Excess Collateral in the LVTS: How Much Is Too Much?

*Kim McPhail and Anastasia Vakos**

Canada's Large Value Transfer System (LVTS) is the payment system used to make large-value or time-sensitive payments, on a final and irrevocable basis. Thirteen financial institutions (and the Bank of Canada) are direct LVTS participants. The LVTS requires these participants to pledge to the Bank of Canada enough collateral to cover the default of the participant with the single largest net debit position. In the extremely remote event of multiple defaults and insufficient collateral, the Bank of Canada guarantees that the LVTS will settle. Sufficient collateral thus facilitates the safe and continuous flow of payments throughout the day and ensures that the LVTS can complete settlement at the end of the day.[1]

Payments sent through the LVTS and received by each participant can vary significantly from day to day, hour to hour, and even minute to minute. Although participants know in advance many of the payments they will receive and send, they cannot always synchronize these flows. They may have to make large payments before receiving incoming funds. From time to time, they can be faced with making unexpectedly large payments. By holding a buffer of collateral for LVTS purposes, participants can accommodate all of these factors without impeding the timely delivery of payments. A participant with sufficient collateral can also meet its clients' payment needs on a more timely basis, compared with a participant with significantly less collateral. The first participant can therefore provide a higher level of service to its clients.

1. For further information on the LVTS, see Box 6 on page 29 of this *Review*. See also the Bank's Web site at <http://www.bankofcanada.ca/en/payments/systems.html#value>.

* This note draws on a recent Bank of Canada working paper (McPhail and Vakos 2003).

If an LVTS participant does not minimize the costs associated with holding and managing collateral for LVTS purposes, excessive costs could be passed on to its clients, who could end up paying more for sending LVTS payments than would be optimal. In such a case, clients of this financial institution may be deterred from sending payments via the LVTS. They may instead choose payment systems that are not as well protected against risk. Alternatively, they may choose another financial service provider.

If participants do not hold sufficient collateral for LVTS purposes, one would expect to see an excessive number of occasions when large-value, time-sensitive, or systemically important payments are delayed because of insufficient collateral. This would disrupt payment systems and could inconvenience the clients of LVTS participants.

It is therefore interesting to consider the amount of collateral pledged to the LVTS. To examine this issue, we build a theoretical model that generates the demand for collateral by LVTS participants under the assumption that they minimize the cost of holding and managing collateral for LVTS purposes. Our fairly simple model predicts that the optimal amount of collateral held by each LVTS participant for this purpose depends on the opportunity cost of collateral, the cost of transferring collateral in and out of the LVTS, and the distribution of an LVTS participant's payment flows in the system. We compare the predictions of our model with actual levels of collateral held in the LVTS.[2] We also estimate regressions using panel data to determine how collateral varies in response to changes in factors affecting the demand for collateral.

2. Data on the payment flows and collateral for individual participants are confidential.

A Brief Description of the LVTS

In the first five months of 2003, an average of about 16,000 payments totalling about $125 billion flowed through the LVTS each day. The LVTS has two payment streams: Tranche 1 (T1) and Tranche 2 (T2). T2 payments account for 98 per cent of payment volumes and about $110 billion per day. T1 payments account for 2 per cent of volumes and about $15 billion in value.

T2 is supported largely by intraday credit. It uses collateral so efficiently that about $110 billion in payments can be supported by only a few billion dollars of collateral. Participants' collateral requirements for T2 payments change little from one day to another. Hence, there is little need for participants to hold a large buffer of collateral for LVTS purposes to accommodate changes in T2 collateral requirements. We therefore focus on T1 payment flows.

T1 payments must be financed, dollar for dollar, by T1 funds already received or by collateral. It is therefore much more expensive in terms of collateral for participants to send T1 payments than T2 payments. T1 payments tend to be reserved for situations in which insufficient credit is available for a payment to pass through T2 risk controls.[3]

T1 payments averaged $15 billion per day in the first five months of 2003. Of these, about $7 billion were sent by financial institutions, and the remainder were sent by the Bank of Canada. T1 payments sent by the Bank are not collateralized, and so are not considered here.

We use data from February 1999 (when the LVTS began operations) up to May 2003. Over this period, daily T1 payments sent by financial institutions averaged $5.7 billion.

3. For example, most payments made to the Bank of Canada to support participants' operations in Canada's securities settlement system, CDSX, or in the foreign exchange settlement system, the CLS Bank, rely on T1. For more on these systems, see Box 6 on page 29 of this *Review*.

A Model of the Demand for Collateral in the LVTS

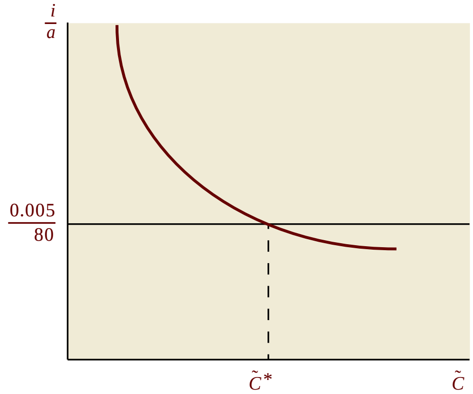
The daily management of collateral by LVTS participants involves making sure that the collateral required to support T1 payments will be available promptly. For LVTS participants, having sufficient collateral for LVTS purposes is analogous to managing an inventory to meet demand. For collateral to be managed efficiently it must be managed at minimum cost. The model used is a simple precautionary demand for collateral.

We assume that participants know the probability distribution of their T1 payments, but do not know their value until the beginning of each day. The distribution of payments is highly skewed—on many days payments are relatively small, and on a few days payments are extremely large.

Participants base the collateral that they pledge to the LVTS on three factors. Each participant chooses an optimal "normal" level of collateral to hold in the LVTS. One dollar of normal collateral has an opportunity cost (defined as i) of 5 basis points. Once payments are known, if normal collateral is insufficient to meet the day's payments, the participant will bring additional collateral into the system. Collateral is then returned to its normal level at the end of the day. The fixed cost of increasing collateral (and of subsequently returning it to its normal level) (defined as a) is $80. The interest foregone when collateral must be added to the LVTS (defined as j) is 43 basis points times the value of the additional collateral. We assume that participants face a higher cost of collateral if that collateral is obtained at short notice. The benchmark values 5 basis points, 43 basis points, and $80 are based on anecdotal evidence but, in practice, may differ considerably among LVTS participants.

To minimize the expected total cost of collateral, participants balance the additional cost of holding a higher normal level of collateral for LVTS purposes against the reduction in transactions cost and the reduced need to acquire extra collateral at premium prices (when payments are large). This determines the optimal level of normal collateral.

Chart 1 Determination of Optimal Normal Collateral



The equilibrium relationship is shown in Chart 1.

The horizontal line is the cost of normal collateral, *i*, divided by the transactions cost, *a*. The curve is a function of the shape of the payments distribution, the transactions cost, and the spread between the cost of normal collateral and the higher cost of obtaining collateral at short notice.

The point at which these lines intersect defines the optimal level of normal collateral, $\tilde{C}^*$. This point is calculated for each LVTS participant, and these values are used to compute the average optimal level of collateral, which is then compared with the actual average level of collateral. Aggregate results for the system can be found by summing across all 13 LVTS participants. Using our benchmark values for the opportunity costs and transactions costs, we found that the actual level of collateral was considerably higher than that predicted by our model. One participant, however, appeared to have a lower cost of collateral, and when this participant was excluded from the analysis, predicted collateral was within 5 per cent of actual.

To gauge the sensitivity of our results to the benchmark values chosen for transactions and opportunity costs, we experimented with different values for these parameters. We found that halving the transactions cost, from $80 to $40, had little effect on the optimal normal level of collateral. A 5-basis-point increase in both the opportunity cost of normal collateral and the price paid for collateral obtained at short notice caused the optimal normal level of collateral to fall by about 20 per cent.[4]

Empirical Analysis Using Panel Data Regressions

We estimate a regression using panel data to explain the amount of collateral pledged to the LVTS. The variables used to explain collateral demand are T1 payments, the variance of T1 payments, the skewness of T1 payments, and the opportunity cost of collateral.[5] Since we have no data indicating how the cost of

4. Note that the relationship is not symmetric—i.e., an equal reduction in the opportunity cost would not lead to a 20 per cent increase in collateral.
5. Collateral, payments, and the variance of T1 payments are expressed as natural logarithms.

obtaining collateral at short notice and transactions costs vary over time, these variables are not included in our regressions. We use a moving 30-day backward window of the variance and skewness of T1 payments. Our opportunity cost is based on the spread between bankers' acceptances and treasury bills. After November 2001, when the list of securities eligible for use as collateral in the LVTS was expanded, we assume the opportunity cost of collateral to be 5 basis points. The fixed effects that capture institution-specific unobservable variables are incorporated by including dummy variables in the equations for each LVTS participant.

The regression results are in line with expectations. Collateral levels vary positively with the level and variance of T1 payments (the skewness measure is not significant). The coefficients, while statistically significant, are nevertheless very small. This is in line with our theoretical model, which predicts that normal levels of collateral held for LVTS purposes should be sufficient to cover all but the largest 10 per cent of daily T1 payments. Collateral varies negatively and statistically significantly with the opportunity cost of collateral, as we would expect. This effect is also quite significant economically, which is consistent with our theoretical model.

Conclusion

Our simple model of collateral demand, based on benchmark values for opportunity costs and transactions costs, explains the aggregate amount of collateral pledged to the LVTS quite well, despite the fact that these costs may vary among participants. We find that when we exclude one LVTS participant that appears to have a lower opportunity cost of collateral, aggregate actual collateral is within 5 per cent of the predicted level. Our panel data regressions broadly support our theoretical model. Thus, in aggregate there does not appear to be an excessive amount of collateral pledged in the LVTS.

Our model suggests that it is unlikely that the clients of LVTS participants would be deterred from using the system because participants passed on to them the costs associated with excessive levels of collateral. Our model indicates that for about 90 per cent of the time the "normal" collateral level in the LVTS is enough to cover daily T1 payments. Occasions may therefore arise when time-sensitive or systemically important payments are delayed as participants try, at short notice, to obtain collateral to meet unexpectedly large payments. These occasions should be rare.

This study suggests several areas for future work. First, in relation to the application of our theoretical model, the use of Extreme Value Theory (EVT) might strengthen our results. Although we have more than 1,100 observations for each financial institution in our sample, relatively few of these lie in the tail of the payments distribution when payments are very large. Second, more information and a greater understanding of the opportunity costs of collateral that is obtained at very short notice would be helpful, because this extra cost is important to explaining the predictions of the model. Finally, our model assumes that collateral can always be obtained at short notice (i.e., stockouts do not occur), so that there is no cost to LVTS participants from delays in making payments. In practice, participants may face financial penalties or reputational damage if it takes time to obtain collateral needed to back time-sensitive payments. This would suggest that participants would choose to hold more collateral than indicated by the model. Including these factors would make for a richer model.

References

McPhail, K. and A. Vakos. 2003. "Excess Collateral in the LVTS: How Much Is Too Much?" Bank of Canada Working Paper No. 2003-36.