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Participant Consolidation in the LVTS: A Simulation Study

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* The views expressed in this presentation reflect those of the authors and do not necessarily represent those of the Bank of Canada.

Introduction and Motivation

- Purpose of paper is twofold
  - Examine the impact of financial sector consolidation on LVPS risk and cost;
  - Demonstrate the usefulness of simulation analysis as a tool to study this issue empirically.
- Motivation
  - Central banks typically responsible for safe and efficient operation of LVPS;
  - Already highly concentrated LVPS participation structure in Canada.

Questions to be Addressed

- What value of payments activity could be internalized by the merged bank?
  - Gives an idea about how payments system costs might change;
  - Potential gauge of risk (e.g., settlement risk) generated outside of the LVPS.
- How could participants' share of payments activity be affected, as well as participants' central role in the system?
  - Measure how participants' share of operating costs will change;
  - Shed light on potential operational risk implications.
- What could be the effect on collateral requirements at the system-wide and participant-level?
  - Understand how participants' liquidity costs could change.
  - Facilitates understanding of how collateral efficiency might be impacted by consolidation, i.e., the "benefit" of each dollar of collateral pledged to LVTS.

Canada's LVTS – Brief Overview

- A net settlement system exceeding International Core Principles
  - All payments processed intraday are considered final;
  - Subject to Bank of Canada oversight.
- Two payments streams available to participants: T1 and T2
  - Each stream has own risk-controls and collateral requirements;
  - Contribution to T2 collateral pool (T2 MaxASO) based on largest Bilateral Credit Line (BCL) extended to another participant;
  - T2 BCLs used to determine loss-allocation in event of participant default;
  - Payments processing in both streams subject to multilateral intraday credit limits (T1NDC and T2NDC).
- Central queue with partial optimization algorithm running every 15 minutes.

Canada's LVTS – Brief Overview

- Daily LVTS payments throughput is significant
  - T1: $22.92 billion; T2: $149.95 billion (H1 – 2007);
  - Approximately 20,000 transactions per day.
- Participation structure is highly concentrated
  - 15 participants (including the Bank of Canada);
  - Largest three participants account for over 60 per cent of daily LVTS value.

Distribution of LVTS Payments Activity by Participant Size (Daily Average, January – June 2007)			
	Number of Participants	Share of Value	Share of Volume
Small	6	6 35	6 02
Medium	6	31 79	35 72
Large	3	61 86	58 26

Simulation Methodology

- Simulation methodology consists of three broad steps
- Step #1: Determine base-case results
  - Simulation run using historical LVTS settlement and credit limits data;
  - BoF-PSS2 specified to exactly replicate LVTS functionality;
  - Base-case metrics calculated based on simulation outcome.
- Step #2: Determine merger-case results
  - Choose participant pairing (will be discussed);
  - Adjust payments data by removing payments between merging participants;
  - Determine new "upper bound" credit limits in T1 and T2 (BCLs and multilateral limits);
  - Merger-case metrics calculated based on simulation preparation and outcome.

Simulation Methodology

- Key assumptions underlying merger-case simulations
  - BCLs between non-merging participants unchanged;
  - Payment submission times are unchanged;
  - Some T2 a ments to Bank of Canada moved to T1.

- Step #3: Perform sensitivity analysis
  - A key attribute of this type of analysis; facilitates understanding of important tradeoffs in the system;

- Choice of metrics for comparison between base-case and merger-case
  - Daily LVTS value and volume settled (internalization, external risk);
  - Share of daily LVTS volume (operating costs and operational risk);
  - Minimum necessary T1NDC and T2 MaxASO (liquidity costs);
  - Turnover ratio: Payment Value/Collateral (liquidity efficiency);
  - Bonachich (2005) centrality (operational risk).

Simulation Methodology

- **Hypothesis**: Size of merged participant will be key determining factor in magnitude of impact.
  - Test by studying four merger scenarios involving participants within and across size categories;
  - ~30 percentage point difference in share of merging participants' volume between first and fourth scenario;
  - Second merger scenario involves a double-merger with significant size difference between merged participants.

Pre-Merger Throughput of Merging Participants		
Merger Scenario	**Combined Percentage Share of Participants' LVTS Daily Payments Value**	**Size of Merging participants**
1	49 74	Large-Large
2	(A) 44 19 (B) 24 68	(A) Large-Large (B) Large-Medium
3	35 67	Large-Medium
4	20 06	Large-Medium

Simulation Results

- What value of activity could be internalized by the merged bank?
  - High degree of variation across merger scenarios;
  - Value internalized ... . 1 ranges from $43 - 790 million;
  - Value internalized in T2 ranges from $2 - 30 billion;

Internalization of Payments Value due to Merger ($ millions)				
	Merger 1	**Merger 2**	**Merger 3**	**Merger 4**
T1 Value Internalized	424 1	(A) 790 2 (B) 163 8	75 7	43 6
T2 Value Internalized	29,460	(A) 17,686 (B) 3,891	6,541	1,837

Simulation Results

- How could participants' share of activity be affected by consolidation?
  - Merged participant experiences decline of between 0.58 and 9 percentage points relative to combined pre-merger payments share;
  - Collective share of non-merging participants rises by the same amount;
  - Outcome is influenced by value of payments internalized.

Simulation Results

- What is the effect of consolidation on collateral requirements?
  - Generally a lower collateral requirement for the merged bank
    - Reduction ranges from -1.5 % to -17%
    - Exceptions: fourth scenario (+32%), and smaller of the merged banks in the double merger (+2%).
  - Generally an increased collateral requirement for non-merging participants
    - Impact differs across merger scenarios and participant categories
      - 1st: 47 to 64% 3rd: 22 to 34%
      - 2nd: 36 to 55% 4th: -3 to 6%
    - Exceptions: small participants in fourth scenario face a decline.
  - It is not always the case that the merged bank is better off and the non-merging banks are worse off.
    - Size of the merged participant plays a role.

Simulation Results

- How is liquidity efficiency affected?
  - T1 system-wide turnover ratio increases 2-38%
  - T2 system-wide turnover ratio declines 19-37%

System-Wide Turnover Ratio					
	Base Case	Merger 1	Merger 2	Merger 3	Merger 4
T1 System-wide Turnover Ratio	2 14	2 96	2 34	2 19	2 28
T2 System-wide Turnover Ratio	38 49	24 41	24 99	29 15	30 99

Simulation Results

- How might operational risk be affected?
  - Concentration of payment activity and the identity of the central participant can change.
  - Could impact magnitude of the potential liquidity trap during operational events.

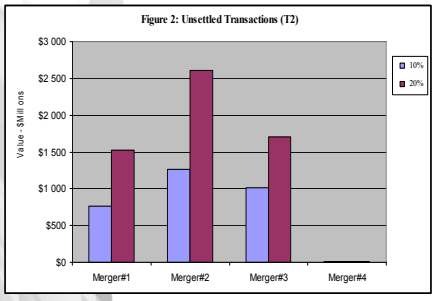
Average Daily Share of Payment Activity (Volume) and Centrality Rank of Merging Participant

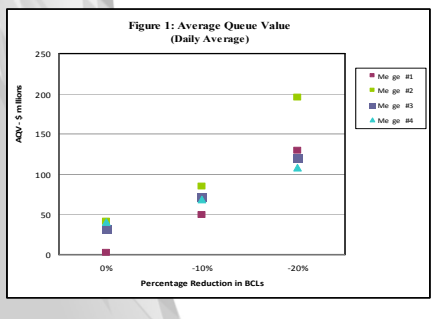
	Merger 1		Merger 2		Merger 3		Merger 4	
	Base Case	Merger	Base Case	Merger	Base Case	Merger	Base Case	Merger
Share of Volume	46 58	37 57	(A) 43 62 (B) 30 28	(A) 39 53 (B) 29 70	34 75	33 41	20 72	18 72
Centrality Rank	1st and 2nd	1st	(A) 1st and 3rd (B) 2nd and 5th	(A) 2nd (B) 1st	1st and 7th	1st	3rd and 4 or 5th	2nd

Sensitivity Analysis

- Motivation for sensitivity analysis
  - Since no behavioural underpinning to BoF-PSS2, we made assumptions about participants' behaviour;
  - Generally, we observe increased T2 collateral requirements for non-merging participants;
  - Incurring this higher liquidity cost may not be optimal, also increased credit risk with higher BCLs;
  - Consider two ways in which lower T2 collateral requirements might be achieved
    – two separate experiments,
    – adjustments made to input data and simulations re-run;
  - Experiments allow us to better understand trade-off between delay and liquidity that emerges under consolidation.
- Introduce two new metrics to capture delay
  - Average Queue Value (Leinonen and Soramäki 1999)
  - Value of unsettled payments

Sensitivity Analysis – Experiment #1





- Reduction in BCLs granted to/from merged participant;
  - Assume that BCLs reduced by 10% and 20% in two separate simulations;
- **Results of Experiment**
  - Delay realized as some payments fail T2 risk-control test;
  - Size of merged participant influences result;
    - Far fewer unsettled payments in fourth scenario
  - Delay spreads to payments between non-merging participants.

Sensitivity Analysis – Experiment #2

- Improved coordination of payments as a means of reducing collateral requirements
  - Could lead to lower net debit peaks and thus liquidity costs.
  - We explore one possibility applied to the 1st merger scenario.
    - Payments to and from merged bank are submitted virtually simultaneously at start of day;
    - Represents case of "perfect" coordination – result serves as "upper bound" for collateral savings.
  - Results of Experiment
    - Perfect offsetting can reduce bilateral credit needs;
    - Collateral required declines 60%, 53% and 63% for non-merging small, medium and large participants, respectively;
    - Decline in BCLs lowers T2NDCs; thus collateral (liquidity cost) savings come only at the cost of increased payments delay.

Summary of Results

What is the Impact of Consolidation on…		
	Merged Bank	**Non-merging Banks**
operating costs?	Decrease	Increase
collateral requirements?	Mixed Results Decrease when merging bank is large	Mixed Results Increases when merging bank is large
liquidity efficiency?	Decreases	
payments concentration?	Increases	
the merged bank's centrality?	Increases	

- Collateral requirements can be reduced at the cost of increased delay;
- The net benefit of consolidation depends on the preferences of policy makers.

Conclusions

- Consolidation has potential to impact cost and risk
  - Impact felt inside and, to a certain extent, outside of the LVPS;
  - Network characteristics of these systems – impact could extend to non-merging participants in the system.
- Size of merged participant is a dominant factor in terms of the impact of consolidation.
- Sensitivity analysis reveals liquidity costs can be lowered, but only at the cost of increased payments delay in the system.
- Lots of possibilities for future research.