very positive development, the low demand for IMF resources has put the Fund's finances under pressure and has raised questions about the viability of its financial model. The Fund derives most of its income from a single source—its lending activities. It borrows from its members and lends these resources on a cost-plus basis. The margin it charges over its cost of funds is the primary source of the income used to cover administrative expenses. As a result, the Fund's current financing model implicitly generates incentives towards lending. As well, when demand for Fund resources is low, the margin required to cover costs can rise to quite high levels, which could lead to a further reduction in the demand for Fund resources if it induces current IMF borrowers to repay the Fund early and to borrow instead on private markets.¹⁷

Some measures to generate additional revenues and to reduce expenditures have already been put in place to deal with expected operating losses over the next few years.¹⁸ However, the IMF's budget difficulties may not be temporary. Although the current favourable global environment may reflect factors of a cyclical nature, such as ample liquidity, widespread improvement in the macroeconomic policy frameworks of many EMEs may have rendered them less likely to access the IMF's resources. As a result, even though Fund lending could increase in the future, it may not do so to an extent that would make the Fund's current financing model sustainable. Hence, a fundamental review of the Fund's financial model has been required.

Financing reform

Efforts to date have focused on the revenue side of the IMF's administrative budget. In May 2006, the

17. Since January 2005, Russia, Brazil, Argentina, Indonesia, Uruguay, and the Philippines have repaid early their outstanding financial obligations to the Fund. Turkey is currently the largest remaining IMF borrower, accounting for just over 50 per cent of total outstanding Fund credit.

18. For example, an account to invest the Fund's accumulated reserves in a portfolio of fixed-income securities was created last year to generate additional revenues. On the expenditure side, the objective is to achieve no growth in real terms (an increase of 3.5 per cent on a nominal basis) for 2007 and a 1 per cent real reduction (a rise of 2.5 per cent in nominal terms) in 2008 and 2009.

Committee of Eminent Persons was appointed to provide an independent view of the options available to broaden the Fund's revenue base and to generate sustainable long-term financing for its running costs. Chaired by Sir Andrew Crockett, President of JP Morgan Chase International and former General Manager of the Bank for International Settlements, the committee released its report at the end of January (IMF 2007a). It proposed a fundamental change to the Fund's revenue model, basically recommending that the sources and uses of Fund resources be linked. Thus, the Fund's revenues from lending would cover intermediation costs (and the buildup of reserves). Because of their nature as a public good, surveillance activities would be financed by means derived proportionately from resources provided by all members. The committee recommends paying for the costs of these activities through expanded investment operations.¹⁹ Charges would cover the costs of capacity-building activities.

The committee's report provides an important step forward. It will also be worthwhile to undertake a review of the scope and size of the Fund's expenditures. Indeed, the IMF has a responsibility to its membership to ensure that it is managed in the most efficient way possible. Moreover, the review of the Fund's finances cannot be isolated from the other aspects of IMF reform. Ideally, the funding model should be integrated with the activities and comparative advantage of the IMF relative to other international institutions.

The role of the IMF in low-income countries

The IMF provides two key public goods for low-income countries. First, technical assistance helps them to develop the human and institutional capacity to put in place sound macroeconomic policies and structural reforms that can reduce their vulnerability to crises and raise the standard of living of their citizens. Second, data standards facilitate best practices in data collection and dissemination. To some extent, the IMF's responsibilities in these areas are complementary to those of the World Bank. Both institutions collaborate regularly and are involved in several joint initiatives.²⁰

Still, with two institutions working on similar initiatives, there is a need to ensure that overlap is minimized, while, at the same time, gaps are avoided and respon-

sibilities are clear. Recognizing that efforts could be unnecessarily duplicated, the IMF's MD, Rodrigo de Rato, and the President of the World Bank Group, Paul Wolfowitz, appointed the External Review Committee on IMF-World Bank Collaboration in March 2006. Chaired by Pedro Malan, Chairman of the Board of Unibanco and a former Minister of Finance of Brazil, the committee has a mandate to examine the areas of collaboration between the two institutions and to propose improvements to ensure that the division of labour is efficient and effective. The committee released its report at the end of February (Malan et al. 2007). It recommended that the collaboration between the two institutions be strengthened to better reflect their comparative expertise. For example, the committee advised that the IMF refocus its activities in low-income countries towards macroeconomic assessments and policy advice and that it gradually withdraw from subsidized long-term financing.

The Report makes a broad set of recommendations that will need to be carefully considered relative to its central insight that each institution could benefit from focusing on its comparative advantage. Thus, the IMF would focus on short-term initiatives to promote the stability of the international financial system, technical assistance in its area of expertise, and its data collection and dissemination efforts, and the World Bank on longer-term initiatives to foster economic development and reduce poverty. This would help to better organize, and thus make more efficient and effective, the activities of both organizations.

Conclusion

The IMF remains the key institution for promoting a well-functioning market-based international monetary system. While it has evolved to meet many of the challenges of an increasingly integrated global economy, further reform is needed. The Fund itself has embraced the reform process, as witnessed by MD de Rato's commitment to the review of its Medium-Term Strategy. The Bank of Canada is involved in facilitating the dialogue on IMF reform and is actively engaged in many of the issues, particularly, governance, surveillance, and lending facilities.

While the task of reforming a multilateral institution may seem daunting, the ongoing efforts of the IMF and its members to seek solutions are encouraging. The implementation of an ad hoc quota increase for the Fund's most under-represented members is a positive step towards a more comprehensive and lasting quota reform. Likewise, the move to revise the

19. Of note, the committee proposes to create an endowment from the sale of a portion of the IMF's gold holdings, which would then be invested.

20. The IMF also collaborates with other regional development banks, such as the African Development Bank, the Asian Development Bank, and the Inter-American Development Bank.

1977 Decision, in conjunction with the proposal of the Surveillance Remit, is a significant step forward in refocusing IMF surveillance. Finally, a rationalization of the Fund's lending instruments and finances and a clarification of its role in low-income countries would greatly facilitate a more focused, and more effective, IMF. Taken together, the reforms to the Fund's governance, instruments, and policies will be mutually reinforcing. It is important not only to improve how the Fund is governed, but also to ensure that it has the right tools to do its job well.

The ultimate aim of these reform efforts is to create an institution that is credible and legitimate in the eyes of its members and effective in supporting global financial stability. By ensuring that the Fund has clear objectives and the right instruments and governance structure to support its goals, the IMF can continue to fulfill its crucial role at the centre of the international monetary system, to the benefit of all its members.

Literature Cited

- Adams, T. 2005. "The U.S. View on IMF Reform." Speech presented at the Conference on IMF Reform, Institute for International Economics, Washington, D.C.
- Akyüz, Y. 2005. "Reforming the IMF: Back to the Drawing Board." G-24 Discussion Paper Series No. 38.
- Calomiris, C. 2000. "When Will Economics Guide IMF and World Bank Reforms?" *Cato Journal* 20 (1): 85-103.
- Cottarelli, C. 2005. "Efficiency and Legitimacy: Trade-Offs in IMF Governance." IMF Working Paper No. 05-107.
- Cukierman, A. 1998. "The Economics of Central Banking." In *Macroeconomic Policy and Financial Systems*, 37-82, edited by W. Holger. Vol. 5 of *Contemporary Economic Issues: Proceedings of the Eleventh World Congress of the International Economic Association*. London: Macmillan Press.
- de Rato, R. 2005. "The Managing Director's Report on the Fund's Medium-Term Strategy." International Monetary Fund, 15 September.
- . 2006. "Statement by Rodrigo de Rato, Managing Director of the International Monetary Fund, on the Work Program of the Executive Board." IMF Press Release No. 06-267.
- de Resende, C. 2007. "IMF-Supported Adjustment Programs: Welfare Implications and the Catalytic Effect." Bank of Canada Working Paper No. 2007-22.
- Dodge, D. 2006. "The Evolving International Monetary Order and the Need for an Evolving IMF." Speech to the Woodrow Wilson School of Public and International Affairs. Princeton, New Jersey, 30 March.
- Goldstein, M. 2000. "IMF Structural Conditionality: How Much Is Too Much?" Paper presented at NBER conference, "Economic and Financial Crises in Emerging Market Economies." Woodstock, Vermont, 19-21 October.
- Haldane, A. and M. Kruger. 2001-2002. "The Resolution of International Financial Crises: Private Finance and Public Funds." *Bank of Canada Review* (Winter): 3-13.
- Independent Evaluation Office (IEO). 2004. "Evaluation of the IMF's Role in Poverty Reduction Strategy Papers and the Poverty Reduction and Growth Facility." International Monetary Fund. Evaluation Report.
- . 2006. "An Evaluation of the IMF's Multilateral Surveillance." Evaluation Report.
- International Monetary Fund (IMF). 2005. "IMF Executive Board Reviews the Fund's Transparency Policy." Public Information Notice No. 05/116.
- . 2006a. "Consideration of a New Liquidity Instrument for Market Access Countries." 3 August.
- . 2006b. "Quotas—Updated Calculations." 4 August.

Literature Cited (cont'd)

- International Monetary Fund (IMF). 2006c. "IMF Surveillance." Factsheet (August). Available on the IMF website at www.imf.org/external/np/exr/facts/surv.htm.
- . 2006d. "IMF Executive Board Holds Board Seminar on Consideration of a New Liquidity Instrument for Market Access Countries." Public Information Notice No. 06/104.
- . 2007a. Committee to Study Sustainable Long-Term Financing of the IMF. 2007. "Final Report." 31 January.
- . 2007b. "Further Consideration of a New Liquidity Instrument for Market Access Countries—Design Issues." 13 February.
- . 2007c. "IMF Executive Board Discusses Design Issues for a New Liquidity Instrument for Market Access Countries." Public Information Notice No. 07/40.
- International Monetary and Financial Committee (IMFC). 2006. Communiqué of the International Monetary and Financial Committee of the Board of Governors of the International Monetary Fund, 22 April.
- King, M. 2006. "Reform of the International Monetary Fund." Speech to the Indian Council for Research on International Economic Relations (ICRIER), New Delhi, India, 20 February.
- Lafrance, R. and J. Powell. 1996. "Canada and International Financial Institutions." *Bank of Canada Review* (Autumn): 37–61.
- Lavigne, R., P. Maier, and E. Santor. Forthcoming. "A Vision for IMF Surveillance." Bank of Canada Working Paper.
- Lomax, R. 2006. "International Monetary Stability—Can the IMF Make a Difference?" Gam Gilbert de Botton Award Lecture, London, England, 1 November.
- Lombardi, D. and N. Woods. 2007. "The Political Economy of IMF Surveillance." Centre for International Governance Innovation Working Paper No. 17.
- Macklem, T. 2006. "Renewing the IMF: Some Lessons from Modern Central Banking." Speech to the Global Interdependence Center, Philadelphia, Pennsylvania, 9 March.
- Malan, P., M. Callaghan, C. Koch-Weser, W. McDonough, S.M. Indrawati, and N. Okonjo-Iweala. 2007. "Report of the External Review Committee on Bank-Fund Collaboration." February.
- Powell, J. 2001. "Reforming the International Financial System." *Bank of Canada Review* (Spring): 7–18.
- Santor, E. 2006. "Governance and the IMF: Does the Fund Follow Corporate Best Practice?" Bank of Canada Working Paper No. 2006–32.
- Van Houtven, L. 2002. "Governance of the IMF: Decision Making, Institutional Oversight, Transparency, and Accountability." IMF Pamphlet Series No. 53 (August).

The Canadian Overnight Market: Recent Evolution and Structural Changes

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- *The introduction of the Large Value Transfer System in February 1999, fixed announcement dates in December 2000, and changes in funding and collateral management practices have had an important effect on the structure and dynamics of the overnight market.*
- *Between 2001 and 2005, there was generally little difference between the overnight rate on collateralized overnight funding transactions and the target overnight rate set by the Bank of Canada. Beginning in early 2005, however, the rate on collateralized funding (repo transactions) began to drift more consistently below the target for the overnight rate.*
- *The increased demand for collateral has altered the behaviour and decision-making process of participants in the overnight market. Optimizing the use of collateral has become an increasingly important consideration among participants in forming their overnight funding strategies.*
- *A significant development in the overnight market has been the introduction of a new product, the overnight index swap (OIS) market in 1999. OIS instruments are used by participants to hedge or speculate and to gauge future expectations in the overnight market and have contributed to the improved informational efficiency of the market.*

Major financial market participants in Canada with a temporary surplus or shortage of funds use the overnight market to lend or borrow among themselves until the next business day. The interest rate at which these transactions occur is referred to as the overnight rate, and it is through its influence on the level of this rate that the Bank of Canada implements monetary policy. This is done by setting a target level for the overnight rate, often referred to as the Bank's key interest rate or policy rate. As part of the transmission mechanism for monetary policy, changes in the target overnight rate influence other interest rates and the exchange rate, leading to changes in asset prices, aggregate demand, the output gap, and eventually, inflation.¹ As a result, the efficiency of the overnight market is of particular interest to the Bank of Canada.

This article provides an overview of the current structure of the Canadian overnight market and describes how it has evolved since the Bank last published a review of this market in 1997.² Among other developments, the introduction of the Large Value Transfer System (LVTS) in February 1999, the adoption of fixed announcement dates (FADs) in December 2000, and changes in funding and collateral management practices have had an important effect on the structure and dynamics of the overnight market. As a result, this market has shifted from being mainly a source of

1. See Macklem (2002) for a description of how monetary policy is formulated.

2. See Lundrigan and Toll (1997–98) for details of that review.

funding to one where collateral management has become an important consideration.

Market Overview

The overnight market brings together financial market participants with temporary surplus funds and those that are potential borrowers. Participants include a broad array of financial entities: banks, investment dealers, interdealer brokers, corporations, investment funds (including hedge funds), pension funds, insurance companies, trust companies, finance companies, government agencies, and the Government of Canada.³ Over the past decade, the range of participants has not changed dramatically. However, their relative importance has changed somewhat, with institutional investors in general playing a modestly larger role in this market.

Commercial banks and investment dealers remain the largest borrowers and lenders of funds in the overnight market, primarily because of their market-making activities in a wide variety of financial assets (e.g., stocks and bonds), which require them to hold inventories of financial securities financed largely by borrowing in the overnight market. Other participants, such as asset managers (including managers of hedge funds) and sophisticated investors, also use the overnight market to finance their market positions, but to a lesser extent.

Financial institutions are the main providers of liquidity in the overnight market and are usually willing to provide quotes for both borrowing and lending overnight funds to their clients and other financial institutions.

Financial instruments in the overnight market

While banks are active participants in the market for overnight funds, most of their funding needs, including the funding of their overall operations, are still met through wholesale deposits. These deposits continue to make up the largest proportion of overnight transactions, followed by collateralized transactions and uncollateralized transactions.⁴ Wholesale deposits provide banks with a stable source of funding and are consistent with maintaining strong client relationships. As a result, deposit-taking institutions provide their

clients with daily bid and offer rates for overnight funding, adjusted slightly to account for the institution's preference to be a net lender or borrower of funds on that day. The functioning of this segment of the market has not changed materially over the past decade.⁵ However, quotes in the wholesale deposit market are now based on the Bank of Canada's target overnight rate (introduced in 1999), which has helped to improve the level of price transparency in this segment of the market.

Quotes in the wholesale deposit market are based on the Bank of Canada's target overnight rate, which has helped to improve the level of price transparency in this segment of the overnight market.

The repo market is by far the largest component of the collateralized segment of the overnight market and is of particular importance, owing to its high level of transparency relative to other segments of the market. Repo and reverse-repo transactions are also an important component of banks' funding and are the main funding vehicles for firms that do not have access to deposits (e.g., securities dealers). A repo combines both an immediate sale of securities and a simultaneous agreement to repurchase these securities at a pre-specified price and date (usually the next day). The opposite transaction is known as a reverse repo.⁶ From an economic standpoint, a reverse repo can be likened to a collateralized loan, where one party loans funds to another and in return receives collateral in the form of acceptable securities as insurance that the loan will be repaid. In Canada, from a legal standpoint, repos and reverse-repo transactions are actually buy/sellback agreements. This implies that the securities are bought and resold at different prices to reflect both the interest on the implicit cash loan and any cash flows that occur over the term of the agreement. Other components of the collateralized segment of the overnight market, such as call loans, once the primary

3. A significant amount of the information in this article was gathered during consultations between the Bank and market participants in April and May 2006.

4. Technically, commercial banks borrow wholesale deposits on an uncollateralized basis.

5. See Lundrigan and Toll (1997–98) for greater detail on the wholesale deposit market.

6. See Morrow (1994–95).

source of financing for investment dealers, have gradually decreased in importance.

Most of the collateral used in the Canadian overnight market consists of Government of Canada marketable debt. The repo market does not usually differentiate between specific Government of Canada securities, collectively referring to them as “general collateral” or the GC repo market. If, however, a security is in particular demand (Government of Canada or otherwise), perhaps because of a specific trading strategy prevalent in the broader market, it can trade at a lower rate⁷ in the repo market and is referred to as being on “special.” Specials markets are common in most major overnight repo markets, including those in the United States and the United Kingdom, and increasingly in the Canadian market.

The use of alternative sources of collateral, including provincial and government-guaranteed securities, has increased somewhat but has yet to become an active component of the Canadian repo market. This may be partly because these products are not perfect substitutes for Government of Canada collateral, given their slightly lower credit quality. The use of other forms of collateral, such as corporate or municipal bonds, presents an additional hurdle. Specifically, a bank that uses these products as collateral must put

7. Since securities in high demand will trade at a lower rate in the repo market, participants who own such securities can lend them in the repo market in return for cash on which they pay a lower interest rate than that available in the GC repo market.

aside additional capital in accordance with the capital-adequacy requirements laid out by the Office of the Superintendent of Financial Institutions (OSFI).

The interbank market in Canada, in which financial institutions borrow from and lend to each other without the borrower posting collateral, is small and continues to decline as a fraction of the overall overnight market. This contrasts with the United States, where the interbank market is deep and broadly based and the targeted policy rate, the federal funds rate, is in fact an interbank rate. The interbank market in Canada is currently used primarily by smaller financial institutions without a broad domestic deposit base. It is also used among direct participants in the LVTTS, not as a significant source of funding, but for end-of-day adjustment transactions. Depending on the institution, foreign exchange swaps⁸ will also be of varying importance in achieving day-to-day funding requirements.

A significant recent development in the overnight market has been the introduction of a new product, the overnight index swap (OIS) market in 1999. OIS instruments are used by participants to hedge or speculate and to gauge future expectations in the overnight market and have improved the market's

8. These are the sale (purchase) of foreign currency on a given date with a matching purchase (sale) arranged for a future date, for the same amount, with the same counterparty. Fully hedged borrowing (lending), called northbound (southbound), involves borrowing (lending) U.S. dollars and entering into foreign exchange swaps in which Canadian dollars are purchased (sold) for settlement today with an agreement to sell (buy) them for settlement at the end of the borrowing period.

Box 1: The Overnight Index Swap Market

An overnight index swap (OIS) is an over-the-counter derivative¹ in which two parties agree to exchange, or swap, for an agreed period, a fixed interest rate determined at the time of the trade for a floating rate that will vary over time. In this regard, OIS contracts are similar to traditional fixed-floating interest rate swaps. The distinguishing feature of the OIS is that the floating rate is the Canadian Overnight Repo Rate Average (CORRA) over the period.

Market participants predominantly use the OIS market for hedging activities, which are often

1. Over-the-counter trades occur directly between participants and not through a centralized exchange.

related to risk management. Specifically, participants can use the OIS to hedge either their funding costs or their exposure to short-term interest rate movements. The OIS market can also be used to alter the term structure of a portfolio or for taking a speculative position on the future path of the Bank of Canada's target overnight rate.

Related to the speculative and hedging functions of the OIS, the fixed-rate portion is also used by some market participants to derive market expectations of the Bank's future policy rate changes. If the duration of the swap extends over a FAD, for example, the difference between the fixed rate and the current overnight rate can be used to calculate the market expectations of a future change in policy

Box 1: The Overnight Index Swap Market (cont'd)

rates. The OIS has several advantages over other money market instruments in calculating expectations. Unlike other financial instruments, it is directly linked to the Canadian overnight rate. Furthermore, given that they are derivatives instruments, the supply of OIS contracts is not fixed. Supply factors can occasionally influence the pricing of other instruments, such as bankers' acceptances (BAs). The use of the OIS market to gauge expectations also presents some challenges. At times there is a lack of price information or market depth in the OIS market, particularly in farther-dated contracts. Moreover, if the CORRA rate were expected to deviate from the overnight target, gauging expectations of future interest rates would become more difficult.

Market development

The Canadian OIS market has grown rapidly since it was introduced in March 1999. Although it is difficult to determine the market's exact size, anecdotal evidence and information obtained from dealers suggest that the notional principal amount outstanding is between \$40 billion and \$100 billion.² This compares reasonably well with other money market instruments, such as BAs and Government of Canada treasury bills, which have outstanding amounts of around \$55 billion and \$130 billion, respectively. The most active and liquid money market instruments, however, remain futures contracts on BAs, which have an open interest of around \$475 billion.

Several factors have contributed to the growth of the OIS market, including both the adoption of the FADs by the Bank of Canada and improvements to the publishing of the CORRA.³ The relative stability and predictability of the CORRA and the off-balance-sheet nature of an OIS transaction,⁴ as well as the flexibility of its term to maturity, have also helped to attract interest from market participants.

Since there is no transfer of principal between counterparties, another advantage of the OIS is that there is relatively little credit risk. Interest rate swaps, including the OIS, do not involve the participants in the exchange of principal. The only transfer of funds occurs at the maturity of the contract and reflects the net obligation of one party to the other. The net obligation is the difference between the interest accrued on the fixed (OIS) rate and the compounded floating rate over the term of the swap.⁵

Market overview

The terms to maturity for OIS typically range from one week to one year, with the majority of trading and quotes concentrated in relatively short and standardized maturities of three months or less. The bid/ask spreads for OIS were originally as wide as five basis points (bps), but are now typically one to two bps for swaps of three months or less and slightly wider for longer-term swaps.⁶ Like those for other money market instruments, the spreads can vary from day to day, depending on market conditions. The more common factors that affect spreads include the predictability and consistency of the CORRA and the relative level of uncertainty about future changes in the target overnight rate by the Bank of Canada.

The standard quote sizes for an OIS tend to be between \$25 million and \$125 million, with the \$125 million applying to contracts up to six months and the \$25 million applying to longer contracts. However, actual transactions tend to be for amounts significantly larger than the standard quotes. Market depth has tended to be quite good in recent years, and it is not uncommon to see transactions for over \$1 billion in the 1-month area and several hundred million dollars for other swap terms on a daily basis.

2. Information used to estimate market size was collected through visits with dealers during the autumn of 2005.

3. These include greater precision (moving from two decimals to four), refining the window in which trades are recorded (06:00 to 16:00), and publishing the CORRA earlier, at 09:00 rather than noon on the next business day.

4. Notional amounts do not appear in the main body of the firm's financial statements.

5. Swaps, including the OIS, are based on an agreed notional amount.

6. Usually the spread compresses quite significantly before a trade is completed, declining from approximately two bps to as little as one-quarter of a basis point.

informational efficiency. The OIS market is discussed in greater detail in Box 1.

Overall, most of the assets that are funded in the overnight market continue to be denominated in Canadian dollars. Therefore, despite the globalization of capital markets, most of the overnight funding requirements of Canadian financial participants continue to be met through Canadian-dollar-denominated overnight financial instruments.

Market transparency and flows

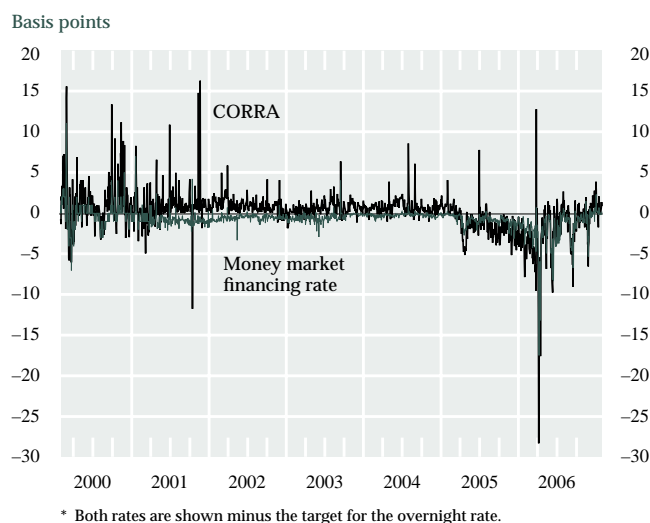
Given the myriad of funding products available in the overnight market, the Bank of Canada uses two measures of the collateralized overnight rate as proxies for the overall average cost of overnight funding. The two measures, which the Bank publishes, are the Canadian Overnight Repo Rate Average (CORRA) and the overnight money market financing rate. The CORRA consists of a weighted average of rates on repo transactions conducted onscreen between 06:00 and 16:00 and subsequently reported by interdealer brokers. The CORRA is limited to repo transactions that involve general collateral (GC) and provides a transparent intraday and end-of-day measure of the level of the overnight rate.

The Bank of Canada uses two measures of the collateralized overnight rate as proxies for the overall average cost of overnight funding.

The overnight money market financing rate is an estimate compiled at the end of the day by the Bank of Canada through a survey of major participants in the overnight market. This estimate, which comprises the weighted-average repo funding cost of major money market dealers, including special purchase and resale agreements (SPRAs)⁹ with the Bank of Canada and trades that are conducted directly between dealers, provides a somewhat broader measure than the CORRA. The overnight money market financing rate observed in Chart 1 is less volatile than the CORRA,

9. SPRAs and SRAs are repo-type and reverse repo-type transactions, respectively, in which the Bank offers to purchase (sell) Government of Canada securities from designated counterparties with an agreement to sell (buy) them back at a predetermined price on the next business day.

Chart 1
The Money Market Financing Rate and the Canadian Overnight Repo Rate*



partly because the average money market financing rate represents a significantly greater volume of overnight transactions from a broader set of participants.

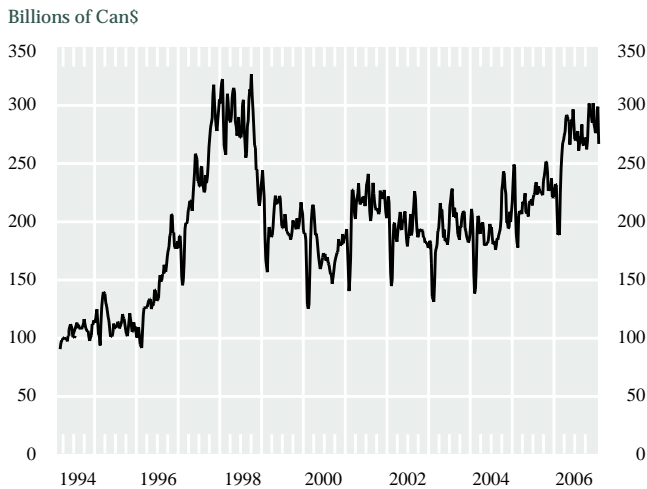
A portion of repo and reverse-repo transactions are visible to most wholesale market participants on various interdealer broker screens (both the size of the trade and the rate at which it was transacted). However, since most transactions (repo and otherwise) in the overnight market are conducted directly between counterparties, not through brokers, the true level of activity in the overnight repo market is not easily discernible by participants. Quarterly trading statistics provided to the Bank and the Investment Dealers Association by government securities distributors suggest that the volume of Canadian repo transactions involving Government of Canada marketable debt is approximately Can\$55 billion a day. The daily volume has grown considerably since 1994–95 when the Bank first reviewed the Canadian repo market (Morrow 1994–95). As can be seen in Chart 2, however, weekly repo volume peaked in 1997–98 and then remained relatively stable, albeit at a modestly lower level, between 1999 and 2005. Recently, repo volumes in Canada have increased and are approaching their highest recorded levels.

Despite the prevalence of direct bilateral transactions, market participants in general believe that the quotes posted by interdealer brokers for Government of Canada securities accurately reflect the price in the broader over-the-counter (OTC) overnight market at any given

Chart 2

Weekly Repo Trading Volumes of Government of Canada Securities

4-week moving average



time. The interdealer broker screens therefore provide a primary source of price discovery throughout the day. In addition, at the end of the day, when most participants are fine-tuning their funding positions, the interdealer broker screens are also used as a way to find counterparties with offsetting positions.

While the repo transactions conducted through the interdealer brokers provide some transparency, the volume of transactions conducted in that segment of the market has, on occasion, been very low. Since

1999, there have been 145 instances where the daily volume of GC repo transactions conducted through interdealer brokers was below \$500 million, the minimum threshold for setting the CORRA since December 2005. When the volume of daily repo transactions recorded by the interdealer brokers is below \$500 million, the CORRA is simply set as the target overnight rate, which may or may not accurately reflect the true rate of collateralized funding. Overall, however, the volume of repo transactions conducted through interdealer brokers has increased since 1999, and this has helped to improve the transparency of the overnight market.¹⁰

In the uncollateralized portion of the market, interbank quotes are also visible on interdealer broker screens, but market depth remains limited. In addition, while rates on wholesale deposits are not visible to the market as a whole, rates quoted to customers are set relative to the target overnight rate. The improvements to the monetary policy framework, including the explicit communication of the target overnight rate, have thus provided some level of transparency to wholesale deposit clients.

Another measure of the uncollateralized portion of the market as proposed by Hendry and Kamhi (2007) can be obtained from the overnight loan and loan repayment transactions that occur through the LVTS (Box 2).

10. Specifically, in 2006, there were only four instances when the daily volume fell below the minimum threshold.

Box 2: An Alternative Measure of the Uncollateralized Portion of the Overnight Market

Hendry and Kamhi (2007) derive an estimate of the uncollateralized portion of the overnight market for the two-year period starting March 2004 by analyzing the transactions flows in Canada's LVTS. Adapting a methodology developed in the United States for imputing federal funds transactions from Fedwire activity,¹ the authors estimate that about US\$5 billion of uncollateralized overnight loans are

1. Fedwire is a real-time gross-settlement system operated by the Federal Reserve that enables participating financial institutions to electronically transfer funds among themselves. In conjunction with the privately held Clearing House Interbank Payments System (CHIPS), Fedwire forms the primary network for large-value domestic and international payments in the United States.

transacted daily. This figure represents a lower bound estimate of the uncollateralized market, given that certain overnight loans do not lead to LVTS payments. As such, the uncollateralized market is slightly larger than the brokered repo market, but only about one-tenth the size of the direct-trade repo market. The implied overnight interest rate on these loans displayed little variation from the target overnight rate, with a mean spread of only 0.017 basis points. This implied interest rate was found to vary with general market conditions, the size of the loan, and the size of the borrower and lender. The data also revealed that, as expected, smaller LVTS participants are, in general, a net source of funds to the larger banks.

Structural Change and the Collateralized Overnight Rate

The Canadian overnight market has continued to evolve since its inception. The past 10 years have witnessed exceptional change, including the introduction of the LVTS and the FADs, changes in market practices regarding risk management, the rise of securities lending, and the growing importance of the collateralized portion of the overnight market.

The LVTS

In Canada, the implementation of monetary policy is closely linked to the system through which payments clear and settle on a daily basis. The LVTS, an electronic network for sending and receiving large payments, was introduced by the Canadian Payments Association on 4 February 1999. The system allows for LVTS direct participants to settle their large payment obligations both among themselves and for their clients. To minimize the risk of one of the participants failing to meet its obligations, members are required to post collateral to support their payment flows. All direct LVTS participants hold settlement accounts at the Bank of Canada.

Earlier, in 1994, the Bank had started to direct its policy actions towards maintaining the overnight rate at a level within a 50-basis-point operating band that was consistent with its objective for overall monetary conditions. The Bank offered SRAs and SPRAs as a mechanism to set the limits of the band. With the introduction of the LVTS, the Bank made various modifications to the framework for the implementation of monetary policy (Howard 1998). The Bank formally set the target overnight rate as the midpoint of the 50-basis-point operating band and reinforced the latter with its end-of-day deposit and lending facility. The upper limit of the band, known as the Bank Rate, became the rate charged to LVTS participants that require an overdraft loan to cover a deficit position and permit LVTS settlement at the end of the day. The lower limit of the band became the rate at which the Bank of Canada remunerates LVTS participants holding deposits at the end of each day's LVTS settlement.¹¹ This mechanism greatly reduces the probability that the overnight rate will trade outside of the band.

11. Both the upper and lower limits of the band are generally thought of as collateralized rates. Technically, however, the Bank does not pledge collateral when it borrows funds at the lower limit, since it poses no counterparty risk. LVTS participants do provide collateral when they take advances from the Bank of Canada.

Given the cost incentives in the LVTS, it is mutually beneficial for participants with short and long funding positions to trade with each other, rather than to leave those positions with the Bank. Furthermore, the symmetry of the operating band creates incentives for LVTS participants to transact at or near the target overnight rate. The Bank also continues to intervene intraday in the overnight market with SPRAs and SRAs, as needed, to reinforce the midpoint as the target overnight rate.

The symmetry of the operating band creates incentives for LVTS participants to transact at or near the target overnight rate.

Assuming that no excess balances are left in the system, the aggregate position of all LVTS members with settlement accounts at the Bank will be zero at the end of the day. Members with a deficit balance will thus be aware that an offsetting positive position exists in the account of one or more other members. While the LVTS framework can operate with zero settlement balances, the Bank has often left a small positive amount of settlement balances to offset transactions costs and other minor market structure frictions (see "Evolution of the Overnight Rate and the Demand for Collateral," below).

Not all financial market participants are LVTS members. As of December 2006, excluding the Bank of Canada, there were 14 direct members of the LVTS. However, since direct LVTS participants transact with their customers, including other financial institutions and commercial and government entities, a link is created between the incentives within the LVTS and the broader cost of overnight funding. Consequently, the LVTS framework has contributed to a more predictable overall cost of funding, thus providing a benefit to both international and domestic investors, the Canadian economy, and, ultimately, the welfare of all Canadians.

The evolution of the Bank of Canada's monetary policy framework is outlined in Table 1.

Fixed announcement dates

In December 2000, the Bank of Canada adopted a new framework, the fixed announcement dates (FADs), consisting of eight pre-specified dates a year on which policy rate decisions would be announced. Before the

Table 1
Evolution of the Monetary Policy Framework

Date	Change in Policy Implementation Framework
Pre-November 1956 and June 1962 to March 1980	Bank Rate set at the discretion of the Bank of Canada
November 1956 to June 1962 and March 1980 to February 1996	Bank Rate set weekly at 25 basis points above the 3-month treasury bill rate at tender
November 1991 to June 1992	Operating framework changed in anticipation of the removal of statutory reserve requirements
June 1992 to June 1994	Phase-out of statutory reserves
Mid-1994	Introduction of 50-basis-point operating band for the overnight rate; changes in operating band are inferred from the Bank's use of SPRAs /SRAs.
February 1996	Bank Rate set at upper limit of operating band; changes in operating band announced by press release
February 1999	Introduction of the Large Value Transfer System
December 2000	Introduction of the fixed announcement dates

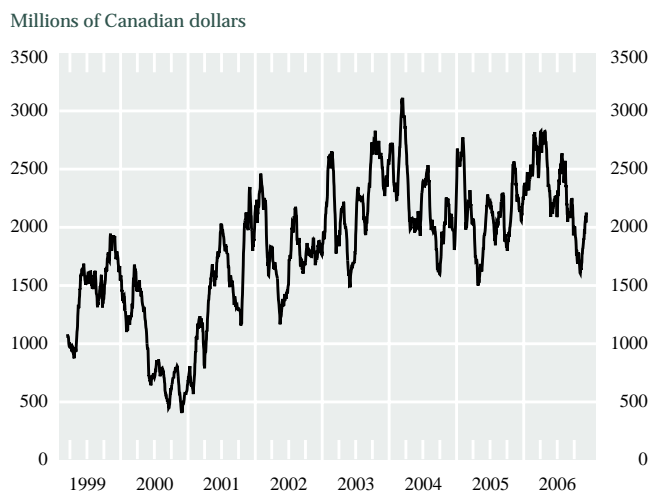
adoption of the FADs, changes to the target overnight rate could be announced at 09:00 on virtually any business day. Because of the uncertainty that surrounded the timing of the announcements, market participants incorporated a risk premium in the price that they were willing to quote their customers to borrow and lend funds for periods longer than one day. The introduction of the FADs has greatly reduced this uncertainty (Parent, Munro, and Parker 2003) and has led to improvements in the efficiency of the Canadian money market, including the development of new financial instruments such as the OIS (Box 1). Among its other uses, the OIS market allows participants to more effectively hedge their funding requirements and/or short-term interest rate exposure.

The introduction of the FADs has increased hedging opportunities and encouraged the use of term repo transactions.

The introduction of the FADs has also contributed to changes in how transactions take place in the repo market, with an increasing proportion of such transac-

Chart 3
Daily Overnight Repo Volume Conducted through Interdealer Brokers

30-day moving average



tions being conducted over longer terms (referred to as term repos) rather than on an overnight basis.¹² Instead of unwinding the next day, a growing number of repo transactions now mature on, or close to, the FADs. The evidence presented in Chart 3 suggests that this shift has not materially affected daily liquidity in the overnight repo market, perhaps because of the growth in overall repo volumes (Chart 2). The growth of term repo transactions has, however, reduced daily rollover risk for financial market participants. It also implies that large volumes may be transacted at or near the FADs.

Overall, however, the introduction of the FADs has increased hedging opportunities and encouraged the use of term repo transactions. This, in turn, has facilitated the management of risk in the daily funding requirements of financial market participants.

Receiver General auctions

As the government's fiscal agent, the Bank of Canada manages the government's cash balances to ensure it can meet its operating requirements and that any balances in excess of daily requirements are invested in a cost-effective manner. These excess short-term Canadian-dollar balances are invested through daily

12. To a lesser extent, transactions and settlement costs may have also influenced the shift in the term of repo transactions.

auctions of Receiver General (RG) balances.¹³ Coincident with the introduction of the LVTS, the frequency of RG auctions was expanded to twice daily (morning and afternoon), and all LVTS participants became eligible participants. In addition, the list of eligible institutions for the morning auction was expanded in 2002 to include certain other qualifying participants. The morning auction typically represents the bulk of the amount auctioned and is to a large extent collateralized. A cushion of balances is maintained through to the afternoon to ensure sufficient balances to meet any unexpected requirements. Once the closing amounts are determined, the final auction is held at 16:15. Only LVTS participants are eligible to participate in the afternoon auctions (which are uncollateralized).

Under the September 2002 revisions to the terms of participation in RG auctions, the morning government auction of deposits to specified participants requires the borrower to post collateral beyond a certain threshold in the form of financial securities such as government bonds and bills.¹⁴ As such, the collateralized portion of the morning RG auction can be likened to a large repo transaction. Since the results of the auction are transparent to all participants in the auction system, it stands to reason that the auction may provide an early source of price discovery in the overnight market.¹⁵ Nonetheless, there is little evidence that the auctions have had a material impact on the daily average repo rate as measured by the CORRA, other than perhaps at times of seasonal peaks in the level of balances. Specifically, since 2002, the spread between the rate received by the Receiver General at the morning auction and the target overnight rate has shown little correlation (0.14) with the spread between the CORRA and the target overnight rate.

Securities lenders

Improvements in the government's fiscal position over the past decade have led to a decline in the supply of Government of Canada marketable debt. In theory,

a significant decline in available collateral could reduce the efficiency of the Canadian repo market, the overnight market, and the Canadian securities market more broadly. However, the decline in the supply of Government of Canada marketable debt has, to date, been a relatively modest percentage of the total outstanding¹⁶ and has been at least partially offset by the growth of securities-lending agreements.

Securities-lending agreements help to mobilize the stock of existing securities sitting with custodians¹⁷ into active use in the collateralized portion of the overnight market. The increase in the amount of securities being made available for overnight transactions has been facilitated by the growth of securities-lending agents, who act as third party to the borrowing or lending of financial securities. Securities lending is generally conducted by large, often global custodians or asset managers on behalf of numerous clients. For instance, an asset manager may hold a number of securities in its portfolio, but for reasons of cost or size, perhaps, may choose not to enter into the repo market directly. In the past, those securities would have been unavailable for use as collateral in the overnight market. Increasingly, however, portfolio managers are entering into agreements with securities lenders (frequently their custodians) to allow them to act (under certain restrictions) as a third-party agent in lending out portions of their portfolio in return for a fee.

In Canada, the pool of securities available from securities lenders has experienced strong growth over the past decade. This may reflect, in part, the removal in 2001 of some restrictions on the participation of Canadian mutual funds in securities lending and in repo and reverse-repo transactions. While mutual funds can now enter the overnight market directly, many may choose, for cost or strategic efficiency reasons, to participate indirectly through securities-lending agreements.

Securities lending has likely been positive, on net, to the liquidity of the Canadian fixed-income market, but its impact on the overnight market remains somewhat difficult to gauge. Specifically, the cost to financial participants of accessing securities via a securities lender is higher, owing to an additional fee structure

13. These daily auctions are also the mechanism for the transfer of balances to and from the Bank of Canada's balance sheet to those of the private sector. The difference between the aggregate amount maturing on any given day and the new balances auctioned typically represents the neutralization of the net impact of any public sector flows to and from the Bank of Canada's balance sheet.

14. For a list of acceptable collateral, see "Terms and Conditions Governing the Morning Auction of Receiver General Cash Balances" on the Bank's website at www.bankofcanada.ca/en/auction/rec_general.pdf.

15. Results are typically released to auction participants at about 09:20.

16. The amount of marketable Government of Canada debt fell from \$467 billion in 1997–98 to \$427 billion in 2005–2006, an 8.5 per cent decline.

17. A custodian is a financial institution that has the legal responsibility for safeguarding and managing a firm's or individual's financial assets. Custodians are required to arrange the settlement of any purchases and sales of such securities and to collect the income from such assets on behalf of their owners.

and the need to provide more collateral (in return for the desired securities). Securities lending therefore provides specific liquidity for securities that may be in high demand and thus command a premium in the repo market.¹⁸ By supplying liquidity in specific bonds and treasury bills as well as a range of other financial securities, securities lending provides a net benefit to financial markets more broadly. This benefit is likely mitigated, however, by the degree to which Government of Canada bonds and treasury bills are posted as collateral by participants to obtain specific issues from securities lenders, since the pool of GC is thereby temporarily reduced.

Evolution of the Overnight Rate and the Demand for Collateral

The introduction of the LVTS

The overnight rate initially exhibited some volatility following the introduction of the LVTS in 1999, generally trading above target (Chart 1). During this early period, the Bank customarily set the level of settlement balances in the system at zero. This consistent trading of the overnight rate above target indicated, however, that there was some demand for excess balances. Beginning in September 1999, at month-ends, and starting in November 1999 on a daily basis, the Bank generally provided some positive level of settlement balances and somewhat higher levels when technical pressures occurred. At that time, the Bank also intervened regularly in the overnight market with SPRAs to reinforce

the target overnight rate. After this transition period, the overnight rate became significantly more stable, tracking the overnight target closely between 2001 and 2005. As a result, the Bank of Canada intervened less frequently with SRAs and SPRAs and gradually reduced the level of settlement balances (Table 2).

Recent divergence between secured and unsecured funding

Between 2001 and 2005, there was generally little difference between the overnight rate on collateralized overnight funding transactions and the target overnight rate set by the Bank of Canada. Beginning in early 2005, however, the volatility of the CORRA increased (Chart 1), and the rate on collateralized funding (repo transactions) began to drift more consistently below the target for the overnight rate. As a result, the frequency with which the Bank conducted SRA operations increased (Chart 4), and in March 2006, the Bank introduced some temporary measures to reinforce the target overnight rate. Further measures were added in February 2007 (Box 3).

Anecdotal evidence suggests that a general increase in the demand for GC from various sources led to the downward pressure on the collateralized overnight rate. In a repo transaction, an increase in the value of collateral would be reflected in a decrease in the repo rate; in other words, participants wanting to obtain GC would need to provide in return an overnight loan of funds at lower interest rates.

Table 2

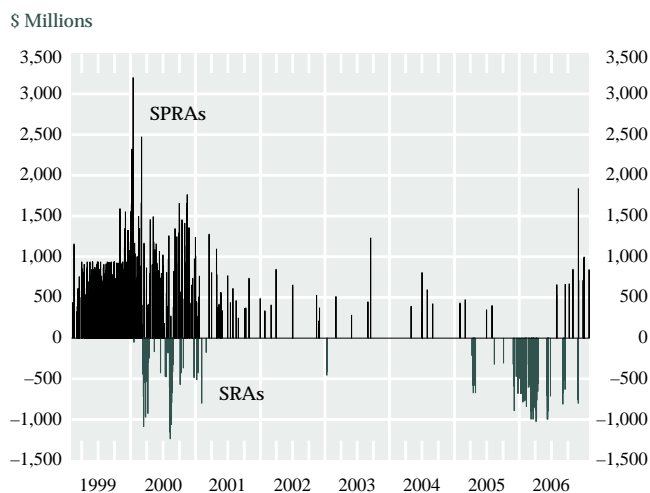
Timetable of Adjustments to Target Settlement Balances

February 1999	End-of-day settlement balances targeted at zero
September 1999	Positive balances on technically tight days (month-ends); zero otherwise
November 1999	Minimum daily balances of \$200 million, higher on technically tight days
April 2001	\$50 million most days; higher on technically tight days (month-ends, mid-months)
March 2006	Zero target balances on a daily basis, with possibility of deficit position

18. Specific securities that are in high demand by borrowers can trade in the repo market at a rate below that of GC. Since these securities are deemed to be trading on special, the rate at which they trade is not included in the CORRA measure of the overnight rate.

Chart 4

SPRA and SRA Operations



Box 3: The Bank of Canada's Temporary Measures to Reinforce the Target for the Overnight Rate

In March 2006, the Bank of Canada introduced temporary measures to help reinforce the target for the overnight rate.¹ Specifically, the Bank announced that, on a temporary basis, it would reduce settlement balances to zero and no longer commit to fully neutralizing SRA operations. That is, when the Bank conducts an SRA, it provides collateral in return for funds on which it pays the target overnight rate. These funds are then usually neutralized (i.e., put back into the system at the end of the day) through a transfer of Receiver General (RG) balances from the Bank's balance sheet to winning participants in the afternoon RG auction. By not committing to fully neutralizing these flows, the Bank could in essence leave the system short, causing one or more LVTS participants to have a deficit position at the end of the day. This short position would then necessitate an advance from the Bank at the Bank Rate (25 basis points above the target overnight rate) and a pledge of collateral. From the

introduction of the temporary measures through to February 2007, the system was left short 15 times. Similar temporary measures were taken in September 1999, soon after the introduction of the LVTS, to not commit to fully neutralize SPRA operations (as opposed to SRAs) at month-end. As a result of the ability to not fully neutralize SRA or SPRA operations, the Bank provides a further incentive to participants to conduct transactions in the overnight market at or very close to the target overnight rate.

In February 2007, to further reinforce the Bank's objective for the overnight rate, the Bank announced that it is prepared to enter into SRAs outside of the regular 11:45 intervention time, including earlier in the morning.²

The Bank has subsequently clarified its policy implementation framework, details of which can be found in the Appendix (p. 28).

1. See "Temporary Measures to Reinforce the Target for the Overnight Rate," Thursday 9 March 2006, available on the Bank's website at www.bankofcanada.ca/en/notices_fmd/2006/not090306.html.

2. See "Temporary Measures to Reinforce the Target for the Overnight Rate," Thursday 15 February 2007, available on the Bank's website at www.bankofcanada.ca/en/notices_fmd/2007/not150207.html.

The Increased Demand for Collateral

Since 1997, there has been a notable increase in the number of uses and hence in the demand for collateral. This greater demand stems in large part from changes in risk-management practices,¹⁹ greater use of financial derivatives, and the increased need for collateral in the major settlement and payments systems. Given these changes, market participants have altered their valuation and management of collateral.

Greater focus on risk management has increased the focus on collateral management. For instance, participants increasingly differentiate between the risks and internal capital costs of collateralized versus uncollateralized funding. Since one loan is backed by collateral and the other is not, there is little reason, from a risk-management perspective, for the rates on the two loans to be equivalent. Overall, participants

are becoming more reluctant to lend in the overnight market on an uncollateralized basis without appropriate remuneration. This trend may intensify as Basel II²⁰ is adopted and even greater emphasis is put on risk management and internally calculated capital costs.

Participants are also putting greater emphasis at the margin on maintaining appropriate internal liquidity ratios, which in essence requires them to maintain larger cushions of collateral to ensure that they are able to raise additional funds in a timely manner, if needed (either in the repo market or by liquidating these positions).

In addition, collateral is increasingly used worldwide to help mitigate the counterparty risk associated with swap and other OTC derivative activity. As these markets

19. Changes in risk management were likely prompted in part by the guidelines for capital-adequacy requirements provided by OSFI to deposit-taking institutions.

20. Basel II is the second Basel Accord and represents a revision of the international standards for measuring the adequacy of a bank's capital. The aim of the Accord is to promote greater consistency in the way banks and banking regulators approach risk management across countries. Implementation of the Accord is expected in 2008.

continue to grow, and more ISDA Master Agreements²¹ are put into place between counterparties, the demand for collateral is expected to increase even more. As an example of recent growth, the amount of collateral pledged for OTC derivative exposure worldwide had grown from US\$200 billion in 2000 to over US\$1.3 trillion by the end of 2005 (BIS 2007).

Demand for collateral has grown for other reasons as well, including the needs pertaining to the clearing and settlement systems (e.g., the LVTS, the Canadian Depository for Securities Limited (CDS), and the CLS Bank)²² and the partial collateralization of RG term deposits. For instance, for many participants, the collateral needs stemming from the LVTS represent their single largest demand for collateral. Not only is this demand for collateral new since the last published overview of the overnight market in 1997, but the requirements have grown, partly because of the growth of foreign exchange settlement via the CLS Bank.²³ The average amount of collateral pledged daily for LVTS/CDS/CLS Bank purposes increased from about \$18 billion in 2000 to \$26 billion in 2006Q2.

Overall, the Bank's measures of the overnight rate have remained predominantly at, or close to, the target overnight rate. However, an increase in the overall demand for Government of Canada collateral has, at the margin, increased the likelihood that participants will have more difficulty finding sufficient collateral on certain occasions. This implies that temporary additional increases in the demand for collateral have been more likely to result in the collateralized overnight rate moving away from the target.

Collateral Management and Changes in Market Behaviour

The implicit, if not explicit, increase in the value of collateral has altered the behaviour and decision-making processes of participants in the overnight market. The optimal use of collateral has become an increasingly

21. The International Swaps and Derivatives Association (ISDA) is a trade organization of participants in the OTC derivatives market. An ISDA Master Agreement is a standardized contract (which includes collateral arrangements) that two parties to an agreement sign before entering into a derivative transaction with each other. The Bank for International Settlements (BIS) reports that the number of ISDA Master Agreements worldwide increased from 12,000 in 1998 to about 110,000 at the end of 2005 (BIS 2007).

22. Based in New York City and regulated by the Federal Reserve Board, CLS Bank International provides "continuous linked settlement" (CLS) for foreign exchange transactions. For more information, see Miller and Northcott (2002).

23. The Bank of Canada provides the CLS Bank with a settlement account for the Canadian-dollar leg of the settlement and acts on its behalf in the LVTS.

important consideration among participants in forming their overnight funding strategies.

Although not a new development, it is important to consider that different types of securities can be pledged as collateral for different purposes (and often at different levels of collateralization). For example, when corporate bonds are used as collateral, the lender typically requires the borrower to pledge a greater amount of collateral than if Government of Canada securities had been pledged, reflecting the difference in credit quality.²⁴ Furthermore, to safeguard the knowledge of its market positions, a participant may be less willing to pledge some types of collateral with competing participants. Collateral management is further complicated by the fact that the exact magnitude of the funding requirements of market participants is not known at the commencement of trading, but evolves throughout the day. Given the increased demand for collateral, the importance of determining which collateral to pledge for each different requirement has therefore increased, requiring participants to evaluate the optimal use of their stock of collateral relative to their needs.

Given the increased demand for collateral, the importance of determining which collateral to pledge for each different requirement has therefore increased, requiring participants to evaluate the optimal use of their stock of collateral relative to their needs.

Examining the evolution of the types of collateral pledged in the LVTS provides an understanding of the growing importance of collateral management and its impact on the behaviour of market participants. For example, the range of securities that can be pledged in the LVTS was expanded in 2001 in response to requests from financial institutions to include (with certain

24. The additional collateral reflects the imposition of a "haircut" by financial participants. A haircut is the percentage by which an asset's market value is reduced for the purpose of calculating the levels of capital requirements, margins, and collateral. Since the value is reduced for the purpose of calculating collateral requirements, a greater amount of collateral is pledged than if no haircut was applied.

restrictions) BAs, promissory notes, commercial paper and short-term municipal paper, and corporate and municipal bonds.²⁵ Of note, the use of the expanded list of collateral has grown, from about 4 to 6 per cent of the total collateral pledged in the LVTS when the expanded list was first introduced, to about 15 to 20 per cent today. This use probably reflects participants' decision to redeploy Government of Canada collateral to other uses, perhaps in the GC repo market.

The emergence of increasingly sophisticated investment practices has also likely led to more dynamic collateral management on the part of securities dealers. A hedge fund, for example, by executing a large trade through a dealer, may in turn force the dealer to enter the repo market, which increases the complexity of the dealer's collateral management.²⁶ In addition, to the extent that commercial banks lend to select institutions, such as hedge funds, the amount of the associated collateral posted with the Bank will also fluctuate with the market value of the fund, and frequent substitutions of collateral may also be required as these funds alter their market positions.

25. See "Terms and Conditions for the Expanded Bank of Canada Collateral List Effective 1 November 2001," available on the Bank's website at www.bankofcanada.ca/en/notices_fmd/2001/not221001.html.

26. An example might be the prevalence among investors to own a futures contract while simultaneously selling short the underlying bond. This strategy would in turn create a need to borrow this bond in the repo market, putting downward pressure on the repo rate of the specific collateral. This may partly explain the recent increase in the number of securities trading on special in Canada.

The changing role of the repo market

While the repo market continues to be an important market in which to finance securities inventories and to raise and lend funds, it has become equally important as a market in which to borrow and lend securities and, therefore, to manage collateral. Correspondingly, the repo market's contribution to market efficiency continues to gain importance. Not only does it facilitate collateral management, the repo market improves price discovery in securities markets by facilitating short sales, lowers trading frictions and settlement risk by improving overall market liquidity, and improves portfolio risk management.

Conclusion

The overnight market is a key component of the transmission mechanism through which monetary policy influences asset prices, aggregate demand, the output gap, and eventually, inflation. Several important changes have taken place since the late 1990s, including the introduction of the LVTS and the FADs, and the growth of securities lending. Overall, despite some volatility, the overnight rate has shown much greater stability than it did under the previous monetary policy framework. These improvements have led to the growth and increased efficiency of the Canadian money market and contribute to the enhancement of liquidity in the Canadian fixed-income market more broadly.

Literature Cited

Bank for International Settlements (BIS), Committee on Payment and Settlement Systems. 2007. "New Developments in Clearing and Settlement Arrangements for OTC Derivatives."

Hendry, S. and N. Kamhi. 2007. "Uncollateralized Overnight Loans Settled in LVTS." Bank of Canada Working Paper No. 2007-11.

Howard, D. 1998. "A Primer on the Implementation of Monetary Policy in the LVTS Environment." *Bank of Canada Review* (Autumn): 57-66.

Lundrigan, E. and S. Toll. 1997-98. "The Overnight Market in Canada." *Bank of Canada Review* (Winter): 27-42.

Macklem, T. 2002. "Information and Analysis for Monetary Policy: Coming to a Decision." *Bank of Canada Review* (Summer): 11-18.

Miller, P. and C. A. Northcott. 2002. "CLS Bank: Managing Foreign Exchange Settlement Risk." *Bank of Canada Review* (Autumn): 13-25.

Morrow, R. 1994-95. "Repo, Reverse Repo and Securities Lending Markets in Canada." *Bank of Canada Review* (Winter): 61-70.

Parent, N., P. Munro, and R. Parker. 2003. "An Evaluation of Fixed Announcement Dates." *Bank of Canada Review* (Autumn): 3-11.

Appendix

The Bank of Canada's Target for the Overnight Interest Rate: Policy Implementation Framework

Within the framework for implementing monetary policy, the Bank of Canada (the Bank) sets a target for the overnight interest rate. This target is the first stage in the transmission mechanism through which the monetary policy actions taken by the Bank affect the level of economic activity and, ultimately, inflation. The key features of this monetary policy implementation framework are the target for the overnight rate, the operating band, the ability to conduct buy-sellback and sell-buyback transactions at the target rate, and the management of settlement balances.¹ Given the nature of this framework and the Canadian overnight market, the Bank is best able to influence short-term rates by targeting a level for the collateralized overnight rate.

Target for the Overnight Rate

The Bank of Canada's target for the overnight rate is the rate on collateralized, market-based overnight transactions.² This is defined as the rate at which major participants in the money market borrow and lend funds fully secured by acceptable collateral for a term of one business day. The Bank will use the rate on overnight general collateral (overnight loans that are secured by non-specific government securities, referred to as the GC overnight rate) as its guide to conditions in the overnight market, although this information may, at times, need to be supplemented by information on conditions in other sectors of the overnight market.³ Implicit in this arrangement is the possibility that, if collateralized funds trade at the Bank's target for the overnight rate, uncollateralized funds may well trade at rates above the target.

1. For further details, see "A Primer on the Implementation of Monetary Policy in the LVTS Environment," and "The Framework for the Implementation of Monetary Policy in the Large Value Transfer System Environment." Both are available on the Bank of Canada's website at www.bankofcanada.ca/en/monetary/lvts/index.html.

2. Previously, the target for the overnight rate had been broadly defined as a target for the rate at which major participants in the money market borrow and lend one-day funds to each other.

3. Such as times when there are relatively few GC trades observed.

Operating Band

The Bank's target for the overnight rate is the midpoint of a 50-basis-point band. The interest rate charged for collateralized overdraft loans (advances) that are made available through the Bank's standing facilities to members of the Large Value Transfer System (LVTS) at final settlement is the upper limit of the operating band, referred to as the Bank Rate. The interest rate paid by the Bank on any positive balances held by LVTS participants after final settlement is set at the lower limit of the operating band.

These arrangements encourage transactions for overnight funds in the marketplace at rates inside of this band, since participants are aware that they will earn at least the Bank Rate less 50 basis points on positive balances, and need not pay more than the Bank Rate to cover negative balances. In addition, given that the opportunity costs of borrowing from and lending to the Bank at the end of the day are the same at the midpoint of the band, trades should generally take place near that point.

Open Market Purchase/Repurchase Agreements

To reinforce the target for the overnight rate, the Bank can intervene in the overnight market by conducting buyback operations at the target rate, if required. If the collateralized overnight rate is generally trading above the target rate, the Bank will intervene with Special Purchase and Resale Agreements (SPRAs), whereby the Bank purchases government securities from primary dealers⁴ with an agreement to resell those securities the next business day, with the difference in price equal to the value of interest for one business day paid at the target for the overnight rate. Conversely, if the collateralized overnight rate is generally trading below target, the Bank will intervene with Sale and Repurchase Agreements (SRAs), selling government securities with an agreement to repurchase them on the next business day, with the price difference equal

4. Primary dealers are a subgroup of government securities distributors that have reached a threshold level of activity in the Government of Canada debt markets.

to one business day's worth of interest calculated at the target for the overnight rate.

These operations are typically conducted at 11:45, encouraging market participants to trade with each other during the morning, when a large proportion of daily funding activity occurs. The Bank is prepared, however, to enter into multiple rounds of open market operations, if necessary, and to conduct those operations outside of the regular time, including earlier in the morning, if warranted by conditions in the overnight market.

Typically, the Bank neutralizes the cash impact on the system of any SPRA or SRA operations. However, as an additional tool to offset pressure on the overnight rate, the Bank has the option of not fully neutralizing the impact of open market operations. If some or all SPRA or SRA operations are not neutralized, the system could be left in a larger surplus or deficit position at the end of the day, requiring at least one LVTS participant to leave funds on deposit at the Bank of Canada at the Bank Rate less 50 basis points, or to take advances at the Bank Rate.

Settlement Balances

Since the introduction of the LVTS, the level of settlement balances in the system has typically been targeted at zero or greater. Any participant in the LVTS with a deficit position is therefore aware that, typically, there is at least one participant in the system with an offsetting surplus position who is a potential counterparty for transactions at market rates.

Several adjustments have been made to the target level of settlement balances since the inception of the LVTS. Currently, the Bank will typically target a small positive amount of settlement balances (\$25 million), thus alleviating transactions costs and other frictions from the end-of-day process and reducing the need for participants to take frequent small advances from the Bank. The Bank retains the right, however, to adjust the targeted level of settlement balances higher or lower if warranted by conditions in the overnight market.

The Large-Value Payments System: Insights from Selected Bank of Canada Research

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- *A well-functioning payments system is fundamental to the soundness of the financial system and the broader economy.*
- *The Bank of Canada has a strong interest in the safe and efficient operation of Canadian clearing and settlement systems and formally oversees those systems that are judged to have the potential to pose systemic risk.*
- *As well, the Bank maintains a rigorous research agenda with a view to informing payments system policy and oversight, both domestically and in international forums.*
- *This article summarizes some recent research conducted at the Bank of Canada regarding the Large Value Transfer System (LVTS), the core payments system in Canada.*

Every day, individual Canadians, businesses, and governments use various payment instruments to purchase goods and services and to make financial investments. These instruments include cash, cheques, debit and credit cards, e-money, and large-value electronic payment orders. All of these payment instruments, except cash, involve a claim on a financial institution that provides transferable deposit services, such as a bank, credit union, or *caisse populaire*. For all of these transactions to be completed, financial institutions need a reliable way to transfer funds between each other. That function is provided by a payments system, which is the set of instruments, rules, and technologies that facilitate the clearing and settlement of funds transfers among system participants.¹

The Bank of Canada and the Payments System

The Bank of Canada has a strong interest in the safe and efficient operation of major clearing and settlement systems, for several reasons. For example, the system used to settle large-value payments among financial institutions, the Large Value Transfer System (LVTS), also provides the setting in which the Bank conducts monetary policy.² In addition, since clearing and settlement systems underpin virtually all of the transactions undertaken in the economy, their safe and efficient operation is important to the sound func-

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1. Clearing is the daily process by which system participants exchange payment orders and related items, and the net amounts owed to each participant are determined. Settlement is the process by which participants fulfill their net financial obligations to one another, which involves the transfer of funds.

2. For a discussion of the implementation of monetary policy in Canada, see Howard (1998).

tioning of the economy. Disruptions in major systems can have serious implications for participants that can extend to the financial system and to the economy more generally. For these reasons, the Bank of Canada oversees those systems that are judged to have the potential to generate systemic risk.³ (Box 1 provides an overview of the Bank of Canada's approach to the oversight of major clearing and settlement systems.)

Research on clearing and settlement issues informs policy development and oversight and supports the Bank's work in multilateral forums, such as the Bank for International Settlements' Committee on Payment and Settlement Systems. This forum brings together major central banks to consider payments systems

3. Systemic risk is the risk that the failure of one system participant to meet its obligations will lead to the failure of another participant to meet its obligations, and so on, with broader adverse effects for the economy.

issues of mutual interest. A well-founded and rigorous research program is also important for the Bank to attract, retain, and develop staff.

This article provides an overview of some of the research conducted at the Bank of Canada on the payments system, with particular attention to work on the LVTS, which is a central component of the Canadian financial system. The work discussed here deals with both the risk and efficiency of the LVTS, and taken together, paints a picture of a payments system that is both safe and efficient.

The LVTS, Certainty of Settlement, and Loss Allocation

The LVTS, which is the core payments system in Canada, is a real-time electronic system for processing large-value or time-sensitive payments and is subject to

Box 1: The Bank of Canada's Oversight Strategy

In the conduct of its oversight of systemically important clearing and settlement systems, the Bank of Canada focuses on several key principles to frame its oversight strategy and to guide the conduct of its oversight activities.

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

Essentially, the Bank of Canada's oversight strategy is to establish minimum standards that condition the behaviour of designated systems to control systemic risk. Private sector system operators, in turn, find the most efficient way of meeting these constraints. In addition, as a system evolves, Bank staff review the design and rule changes proposed by system operators to satisfy themselves that

systemic risk continues to be well controlled. The Bank also periodically confirms that systems are operating as expected to mitigate systemic risk, for example, through audits.

The private sector's central role in designing and operating systems, subject to minimum standards established by the Bank of Canada, is important for achieving both safe and efficient systems. For example, significant private sector involvement is an important reason why Canada's large-value payments system (the LVTS) is based on the netting of payment orders, as opposed to real-time gross-settlement (RTGS) principles.¹ More generally, the Bank's approach to oversight provides incentives for the safe and efficient operation and evolution of systemically important clearing and settlement systems.

For more on the Bank of Canada's role in the oversight of major clearing and settlement systems, see Engert and Maclean (2006).

1. RTGS refers to the continuous (real-time) settlement of funds or securities transfers individually, on an order-by-order basis. Netting refers to the process whereby individual obligations among system participants are offset against one another (over a day, for example) to produce a single net payable or receivable balance for each participant. This considerably reduces the number and value of obligations to be settled, which, in turn, can reduce risks and costs. However, netting systems are more complex analytically and from a legal perspective, than RTGS-based systems. For more on netting, see Engert (1992, 1993).

oversight by the Bank of Canada.⁴ This system is used by participating financial institutions to discharge payment obligations on their own account and on behalf of their customers. Owned and operated by the Canadian Payments Association (CPA), the LVTS began operations in February 1999. It is used to settle about 20,000 payments each day, with a total daily value of \$160 billion. Some of these payments are time-sensitive, because the LVTS is used to settle funds transfers from other important clearing and settlement systems, such as those for securities transactions and also for the Canadian-dollar leg of foreign exchange transactions.

In the LVTS, electronic payment messages are processed during the day in real time, while settlement of participants' corresponding obligations to the system occurs on a multilateral net basis at the end of the day. Payments processed by the LVTS are final, so that recipients of payments can use these funds immediately upon receipt without any risk of the payment being reversed later. The LVTS contains two payment streams, Tranche 1 and Tranche 2, which have different characteristics and risk controls. Participants can use either stream to send payments through the system, subject to each stream's risk controls.

In Tranche 1, a participant cannot incur an overall net debit (payable) position that exceeds its Tranche 1 Net Debit Cap (T1NDC) when sending payments through the system. A participant's T1NDC is determined by the amount of eligible collateral that it has pledged in the system for this purpose. In this way, participants collateralize their own obligations, and Tranche 1 is therefore referred to as a "defaulter-pays" payment stream.

In Tranche 2, bilateral credit limits and multilateral net debit caps are used to limit risk. A bilateral credit limit (BCL) constrains exposures between any pair of system participants. Specifically, each participant in the LVTS can provide a BCL to any other participant, and this limit determines the maximum payment obligation that the recipient of a BCL can owe to the provider of the BCL. In addition, a "multilateral cap" limits exposures that each participant can present to the system as a whole. A participant's multilateral cap, called its Tranche 2 Net Debit Cap (T2NDC), is calculated as the sum of all the BCLs it has received, multi-

plied by a fixed proportion (called the "system-wide parameter"), which is currently equal to 0.24.⁵

In Tranche 2, a collateral pool also helps to manage risk and facilitate settlement of the LVTS in the event of a participant default. Each participant must pledge collateral to the system equal to the largest BCL that it has provided to any other participant, multiplied by the same system-wide parameter, 0.24. Since the collateral pool is funded by all participants, and losses from default are allocated to participants, Tranche 2 is referred to as a "survivors-pay" payment stream.

Early payments system research at the Bank of Canada showed that the LVTS design would meet international standards for risk control.

An early example of payments system research at the Bank of Canada is Engert (1993), which explored the robustness of these risk-control mechanisms when the LVTS was under development. This work showed that total Tranche 2 collateral would always be at least as large as the single largest possible net debit (payable) position in the system. As a result, in the event of the default of any single participant, the system would be able to settle, which is the internationally accepted standard for risk control in such systems (Goodlet 2001).⁶ As well, this work demonstrated that each participant would individually pledge sufficient collateral in Tranche 2 to cover the largest possible loss it would sustain in the event of any single participant failure. In effect, participants prepay their potential losses, which are proportional to the BCLs that they have provided to other participants. In turn, this provides

5. The value of 0.24 for the system-wide parameter is determined by the effectiveness of the netting in the system. That is, the multilateral netting of a given set of bilateral transactions leads to a multilaterally netted balance that is a fraction of the underlying bilateral positions; the system-wide parameter corresponds to this fraction. For more on the rudiments of netting, see Engert (1992, 1993).

6. In the extremely unlikely event of several participants defaulting on their LVTS settlement obligations on the same day, it is possible that such defaulted obligations could exceed available LVTS collateral. In this case, the Bank of Canada would advance funds on the security of the available collateral to guarantee settlement of the system and could become an unsecured creditor of the defaulting institutions. This provision is part of the Bank of Canada's lender-of-last-resort policy; see Daniel, Engert, and Maclean (2004–2005).

4. While the average value of payments processed by the LVTS is \$8.5 million, participants can submit payments of any size to the system, including small-value payments.

incentives to participants to manage their exposures in the LVTS prudently, an issue considered in more detail in the next section.

Taken together, these various elements provide for “certainty of settlement,” whereby the LVTS is guaranteed to settle at the end of the day. Accordingly, participants and their customers can (and do) treat payment messages sent and received over the LVTS as final, thus reducing risk for participants and their customers. These features also mitigate the potential for the LVTS to pose systemic risk.

How Large Are Potential Losses in the LVTS?

When the LVTS began operations in early 1999, it was clear that the system would provide for certainty of settlement and that loss-allocation rules would work if necessary in the event of a default, as discussed above. However, the size of the potential loss to each

surviving participant in the event of a failure was uncertain. This is essentially an empirical matter, depending on the behaviour of system participants. Put differently, while LVTS rules ensure that the *system* is robust to defaults, the system’s rules do not ensure that *individual participants* are robust to defaults.

To assess this empirical question, two recent papers, McVanel (2005) and Ball and Engert (forthcoming), consider actual daily LVTS payment data (courtesy of the CPA) to measure potential losses to participants. Specifically, these papers analyze unanticipated defaults in the LVTS using a payments system simulator (Box 2). The defaults are simulated in the following manner: Each LVTS participant’s net payment positions (Tranche 1 plus Tranche 2) throughout each day of the sample period are determined. From these positions, each participant’s largest daily net debit (payable) position is identified, and considered to be a default. Each such default position is then compared with the participant’s collateral available to offset the default. If collateral is

Box 2: Simulation Analysis at the Bank of Canada

An important innovation in payments system research has been simulation analysis. Simulation models are useful tools because they can often be calibrated to replicate a specific large-value payments system environment. These models can then be used to assess the impact of changes in the structural arrangements and decision parameters of a payments system without causing any costly disruption to the operation of the actual system. An early example of this kind of work at the Bank of Canada is Northcott (2002).

There is growing interest among central banks in using simulation analysis to conduct research on payments systems. As a contribution to this initiative, the Bank of Finland has developed a general simulation application, called BoF-PSS2, and is offering this software to other central banks free of charge. The BoF-PSS2 is currently being used by over thirty central banks. The Bank of Canada has recently adopted the BoF-PSS2 and has collaborated with the Bank of Finland, the Bank of England, the Federal Reserve Bank of New York, and MSG Inc. (a Finnish software development company) to refine and improve the simulator. Indeed, the current version of the simulator provides a reasonably complete representation of the LVTS environment.

The BoF-PSS2 operates in a similar fashion to the LVTS. Payments are submitted for processing based on their time of entry. A submitted payment is processed by the simulator provided that the appropriate risk-control test is passed. Payments that are not processed upon submission can be temporarily stored in the simulator’s queue, or can be rejected outright, depending on the user’s preference. For queued payments, the BoF-PSS2 offers users a choice of various release algorithms representing alternative queuing arrangements typically available in large-value payments systems.

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

not sufficient to cover a net debit position, then a loss is identified, which is allocated to other participants following LVTS rules (in proportion to the BCLs extended to the defaulter). In this way, a large number of defaults and loss allocations are simulated. For example, Ball and Engert (forthcoming) consider daily payment data from April 2004 to April 2006 and simulate over 7,000 defaults and over 43,000 loss allocations.

Results from these two papers, which consider different sample periods, are very similar. Over the period from April 2004 to April 2006, average simulated losses to participants amount to only 0.4 per cent of regulatory tier 1 capital, and the average of participants' largest simulated losses is only 7 per cent of their tier 1 capital (Ball and Engert forthcoming). Two small participants peak at relatively large losses of over 20 and 30 per cent of tier 1 capital, respectively; while significant, these values would not be solvency-threatening on their own.

Ball and Engert also explore simulated losses to the Bank of Canada. As a participant in the LVTS, the Bank routinely extends a BCL to each participant equal to 5 per cent of the sum of all BCLs received by the participant.⁷ In doing so, the Bank undertakes risk related to loss allocations as well. Ball and Engert find that the average simulated loss to the Bank of Canada is only \$24.1 million, and the single largest loss is \$121.7 million. To put this into context, the Bank's net revenue in 2005 was \$1.7 billion (Bank of Canada 2006).

Notwithstanding the small size of simulated losses, the methodology followed in these papers generates losses that are almost certainly larger than would actually be experienced, as stressed in McVanel (2005). There are several reasons for this. First, the simulated losses are based on the largest possible (or peak) daily exposures, given actual LVTS payments, and participant failure is assumed to occur at the time of peak exposure during LVTS operating hours. In practice, however, regulators would probably try to close a failing institution after LVTS operating hours, if possible. Second, defaults are assumed to be unexpected (i.e., surprises). Therefore, participants do not take steps to reduce potential losses by decreasing BCLs to potential defaulters. Doing so would reduce a suspect partici-

7. The Bank follows this mechanical rule to avoid giving rise to conflicts of interest (real or apparent), in light of its access to confidential prudential information. The 5 per cent value has been in place since the LVTS began operating in February 1999 and was based on an estimate of daily Government of Canada payments sent to the Bank by LVTS participants. (The Bank of Canada is the federal government's banker.) The Bank can increase its BCL to a participant as a contingency measure under exceptional circumstances; this has never been done (Arjani and McVanel 2006).

part's Tranche 2 Net Debit Cap, and hence its capacity to generate losses. Similarly, the analysis assumes that prudential supervisors do not take measures to mitigate loss (notwithstanding the early-intervention regime that characterizes the federal safety net).⁸ Finally, it is assumed that surviving participants do not recover any of their losses from the estate of the defaulter. Consideration of these factors would lead to smaller losses than those reported above.

Losses from a participant failure in the LVTS are very likely to be small. The risk controls of the system allow and encourage participants to keep their potential losses manageable.

Overall, then, these papers conclude that losses from a participant failure in the LVTS are very likely to be small and readily manageable. In the case of one or two small participants, under worst-case assumptions, losses could be significant, but not solvency-threatening on their own. In sum, the risk controls of the LVTS allow and encourage participants to keep their potential losses manageable.

Is Collateral in the LVTS Excessive?

So far in this article, we have discussed how the design of the LVTS provides for certainty of settlement and loss allocation, and provides incentives that encourage participants to manage their exposures prudently, which, in turn, mitigates systemic risk. In this regard, the evidence indicates that potential losses in the LVTS are small. A central part of the LVTS risk-control mechanisms, as discussed above, is the use of high-quality collateral to secure exposures. Early in the operation of the LVTS, it appeared that participants pledged an amount of collateral in the system that was in excess of requirements. Accordingly, Bank researchers have examined whether collateral use in the LVTS is efficient, or if collateral pledged to the system is somehow excessive.

LVTS payments sent and received by each participant can vary significantly from day to day, hour to hour,

8. For more on the prudential safety net in Canada, see Engert (2005).

and even minute to minute.⁹ Participants know in advance many of the payments they will receive and be required to send. They cannot, however, always synchronize these flows. They may have to make large payments before they receive incoming funds, sometimes unexpectedly. In such instances, when LVTS risk controls limit a participant's payment-sending capacity, a buffer of collateral in the system can support an increase in the participant's Tranche 1 Net Debit Cap, which, in turn, would allow the participant to complete the timely delivery of payments. As well, an LVTS participant may occasionally require an unusually large advance at the end of the day from the Bank of Canada, perhaps because of an operational problem.¹⁰ A buffer of collateral can also serve to back any large advances that may be required in such a situation. In sum, if participants do not hold sufficient collateral for LVTS purposes, large-value, time-sensitive, or systemically important payments could be delayed, with attendant costs, including disruption of payments systems and delays to clients of LVTS participants.

On the other hand, if an LVTS participant does not minimize the costs associated with holding and managing collateral, excessive costs could be passed on to its clients, who could pay more for sending LVTS payments than would be optimal. If they are systematically deterred from sending payments via the LVTS, clients may choose payments systems that are less well protected against risk. It follows from this discussion that the efficiency with which collateral is used in the LVTS can have broader effects that extend beyond the payments system.

To gain a better understanding of the efficiency of collateral use in the LVTS, and the associated trade-offs, McPhail and Vakos (2003) study whether participants pledge cost-minimizing levels of collateral in the system. As already discussed, there are two payment streams in the LVTS, Tranche 1 and Tranche 2, and the latter accounts for about 85 per cent of the payment value sent over the LVTS. Tranche 2 uses collateral so efficiently that only a few billion dollars of collateral are needed to support about \$140 billion per day in payments. As well, since collateral requirements for Tranche 2 payments change relatively little from one day to the next, there is little need for participants to hold a large buffer of collateral to accommodate changes

in Tranche 2 collateral requirements. For these reasons, McPhail and Vakos (2003) focus on Tranche 1 payment flows to assess the efficiency of collateral usage.

Tranche 1 payments currently account for about 15 per cent of the value sent over the LVTS—about \$20 billion per day. Tranche 1 payments must be financed, dollar for dollar, by Tranche 1 funds already received or by intraday credit, which must be fully secured by eligible collateral. It is therefore much more expensive for participants to send Tranche 1 payments than Tranche 2 payments, and so Tranche 1 tends to be reserved for situations in which insufficient credit is available for a time-critical payment to pass through the Tranche 2 risk controls. To study collateral-use efficiency in the LVTS, McPhail and Vakos consider data from February 1999 (when the system began operations) to May 2003. Over this period, daily Tranche 1 payments sent by financial institutions averaged \$6 billion.

The authors build a theoretical model that generates the demand for collateral by LVTS participants under the assumption that they minimize the cost of collateral management. Their model predicts that the optimal amount of collateral pledged by each LVTS participant depends on the opportunity cost of collateral, the transactions costs of acquiring assets eligible as collateral and transferring them in and out of the LVTS, and the distribution of a participant's payment flows in the LVTS.¹¹ McPhail and Vakos use estimates for the opportunity cost of collateral and transactions costs to apply their model to LVTS participants. They find that their model of optimal collateral demand, which is based on benchmark values for the various relevant costs, explains the aggregate amount of collateral pledged to the LVTS quite well, despite the fact that these costs may vary among participants. Specifically, the authors find that when one LVTS participant with an apparently lower opportunity cost of collateral is excluded, aggregate actual collateral is within 5 per cent of the level predicted by their model.

As expected, the opportunity cost of collateral is particularly important in explaining the amount of collateral pledged to the LVTS. Sensitivity analysis of the model indicates that, as this cost of collateral increases, the amount of collateral that participants hold would be greatly reduced. The analysis also indicates that, for about 90 per cent of the time, the level of

9. For a discussion of intraday payment flows in the LVTS, see Cheung (2002).

10. Such advances occur under the Bank of Canada's standing liquidity facilities; see Daniel, Engert, and Maclean (2004–2005).

11. The authors define the opportunity cost of collateral as the spread between the rate of return on assets pledged as collateral and the rate of return on assets likely to be held in the absence of collateral requirements in the LVTS.

collateral demand predicted by the model is sufficient to cover daily Tranche 1 payment activity. That is, participants would have to pledge additional collateral to the LVTS to meet their Tranche 1 payment obligations about 10 per cent of the time. McPhail and Vakos note that this creates the possibility that time-sensitive or systemically important payments could be delayed, since participants must try, possibly on short notice, to obtain and pledge additional collateral to meet unexpectedly large payments needs. These occasions would be rare, however.

The evidence indicates that collateral (liquidity) use in the LVTS is cost efficient.

The authors conclude that there does not appear to be an excessive amount of collateral pledged in the LVTS. On the contrary, the aggregate level of collateral in the system corresponds well with the optimal cost-minimizing behaviour indicated by their model.

What Is the Trade-Off between Liquidity and Payment Delay?

The preceding section focused on the efficiency of collateral use in the LVTS, with particular attention to Tranche 1. This section discusses recent Bank of Canada research on the nature of the trade-off between the amount of liquidity in Tranche 2 (secured by collateral) and the capacity of the system to process payments expeditiously—which is captured by the notion of “payment delay.”¹² Also discussed are innovations that might improve this trade-off by providing for reduced liquidity and collateral requirements while simultaneously improving payment-processing capacity.

In the LVTS, as in other large-value payments systems, intraday credit is an important source of the liquidity that participants need to process payments. As discussed above, participants routinely grant bilateral credit lines to each other in Tranche 2, and pledge collateral proportional to the largest BCL that they extend as part of the risk controls. Of course, this is costly,

12. Payment delay refers to the lag between the time of a participant’s submission of a payment to the LVTS for processing and the time when the payment is actually processed by the system with finality.

given that collateral in the LVTS consists of highly liquid and marketable securities.

Smaller BCLs in Tranche 2 would reduce collateral requirements (and related costs). However, this could also lead to delays in the intraday processing of payment messages, since participants’ ability to send payments would be constrained by tighter bilateral and multi-lateral Tranche 2 risk controls. When a participant has insufficient intraday liquidity in Tranche 2, payments are held and are not released for processing until the participant sending the payment message has sufficient liquidity to do so, or decides to send the payment through the more expensive Tranche 1.

In turn, delays in processing payments raise other costs. For example, a participant could be expecting to receive payments by a certain time of day, such that any delay in payment will lead to a shortfall in its intraday funds position and, hence, to a possible shortfall in fulfilling its obligations to its customers. The participant may then have to incur additional liquidity costs to replace these funds on short notice. It follows that a payment delay created by one participant could spread to others in the system. There might also be other system-wide implications. For example, the prolonged or routine delay of payments might increase potential losses associated with other risks in the financial system, such as operational or systemic risk.

To understand better the trade-off between liquidity and payment delay in Tranche 2 of the LVTS, Arjani (2006) simulates this relationship using three months of data (July–September 2004) on daily Tranche 2 credit limits and payments (courtesy of the CPA). The author finds that, as intraday liquidity is decreased, payment delay escalates at an increasing rate.¹³ That is, as shown in Chart 1, this work estimates a convex relationship between Tranche 2 liquidity (horizontal axis) and a measure of payment delay (vertical axis). The measure of payment delay in Chart 1, the percentage value of unsettled transactions, indicates the percentage of the value of total payments submitted to the system that remain unprocessed at the end of the day.

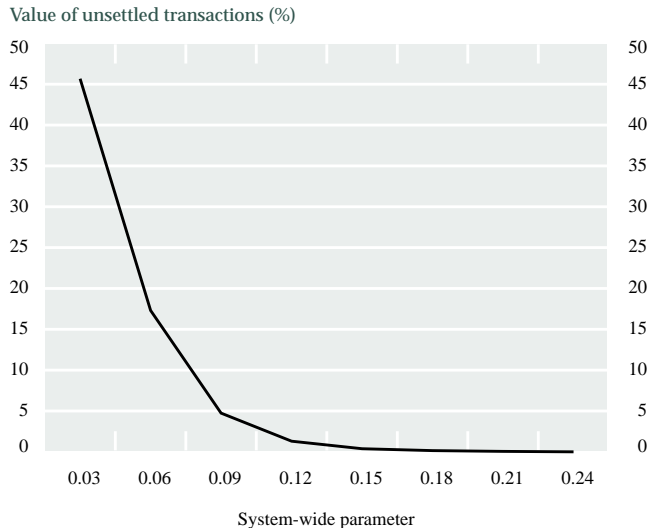
A simulated reduction in the system-wide parameter, from its current value of 0.24 to 0.18, increases unsettled daily payments by only a very small amount. At the same time there is a corresponding reduction of the collateral needed in the system, of about \$750 million

13. The reduction in intraday liquidity is simulated by decreasing the system-wide parameter (discussed above). This, in turn, directly reduces participants’ Tranche 2 net debit caps (T2NDCs) and thereby reduces their capacity to send payments over the LVTS.

per day on average, representing a savings of 25 per cent of Tranche 2 collateral. As the amount of simulated liquidity in the system declines further, however, the percentage of unsettled payments rises sharply, as shown in Chart 1.

Arjani (2006) also examines a potential improvement in the trade-off between Tranche 2 liquidity and payment delay. Specifically, the author examines how to achieve a reduction in payment delay for any given amount of intraday liquidity by making more intensive use of “centralized queuing” in the LVTS; that is, restrictions that currently exist on the use of the LVTS central queue are assumed to be relaxed. The LVTS has a complex queuing algorithm that can offset batches of queued (delayed) payments against one another (on a multi-lateral basis) throughout the day. More intensive use of such algorithms could lead to lower liquidity needs and faster processing of payments. Under current LVTS rules, however, participants are generally discouraged from using the central queue.¹⁴ Instead of relying on the central queue when payments are delayed, LVTS participants currently hold their delayed payments in their own internal queues.

Chart 1
Payment Delay and Liquidity



14. There are good reasons for this. Perhaps most important is a concern that increased use of the central queue could lead to increased credit risk for participants from crediting clients' accounts with expected incoming funds before these payments are processed and received. Of course, that could happen only if participants were aware of all payments in the central queue that were to be sent to them; that is, if queued payments were observable (as is the case in the LVTS).

Arjani simulates increased use of the LVTS queue by assuming that Tranche 2 payments not passing the risk controls become centrally queued, where, unlike the case of internal queuing, all queued payments are subject to multilateral offsetting at regular intervals. The author finds that, under these conditions, payment delay is reduced for each amount of intraday liquidity considered. In addition, the relative benefit of central queuing (in terms of reduced payment delay) increases as intraday liquidity is lowered. For example, with a 75 per cent reduction in system liquidity (a system-wide parameter of 0.06), the simulations suggest that it is still feasible to reduce the value of unsettled transactions by 9 percentage points, or \$10 billion, by making more intensive use of the central queuing arrangement. This also implies significant collateral savings.

Research suggests that additional improvements in the efficiency-risk trade-off in the LVTS might be possible.

Arjani (2006) stresses that these results are preliminary and suggests possible extensions. One would be to examine the actual cost of payment delay, so that a direct comparison could be made between this cost and collateral savings resulting from a reduction in the system-wide parameter, or from more intensive use of the LVTS central queue. Another would be to consider participants' reactions to a change in the queuing environment. In this regard, more intensive use of central queuing is likely to alter participants' behaviour with respect to both payment submission and the provision of bilateral credit lines. Such responses could affect (possibly adversely) the net impact of the trade-off between liquidity and payment delay. These extensions, and others, are necessary before firm conclusions can be drawn regarding net benefits from more intensive use of the queuing mechanisms in the LVTS.

Concluding Remarks

The research summarized in this article suggests that the LVTS strikes an effective balance between safety and efficiency, and that further improvements to this balance may be possible. Engert (1993) demonstrates that the design of the LVTS risk-control mechanism

meets internationally accepted standards for risk containment and supports the provision of intraday payment finality. One aspect of the LVTS risk-control mechanism is the use of a survivors-pay collateral pool (and loss-allocation rules) to secure intraday credit in Tranche 2. In this regard, the LVTS design may be viewed as accepting risk of loss to stakeholders in the event of a participant default in return for relatively economical daily collateral (or liquidity) requirements. A natural question is: How much risk is accepted to achieve these savings? That is, how large are potential losses to surviving participants, in the event of a default, from this efficient design? Using simulation analysis, McVanel (2005), and Ball and Engert (forthcoming) address this question by assessing the impact of an unanticipated default in the LVTS under worst-case conditions. These authors find that the risk of loss faced by surviving participants generally appears to be small and, in all cases, manageable.

McPhail and Vakos (2003) explore the efficiency of the daily operation of the LVTS by studying whether the amount of collateral pledged by participants for LVTS purposes is efficient from a cost-minimization perspective. Focusing on Tranche 1, the authors find that, in general, their model of optimal collateral demand fits actual behaviour in the LVTS well, suggesting that collateral use in the LVTS is efficient.

Finally, Arjani (2006) employs simulation analysis to examine a fundamental safety-efficiency trade-off—between intraday liquidity and payment delay—in Tranche 2 of the LVTS. Based on the current trade-off, the author finds that substantial liquidity savings, in terms of reduced daily Tranche 2 collateral requirements, could be realized with only a minor increase in payment delay. That is, further efficiency gains might be possible in Tranche 2 without significantly compromising risk control. This work also suggests that more intensive use of the LVTS's centralized queuing mechanism could lead to improvements in the trade-off between payment delay and intraday liquidity, thus further increasing the efficiency of the system.

While the focus of this article is on the LVTS, research at the Bank of Canada on clearing and settlement systems certainly extends beyond that system. For example, Northcott (2002) uses simulation analysis to assess the potential for Canada's Automated Clearing Settlement System (a small-value payments system) to pose systemic risk. This research was influential in the Bank of Canada's decision to not designate this system

under its formal oversight authority. Lai, Chande, and O'Connor (2006) build a theoretical model to explore competition and efficiency under particular organizational arrangements common to payments systems around the world (known as "tiering"). McPhail (2003) applies recent advances in the management of operational risk and related academic work to develop a framework to assess and manage operational risk in clearing and settlement systems. Insights from this work have been applied to the Bank of Canada's own operational risk-management framework. Most recently, Chiu and Lai (forthcoming) provide a review of the academic literature on payments-system modelling to inform future research initiatives.

A key goal for longer-term research is to improve the modelling of the behaviour of the participants in the payments system.

Looking ahead, a key longer-term goal for future research on clearing and settlement systems is the modelling of participant behaviour so that analysis can explicitly and more rigorously take into account changes in behaviour motivated by, for example, potential design innovations in clearing and settlement systems. Another focus at the Bank of Canada will be continuing collaboration, since Bank staff intend to deepen their relationships with researchers in other organizations sharing these interests. A current example of this is collaboration with staff of the Federal Reserve Bank of New York on the impact of participant operational problems on the functioning of large-value payments systems, including effects on system liquidity and the ability to settle payments. Another example of such collaboration is work with Bank of England staff on fundamental issues concerning the design of large-value payments systems.

The Bank of Canada's research on payments systems has yielded a variety of useful insights and applications. At the same time, it has also stimulated additional questions and new ideas, and the Bank's research efforts in this area are expected to continue for years to come.

Literature Cited

- Arjani, N. 2006. "Examining the Trade-off between Settlement Delay and Intraday Liquidity in Canada's LVTS: A Simulation Approach." Bank of Canada Working Paper No. 2006-20. For a summary of this research, see also Bank of Canada *Financial System Review*. 2005. (December): 55-63.
- Arjani, N. and D. McVanel. 2006. "A Primer on Canada's Large Value Transfer System." 1 March 2006, available at www.bankofcanada.ca/en/financial/lvts_neville.pdf.
- Ball, D. and W. Engert. Forthcoming. "Unanticipated Defaults and Losses in Canada's Large-Value Payments System Revisited." Bank of Canada Discussion Paper.
- Bank of Canada. 2006. *Annual Report 2005*. Ottawa: Bank of Canada.
- Cheung, L. 2002. "Understanding Intraday Payment Flows in the Large Value Transfer System." Bank of Canada *Financial System Review* (December): 49-52.
- Chiu, J. and A. Lai. Forthcoming. "Payments System Modelling: A Review of the Literature." Bank of Canada Working Paper.
- Daniel, F., W. Engert, and D. Maclean. 2004-2005. "The Bank of Canada as Lender of Last Resort." *Bank of Canada Review* (Winter): 3-16.
- Engert, W. 1992. "An Introduction to Multilateral Foreign Exchange Netting." Bank of Canada Working Paper No. 92-5.
- . 1993. "Certainty of Settlement and Loss Allocation with a Minimum of Collateral." Bank of Canada Working Paper No. 93-14.
- . 2005. "On the Evolution of the Financial Safety Net." Bank of Canada *Financial System Review* (June): 67-73.
- Engert, W. and D. Maclean. 2006. "The Bank of Canada's Role in the Oversight of Clearing and Settlement Systems." Bank of Canada *Financial System Review* (June): 57-64.
- Goodlet, C. 2001. "Core Principles for Systemically Important Payments Systems and Their Application in Canada." *Bank of Canada Review* (Spring): 19-31.
- Howard, D. 1998. "A Primer on the Implementation of Monetary Policy in the LVTS Environment." *Bank of Canada Review* (Autumn): 57-66.
- Lai, A., N. Chande, and S. O'Connor. 2006. "Credit in a Tiered Payments System." Bank of Canada Working Paper No. 2006-36. For a summary of this research, see Bank of Canada *Financial System Review* (December 2006): 67-70.
- McPhail, K. 2003. "Managing Operational Risk in Payment, Clearing, and Settlement Systems." Bank of Canada Working Paper No. 2003-2. For a summary of this research, see Bank of Canada *Financial System Review* (June 2003): 79-81.
- McPhail, K. and A. Vakos. 2003. "Excess Collateral in the LVTS: How Much Is Too Much?" Bank of Canada Working Paper No. 2003-36. For a summary of this research, see Bank of Canada *Financial System Review* (December 2003): 85-88.
- McVanel, D. 2005. "The Impact of Unanticipated Defaults in Canada's Large Value Transfer System." Bank of Canada Working Paper No. 2005-25. For a summary of this research, see Bank of Canada *Financial System Review* (June 2006): 69-72.
- Northcott, C.A. 2002. "Estimating Settlement Risk and the Potential for Contagion in Canada's Automated Clearing Settlement System." Bank of Canada Working Paper No. 2002-41. For a related article, see C.A. Northcott (2002). "Systemic Risk, Designation, and the ACSS," Bank of Canada *Financial System Review* (December): 29-35.

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