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Unanticipated Defaults and Losses in Canada's Large-Value Payments System, Revisited

by Devin Ball and Walter Engert

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Abstract

Recent work at the Bank of Canada studied the impact of default in Canada's large-value payments system, and concluded that participants could readily manage their potential losses (McVanel 2005). In an extension of that work, the authors use a much larger set of daily payments data – with three times as many observations – to examine the simulated losses of private sector participants and the Bank from defaults in the payments system. They also gauge the upper bound of possible losses in the period April 2004 to April 2006. The authors conclude that losses from a participant failure in the large-value payments system are very likely to be small and readily manageable, as in McVanel (2005). For one or two small participants, under some (probably extreme) conditions, losses could be significant, but not solvency threatening. In sum, the risk controls of the large-value payments system allow and encourage participants to keep potential losses manageable.

JEL classification: E44, E47, G21
Bank classification: Financial institutions; Payment, clearing, and settlement systems

Résumé

D'après de récents travaux effectués à la Banque du Canada (McVanel, 2005), les participants au système canadien de transfert de gros paiements pourraient aisément absorber les pertes découlant de la défaillance de l'un d'eux. Dans le prolongement de ces travaux, les auteurs exploitent un vaste ensemble de données quotidiennes sur les paiements – qui compte trois fois plus d'observations que celui de McVanel – afin d'étudier, au moyen de simulations, les pertes que la défaillance d'un participant au système de paiement ferait subir aux autres participants du secteur privé et à la Banque du Canada. Ils calculent également la perte maximale possible pour la période d'avril 2004 à avril 2006. À l'instar de McVanel, les auteurs concluent qu'il y a de fortes chances pour que les pertes découlant de la défaillance d'un participant dans le système de paiement soient faibles et puissent être absorbées. Dans certaines conditions (probablement extrêmes), les pertes d'un ou de deux petits participants pourraient être importantes, sans toutefois mettre en péril leur solvabilité. En somme, non seulement les mécanismes de maîtrise des risques du système canadien de transfert de gros paiements permettent aux participants de limiter les pertes à un niveau acceptable, mais ils les y encouragent.

Classification JEL : E44, E47, G21
Classification de la Banque : Institutions financières; Systèmes de paiement, de compensation et de règlement

1 Introduction

Recent work at the Bank of Canada studied the impact of participant default in Canada's large-value payments system, the Large Value Transfer System (LVTS), and concluded that participants could readily manage their potential losses (McVanel 2005, 2006). This paper extends that work in several ways. Most importantly, we use a much larger set of daily LVTS payments data – with three times as many observations – to examine the simulated losses of private sector LVTS participants and the Bank of Canada. As well, we gauge the upper bound of possible loss allocations in the April 2004 to April 2006 period. We also use the most recent version of the Bank's payments system simulator, which provides a reasonably complete representation of the LVTS environment, including credit limits and the LVTS queue.[1]

This paper is organized as follows. Section 2 describes the basic methodology that we follow. Section 3 reports simulation results, including losses (relative to regulatory tier 1 capital) from unanticipated defaults in the LVTS. Section 4 gauges the upper bound of losses to participants. Section 5 examines more closely two LVTS participants that appear to be outliers in important respects. Section 6 provides conclusions.

We conclude that losses from a participant failure are very likely to be small and readily manageable for other participants, as in McVanel (2005). For one or two small participants, under some (probably extreme) conditions, losses could be significant, but not solvency threatening. The risk controls of the LVTS allow and encourage participants to keep potential losses manageable.

2 Basic Methodology

As in McVanel (2005), we use actual daily LVTS payments data, courtesy of the Canadian Payments Association (CPA), to calculate each LVTS participant's net payment positions (tranche 1 plus tranche 2) during each day of the sample period.[2] From these positions, we identify each participant's largest daily net debit and consider this to be a default. We then compare each such default position with the participant's collateral (in tranche 1 and tranche 2).

1. The version of the simulator used in McVanel (2005, 2006) does not include credit limits or the LVTS queuing facility. As a result, in McVanel's work, payments are treated as being settled at the time they are submitted to the system. This simplification is not significant, since the data used include only settled transactions. However, payments that would have failed credit limits upon submission, and would therefore be sent to the queue for later settlement, settle prematurely. This can have (small) effects on simulated exposures. For more on payments system simulation at the Bank of Canada, see Appendix A.
2. For background on how the LVTS operates, see Arjani and McVanel (2006).

If collateral is not sufficient to cover a net debit, then an "own collateral shortfall" (a loss) is identified, which is distributed to other participants following LVTS rules. In this way, a large number of defaults, own collateral shortfalls, and loss allocations are simulated.

As noted, the own collateral shortfall (OCS) of any participant is related to the difference between its net payment position in the LVTS and its available collateral (allocated to LVTS). Put differently,

$$OCS = (T1 + T2) - (C1 + C2), \tag{1}$$

where

$T1$ is the participant's tranche 1 net debit position,

$T2$ is the participant's tranche 2 net debit position,

$C1$ is the participant's tranche 1 collateral, and

$C2$ is the participant's tranche 2 collateral.

When $(T1 + T2) > (C1 + C2)$, then OCS > 0. That is, there is a collateral shortfall, and so a loss to be allocated to other (surviving) participants in the LVTS. On the other hand, when $(T1 + T2) \leq (C1 + C2)$, then OCS ≤ 0. In such cases, collateral is adequate (or surplus) to cover the net debit position, and there is no loss to be allocated to other participants.

In our simulations, OCSs are also considered relative to the maximum possible OCSs of participants, to assess capacity use in LVTS. Rearranging the terms in equation (1), we have

$$OCS = (T1 - C1) + (T2 - C2). \tag{2}$$

By design in LVTS, $(T1 - C1) \leq 0$. That is, tranche 1 collateral is always greater than or equal to a participant's tranche 1 net debit position. It follows that the maximum possible OCS occurs where $(T1 - C1) = 0$, and when T2 is at the participant's tranche 2 net debit cap, T2NDC. Therefore, the maximum possible OCS is

$$maxOCS = (T2NDC - C2). \tag{3}$$

All of these variables are related to the bilateral credit lines (BCLs) extended between participants. Each participant's T2NDC is equal to the sum of the BCLs that it has received from all other (n–1) participants (denoted j below), multiplied by the "system-wide parameter," q. (The specific value of q reflects the power of netting in the system; in the LVTS, q is 0.24.)

So, for any participant i,

$$T2NDC_i = q\left(\sum_{j=1}^{n-1} BCL_{ji}\right). \tag{4}$$

Also, for any participant i, C2 is equal to the largest BCL that participant i has extended multiplied by q. That is,

$$C2_i = q\,(BCL_{i\beta}), \tag{5}$$

where β denotes the recipient of the largest BCL extended by participant i.

And any loss to any participant i from the default of any participant x is allocated in proportion to the bilateral credit line from participant i to the defaulter x (BCL_{ix}). That is,

$$Loss_{xi} = OCS_x\left(\frac{BCL_{ix}}{\sum_{x=1}^{n-1} BCL_{ix}}\right). \tag{6}$$

This is also known as an "additional settlement obligation" (ASO) in the LVTS.[3]

3 Simulated Losses

3.1 Own collateral shortfalls

Chart 1 shows the frequency distribution of all simulated own collateral positions (surplus and shortfall) for April 2004 to April 2006. For our analysis, in cases where collateral is adequate or surplus to cover a participant's net debit, a value of zero is assigned to OCS. Chart 2 shows the resulting frequency distribution of OCS ≥ 0 for April 2004 to April 2006. Chart 3 shows the frequency distribution for the subset of cases where OCS > 0.

3. For discussions of how these various elements provide for certainty of settlement and loss allocation, and incentive-compatible risk management, see Engert (1993); McVanel (2005); and Arjani and McVanel (2006).

Chart 1
Frequency Distribution of Own Collateral Positions
April 2004 – April 2006

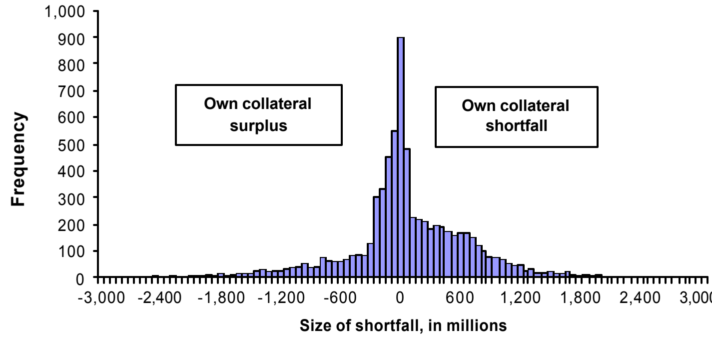

Chart 2
Frequency Distribution of Own Collateral Shortfalls ≥ 0
April 2004 – April 2006

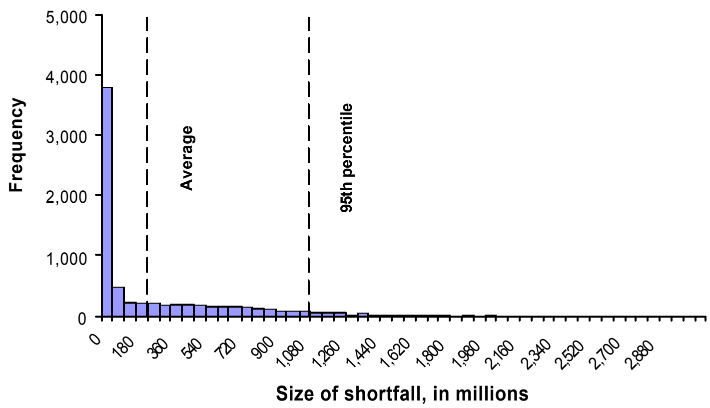

Chart 3
Frequency Distribution of Own Collateral Shortfalls > 0
April 2004 – April 2006

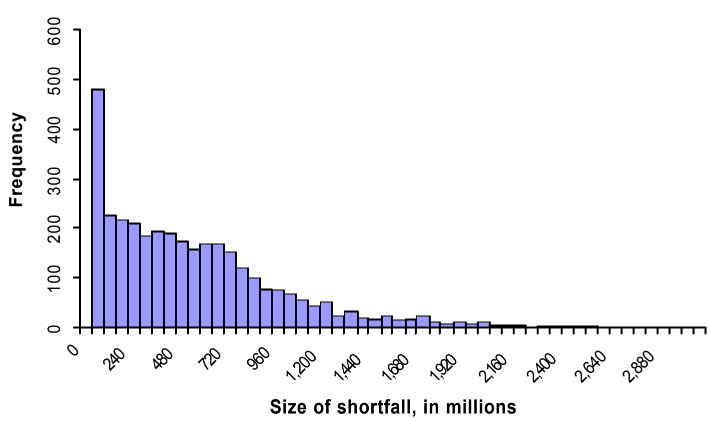

Table 1 provides simulation results for OCSs for two different samples. Column 2 of Table 1 considers the period March to October 2004 without the queue operating in the simulator, as in McVanel (2005). Column 3 shows results for the period April 2004 to April 2006 with the queue operating in the simulator (Chart 2).[4]

The simulation results can be summarized as follows:

- The April 2004 to April 2006 period has over three times as many simulated defaults and OCSs as the earlier period. However, the ratio of the number of OCSs to defaults is very similar in the two samples (47 per cent in the first period and 48 per cent in the longer period).

- OCSs average about 20 per cent of the maximum possible shortfall in both periods.

- Each participant's largest OCS relative to its maximum possible shortfall is, on average, about 80 per cent in both periods.

- The single largest OCS is 100 per cent of the maximum possible shortfall in both periods.

The latter two results suggest that participants use reasonable amounts of debit space in LVTS, and encounter their net debit caps (consistent with Arjani 2006).

4. The second period has a later start date than the first period (April 2004 rather than March 2004) because of (minor) inaccuracies in the data for March 2004. This, in turn, precludes reliable application of the queue in the simulator. (March 2004 was the first month for which the CPA provided detailed intraday LVTS payments data to the Bank of Canada on an ongoing basis .)

Table 1
Simulation Results for Own Collateral Shortfalls

	March to October 2004 Simulator queue not operating (as in McVanel 2005)	**April 2004 to April 2006 Simulator queue operating**
Number of days in simulation	170	522
Number of simulated defaults	2,172	7,034
Number of OCSs	1,026 (47% of defaults)	3,373 (48% of defaults)
Average OCS relative to maximum possible OCS	18%	19%
Average of each participant's single largest OCS relative to its maximum possible OCS	81%	82%
Single largest OCS relative to maximum possible OCS	100%	100%
Average OCS	$210,416,322	$237,486,234
95th percentile of OCS distribution	$969,088,151	$1,070,011,331
Single largest OCS	$2,872,865,586	$2,555,557,411

- As row 7 shows, the average OCS (the loss to be shared among the other LVTS participants) is small in both periods. It is somewhat higher (by 13 per cent) in the longer period.

- The 95th percentile of the OCS distribution is similar in both periods. It is somewhat higher (by 10 per cent) in the longer period.

- The single largest OCS is somewhat smaller (by 11 per cent) in the longer period.

- In both periods, the 95th percentile of the distribution is significantly smaller than the largest OCS. That is, the 95th percentile amounts to only about 35 to 40 per cent of the single largest OCS in each period.

These results indicate that the data related to OCS, tranche usage, and losses to be allocated are quite similar in the two periods.[5] Next, we examine simulated losses to participants (equation (6)).

3.2 Losses from the single largest own collateral shortfall

We first consider the losses associated with the single largest OCS from April 2004 to April 2006, a shortfall of $2.6 billion. As Table 2 shows, average loss allocations in this case are small, amounting to about 5 per cent of tier 1 capital. (Appendix B describes how capital is measured.) Participants F and H are outliers, subject to losses that are substantially larger than those of other participants. The largest loss for any single participant is about 19 per cent of tier 1 capital (participant H), which is considerably larger than the average, but not sufficient to threaten solvency.

3.3 All losses relative to tier 1 capital

Next, we examine all 43,029 (non-zero) loss allocations generated in our simulations.[6] Table 3 shows the average and maximum losses of each participant. Generally, losses are small; the average loss allocation is only 0.4 per cent of tier 1 capital, and the average of each participant's maximum loss is 7 per cent of tier 1 capital. Two participants, F and H, have relatively large maximum losses, of 23 per cent and 34 per cent of tier 1 capital, respectively. However, while significant, these values would not be solvency threatening on their own. (We examine these cases further in section 5.)

Notwithstanding the small size of simulated losses, the methodology 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. However, in practice, regulators probably would try to close a failing institution after LVTS operating hours, if possible. Second, defaults are assumed to be unexpected (that is, they are assumed to be surprises). Therefore, participants do not take steps to reduce potential losses by decreasing BCLs to potential defaulters. Doing so would reduce a suspect participant's tranche 2 net debit cap, and consequently its capacity to

5. Based on our simulations, it appears that the effect of the queue operating is to lower OCSs slightly.
6. This excludes loss allocations to the Bank of Canada, which are discussed in section 3.4.

generate losses.[7] 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. Including these factors in the analysis would lead to even smaller losses than those reported above.

Overall, these results suggest that losses in the LVTS would be manageable, and probably small, as McVanel (2005) concludes. Indeed, our results are virtually the same as those found by McVanel for the period March to October 2004.[9]

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7. However, according to the rules of the LVTS, a participant that had reduced its BCL to another participant during the day would still be liable for losses proportional to the (larger) BCL originally provided, until the end of the daily clearing and settlement cycle.
8. For more on the prudential safety net in Canada, see Engert (2005).
9. In McVanel (2005), average loss allocation also is 0.4 per cent of tier 1 capital. The average of each participant's maximum loss is 6 per cent of tier 1 capital, and the single largest loss allocation from March to October 2004 is 33 per cent of tier 1 capital.

Table 2
Loss Allocations from the Single Largest Own Collateral Shortfall
April 2004 to April 2006

LVTS participant	Loss allocation relative to tier 1 capital (%)
A	2.1
B	3.7
C	2.0
D	0.3
E	3.1
F	12.0
G	2.1
H	18.6
I	6.4
J	4.4
K	2.3
L	1.3
M	1.8
Average	4.6

Note: The largest OCS, which is allocated above, is $2,555,557,411.

Table 3
Loss Allocations Relative to Tier 1 Capital
April 2004 to April 2006

LVTS participant	Average loss allocation relative to tier 1 capital (%)	Maximum loss allocation relative to tier 1 capital (%)
A	0.2	2.9
B	0.3	4.9
C	0.2	2.0
D	0.03	1.4
E	0.4	5.4
F	0.4	23.1
G	0.2	2.6
H	2.0	34.3
I	0.5	6.5
J	0.2	5.7
K	0.3	2.4
L	0.2	3.9
M	0.1	3.5
N	0.2	2.7
Average	0.4	7.2

3.4 Losses to the Bank of Canada

The Bank routinely extends a BCL to each participant equal to 5 per cent of the sum of all BCLs received by the participant.[10] In doing so, the Bank undertakes risk related to loss allocations as well. In our simulations, the average (non-zero) loss allocation to the Bank of Canada is $24.1 million, and the single largest loss is $121.7 million. As a frame of reference, the Bank's net revenue in 2005 was $1.7 billion (Bank of Canada 2006).[11]

4 Gauging the Upper Bound of Loss Allocations

4.1 Tranche 2 collateral relative to capital

In the preceding section, we considered the simulated losses based on actual intraday LVTS payments. However, it might be the case that other realizations of payments could lead to larger OCSs and losses. In this section, we gauge the upper bound of loss allocations relative to capital from April 2004 to April 2006, given the BCLs extended by participants in that period.

It can be shown that the collateral posted by any LVTS participant in tranche 2 (C2 in the above equations) is always greater than any single possible loss allocation that a participant could experience (Engert 1993). Again, the loss allocation from the default of any participant x to any participant i is

$$Loss_{xi} = OCS_x \left(\frac{BCL_{ix}}{\sum_{x=1}^{n-1} BCL_{ix}} \right). \tag{7}$$

10. The Bank follows this mechanical rule to avoid scope for conflicts of interest (real or apparent) due to its access to confidential prudential information. The value of 5 per cent has been in place since the LVTS began operating in February 1999, and it is 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).

11. In the extremely unlikely event of the failure of more than one LVTS participant on the same day during LVTS operating hours, where the sum of the exposures of the failed participants exceeds the value of the collateral pledged in the system, the Bank of Canada guarantees settlement of the LVTS. In this event, the Bank could be obliged to lend to a failed institution on a partially unsecured basis, to ensure certainty of settlement and thereby protect against systemic risk (Daniel, Engert, and Maclean 2004–2005; Goodlet 1997).

And the single largest possible OCS from any defaulter x is

$$maxOCS_X = (T2NDC_X - C2_X). \tag{8}$$

Substituting equation (8) into equation (7) gives the largest possible loss allocation to participant i from the default of any participant x; that is,

$$maxLoss_{xi} = (T2NDC_x - C2_x)\left(\frac{BCL_{ix}}{\sum_{x=1}^{n-1} BCL_{ix}}\right). \tag{9}$$

And, since

$$T2NDC_x = q\left(\sum_{i=1}^{n-1} BCL_{ix}\right), \tag{10}$$

we can express equation (9) as

$$maxLoss_{xi} = q(BCL_{ix}) - \left(\frac{BCL_{ix}}{\sum_{i=1}^{n-1} BCL_{ix}}\right)C2_x. \tag{11}$$

Finally, note that for any participant i, C2 is equal to the largest BCL that participant i has extended multiplied by q. That is,

$$C2_i = q\,(BCL_{i\beta}), \tag{12}$$

where β denotes the recipient of the largest BCL extended by participant i.

Comparing equations (11) and (12), it is clear that $C2_i > maxLoss_{xi}$, because $q\,(BCL_{i\beta}) \geq q\,(BCL_{ix})$, and given a positive value for $C2_x$.[12] More precisely, $C2_i > maxLoss_{xi}$ because

$$q\,(BCL_{i\beta}) > q\,(BCL_{ix}) - \left(\frac{BCL_{ix}}{\sum_{i=1}^{n-1} BCL_{ix}} \right) C2_x .$$

Thus, the collateral posted by any participant in tranche 2 of the LVTS would exceed its largest possible loss from the default of any other participant. Therefore, comparing each participant's daily C2 value relative to its capital provides a conservative (and relatively simple) measure of the potential burden of loss: if the ratio of C2 to capital is small, then the ratio of possible loss to capital (from any single default) is even smaller.

As well, under the bylaws of the LVTS, a participant's tranche 2 collateral (C2) is the legal limit of its liability for loss allocation (maximum ASO) in the event of *multiple* participant failures (Arjani and McVanel 2006).

Table 4 shows the ratio of tranche 2 collateral to capital for the period April 2004 to April 2006. In most cases, these values are small. For example, the average of tranche 2 collateral relative to capital is about 6 per cent, and the average maximum value for this ratio is about 15 per cent. Keeping in mind that this measure exceeds the largest possible single loss in the event of a default, we see that the potential for solvency-threatening losses in the LVTS is remote.

Comparing loss allocations relative to capital (Table 3) with tranche 2 collateral relative to capital (Table 4) shows that the former is significantly smaller than the latter. This is because losses are a function of a defaulter's net debit position less the collateral that it has pledged to the system. In our simulations, defaulting participants generally are not at their net debit caps, and their own collateral reduces losses to be allocated to other participants. Of course, neither of these considerations applies to the results in Table 4.

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12. If the defaulter has not extended any BCLs, then $C2_x$ would be zero. This would be a very peculiar situation, since it would mean that the defaulter has received BCLs from other participants, which creates its tranche 2 space, but it has not reciprocated by extending any BCLs to other participants. Nevertheless, if $C2_x$ were zero, then $C2_i \geq maxLoss_{xi}$, and there is little effect on the above analysis.

5 Participants F and H

There are two participants, F and H, that appear to take larger risks than others. For example, as Table 4 shows, participant H systematically extends comparatively large BCLs relative to its tier 1 capital. To see whether the large BCLs extended by these two participants translate into correspondingly large losses, we examine the losses for F and H on several recent dates when they extended relatively large BCLs. Tables 5 and 6 show the results. Loss allocations relative to capital are generally much smaller than the ratio of collateral to capital (as discussed above). Also, there is not a linear mapping of large BCLs to large losses. Consider the case of H on dates *Y* and *Z*, when similarly large BCLs were extended but the simulated losses were much different.

For participant H, loss allocations in these cases average about 19 per cent of tier 1 capital; for participant F, loss allocations average about 17 per cent of capital. While these amounts are not sufficient on their own to threaten solvency, in a few cases losses could be significant (such as 34 per cent for H on date *Z*).

6 Conclusion

In this paper, we study the potential losses to LVTS participants using a large set of daily LVTS data and the most recent version of the Bank's payments system simulator. We conclude that losses from a participant failure are very likely to be small and readily manageable. For one or two small participants, under some (probably extreme) conditions, 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 potential losses manageable.

Table 4
Tranche 2 Collateral Relative to Tier 1 Capital
April 2004 to April 2006

LVTS participant	Average of daily T2 collateral relative to tier 1 capital (%)	Maximum T2 collateral relative to tier 1 capital (%)
A	3.1	8.0
B	4.8	8.2
C	2.1	6.0
D	0.5	2.3
E	4.3	9.1
F	7.5	35.6
G	2.9	7.9
H	28.4	64.8
I	8.0	19.0
J	6.3	16.1
K	3.1	8.6
L	2.2	6.9
M	2.0	4.4
N	2.9	7.5
Average	5.6	14.6

Table 5
Participant F: Collateral and Losses Relative to Tier 1 Capital on Selected Dates

Date	T2 collateral relative to tier 1 capital (%)	Largest loss allocation relative to tier 1 capital (%)
Q	30.7	20.1
R	28.3	15.3
S	30.5	8.3
T	35.6	23.1
Average	31.3	16.7

Table 6
Participant H: Collateral and Losses Relative to Tier 1 Capital on Selected Dates

Date	T2 collateral relative to tier 1 capital (%)	Largest loss allocation relative to tier 1 capital (%)
U	51.3	29.3
V	52.5	19.5
W	51.8	10.9
X	57.0	7.8
Y	64.8	9.3
Z	62.2	34.3
Average	55.8	18.5

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Appendix A: Payments System Simulation at the Bank of Canada

An important innovation in payments system research has been simulation analysis. Simulation models are useful because they can often be calibrated to replicate a specific large-value payments system. 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 30 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 manner similar to the LVTS. Payments are submitted for processing in order, based on a time stamp. A submitted payment is processed by the simulator if the payment does not result in the sending participant incurring a net debit position that exceeds either its bilateral or multilateral risk-control test.[1] Payments that cannot be processed upon submission because of a sender's lack of intraday liquidity are stored in the simulator's queue.[2] The BoF-PSS2 offers various queue-release algorithms for users to choose from, representing alternative queuing arrangements typically available in a large-value payments system.

The BoF-PSS2 generates a variety of 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 on 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 the individual-participant level.

1. For definitions of the LVTS multilateral and bilateral risk-control tests, see Arjani and McVanel (2006).
2. Under the current queue operating practices in the LVTS, only jumbo payments are sent to the queue upon failing either risk control. Non-jumbo payments are immediately rejected from the system. For more information, see Arjani and McVanel (2006).

Appendix B: How Capital Is Measured

LVTS participants	Measure of capital	Frequency	Source
Federally chartered banks (including foreign bank subsidiaries)	Tier 1 capital	Quarterly	Office of the Superintendent of Financial Institutions quarterly return of assets and liabilities
Bank of America	Tier 1 capital of parent Bank of America National Association (United States)	Annual	Annual reports
State Street	Tier 1 capital of parent State Street (United States)	Annual	Annual reports
Alberta Treasury Branches	Tier 1 capital	Annual	Annual reports
Caisse centrale Desjardins du Québec	Equity	Annual	Annual reports
Credit Union Central of Canada (CUCC)	Equity of CUCC plus all provincial credit union centrals	Annual	CUCC

Notes:

In the LVTS, Bank of America and State Street are domestic branches of U.S.-based banks. As a result, in the calculations reported in the text, the capital of Bank of America and State Street is that of their U.S.-based parent, which bears legal liability for commitments of their branches operating in the LVTS.

In the calculations reported in the text, the nearest prior observation of capital is used as a scale variable. For example, to calculate the ratio of loss to capital at 19 February 2006, capital reported at December 2005 is used as the denominator.