Examining the Balance between Risk and Efficiency in Canada's LVTS: A Simulation Approach

Neville Arjani

narjani@bank-banque-canada.ca

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Objectives of the Presentation

- Describe the tradeoff between settlement delay and intraday liquidity in the T2 payment stream of Canada's Large-Value Transfer System (LVTS)

- Present results of simulation analysis:
  - Under current (internal) queuing arrangements, does a tradeoff exist between intraday liquidity and settlement delay in the T2 payment stream? Is this tradeoff consistent with BHM (1996)?
  - Will allowing increased use of the LVTS central queue lead to improvements in this tradeoff, i.e., lower settlement delay for each amount of intraday liquidity?

Description of the T2 Payment Stream (1 of 2)

- Dominant payment stream for LVTS payment throughput
- T2 intraday line of credit as a major source of intraday liquidity

$$T2NDC^{n} = SWP \bullet \sum_{j=1}^{N-1} BCL_{jn}$$

- Bilateral and multilateral real-time risk control checks applied
- Survivors-pay collateral pool used to secure T2 intraday credit provision

$$MaxASO^{n} = \max(BCL_{n,j\neq n}) \bullet SWP$$

- Importance of the system-wide parameter (SWP)
  - As SWP↓ → T2NDC ↓ , T2 collateral req'd/cost ↓

Description of the T2 Payment Stream (2 of 2)

- The LVTS contains a central queue – queued payments stored and released on a FIFO basis
- Two queue-release algorithms
  - Re-submission upon receipt of T2 payment, increase in T2NDC (BCL↑)
  - LVTS Jumbo Algorithm: Performs offsetting of queued T2 payments at 20 min. intervals throughout day
- Participants' excessive use of the central queue is not encouraged
- Anecdotal evidence: participants use internal queues with automatic by-pass FIFO queue release
  - Payments released form internal queues on a gross basis

Settlement Delay in the LVTS

- Definition of settlement delay (BIS 1997):
  - Potential time-lag occurring between intended submission of a payment and when payment becomes final
  - Primary source of settlement risk examined at individual transaction level

- Nature of settlement delay in the LVTS
  - Participants face intraday liquidity constraints w.r.t. T2 intraday credit provision (BCL, T2NDC)
  - A time-lag may exist b/w participants' intended and actual submission of payments (source of settlement delay in the LVTS!)

- Possible consequences of settlement delay in the LVTS
  - Borne by sender, intended receiver, other participants, participants' clients
  - May exacerbate financial losses associated with operational risk
  - Could lead to increased systemic risk in the broader financial system

Settlement Delay and Intraday Liquidity in the LVTS

- Hypothesis: A tradeoff exists between settlement delay and intraday liquidity in the LVTS T2 payment stream

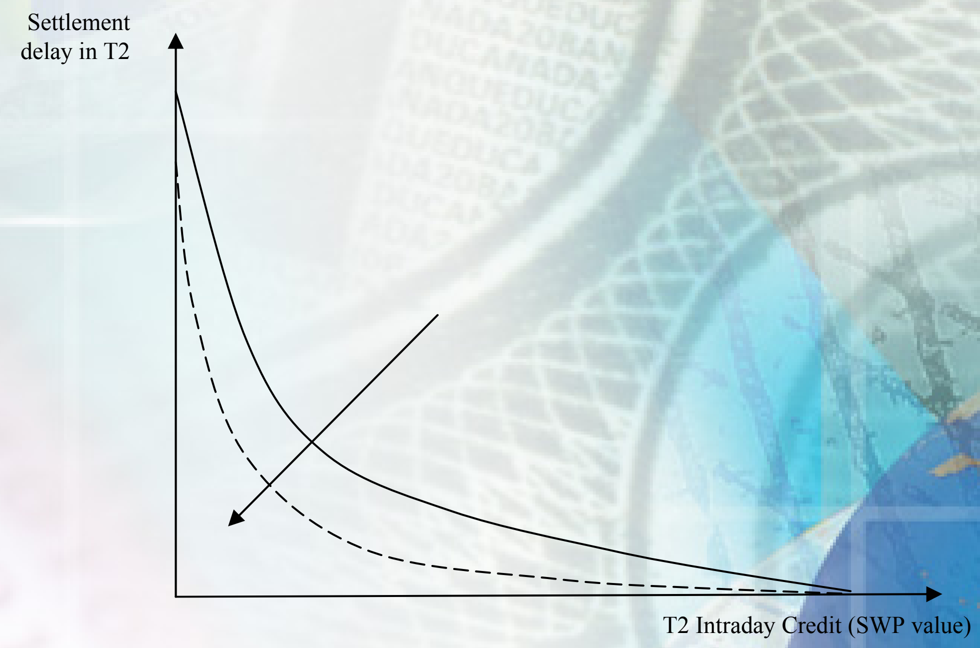
- Assumptions:
  - BCL values remain constant
  - No migration of T2 payments to the T1 payment stream

- Nature of this tradeoff:
  - SWP lowered from current value of 0.24 → T2NDCs ↓
  - Likelihood of T2 payments failing risk controls upon intended submission ↑
  - Vol/Val of payments held in participants' internal queues at any time ↑
  - Settlement delay in system will increase at an increasing rate as SWP → 0

Graphical Representation of this Tradeoff (BHM 1996)

- Modeled as a decreasing convex curve in delay-liquidity space
- Role of innovation to improve tradeoff (dotted line)
- Proposed innovation: Introducing a complex queue-release algorithm to the central queue
- Application to the LVTS: Increased use of central queue should lead to an improved tradeoff!

Settlement Delay and Intraday Liquidity: Tradeoff in the LVTS T2 Stream



Simulation Methodology (1 of 2)

- Paper employs simulation approach to confirm above hypotheses

- Simulation Specification
  - Version 1.0 of Bank of Finland Payment and Settlement Simulator (BoF-PSSII)
  - B=1,2 batches of simulations; s=1-8 simulations per batch
  - B1: Internal Queuing (bypass-FIFO) – SEBASIC1, QUBYPAFI

    B2: Central Queuing (Partial Offset, FIFO) – SEBASIC1, QUFIFOPR, PNFIFOPI
  - Imposing the intraday liquidity constraint: each simulation s characterized by lesser value of T2NDC for each participant n (holding BCLs constant)

$$T2NDC_s^n = SWP_s \bullet \sum_{j=1}^{N-1} BCL_{jn}$$

where $SWP_{1,\ldots,8}$ = 0.24, 0.21, 0.18, 0.15, 0.12, 0.09, 0.06, 0.03

Simulation Methodology (2 of 2)

- 3 measures of settlement delay calculated for each simulation s in each batch B:
  1. Daily Proportion of Unsettled Payments (PU)

$$PU_t^N = \left(\frac{Value\ of\ Unsettled\ Transactions_t^N}{Value\ of\ Submitted\ Transactions_t^N} \right)$$

  2. Daily System-Wide Delay Indicator (DI) (L&S 1999)

$$DI_t^N = \left(\sum_{n=1}^{N} \omega^n \rho^n \right)$$

where $\rho_n = \left(\frac{\sum_{i=1}^{T} Q_i^n}{\sum_{h=1}^{T} \sum_{i=1}^{h} V_i^n} \right)$ and $0 \le \omega^n, \rho^n, \text{P} \le 1$

  3. Average Intraday Queue Value (AQV)

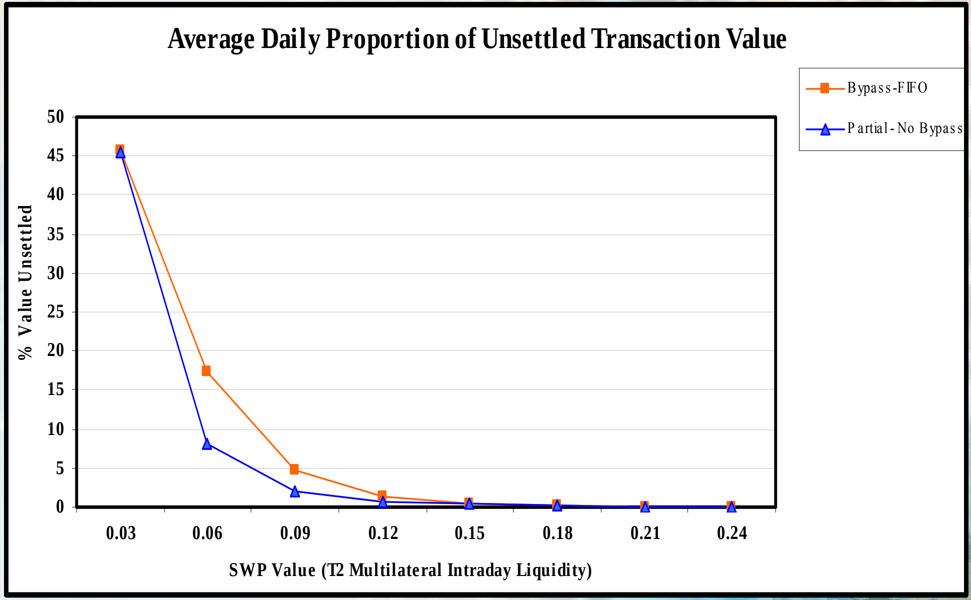
$$AQV_t^N = \left(\frac{\sum_{i=1}^{T} Q_i^N}{T} \right)$$

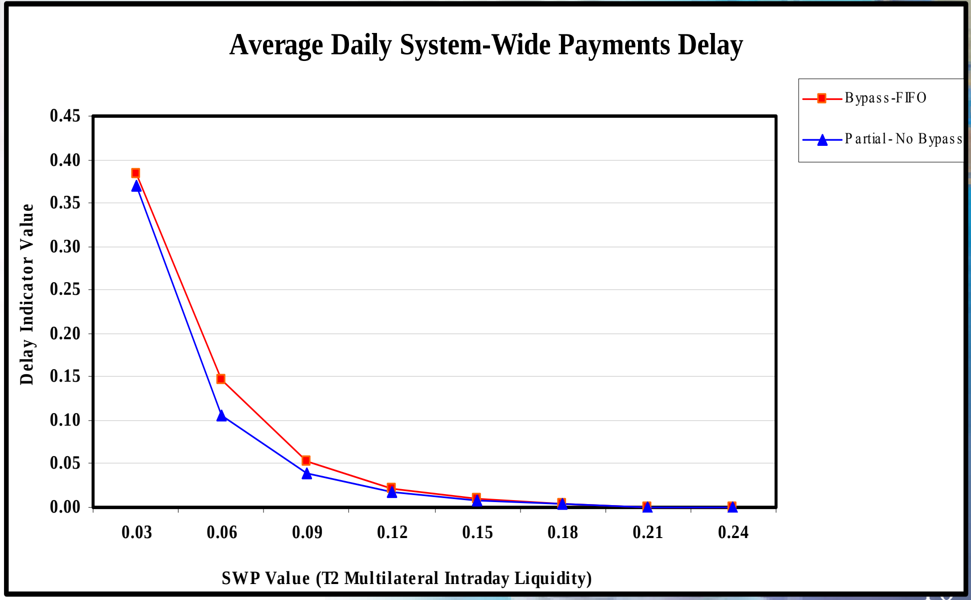
Simulation Results (1 of 3)

- Tradeoff exists between settlement delay and intraday liquidity in the T2 stream according to all 3 measures

- Tradeoff characterized as a decreasing convex curve, like that defined in BHM (1996)

- Introduction of an innovation (increased central queue use) improves tradeoff – settlement delay reduced for all amounts of intraday liquidity

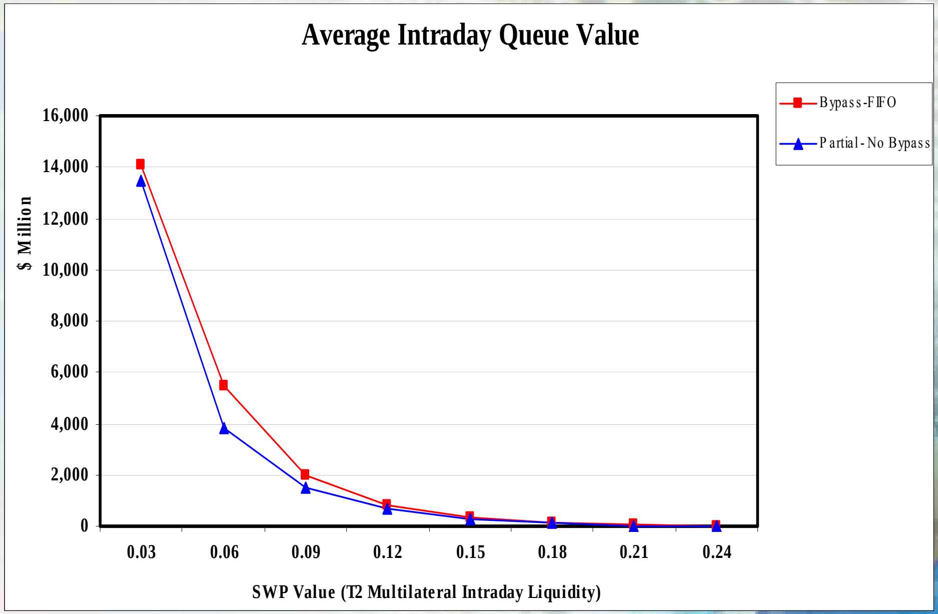




Simulation Results (2 of 3)

- Relative benefit of central queuing reaches peak when SWP = 0.06
  - PU ↓ by 9% (~ $10 billion)
  - AQV ↓ by 29% (~$1.6 billion)
  - DI ↓ by 28%

- As SWP → 0, potential gridlock/deadlock ensues under both queuing arrangements



Simulation Results (3 of 3)

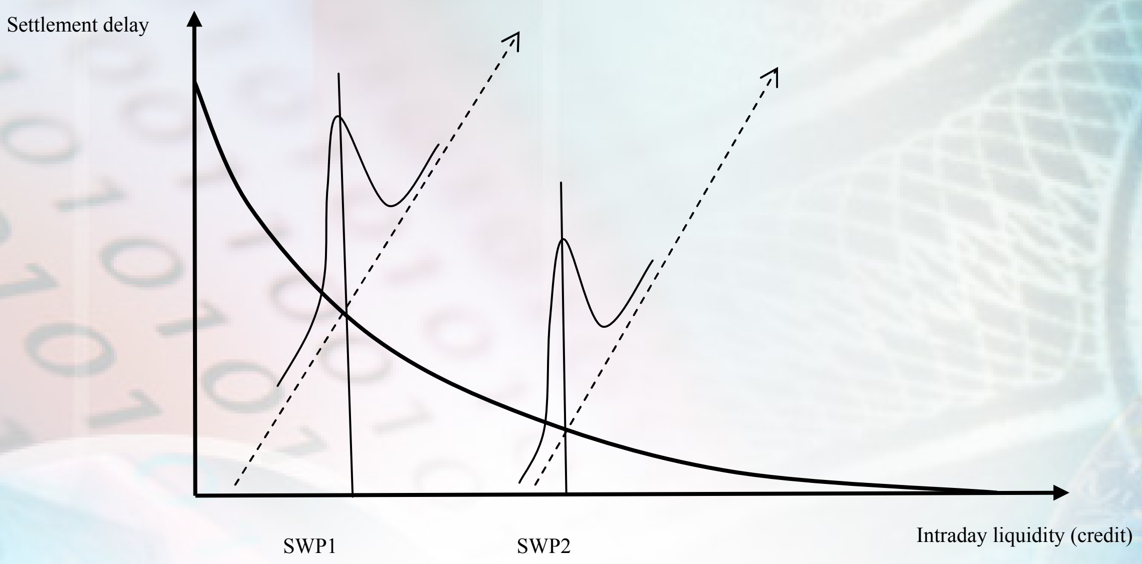
- What are potential implications of increased central queue usage?
  - Increase in external credit risk related to queue transparency?
  - Reduction in settlement delay offset by reductions in BCLs?
  - Further reduction in settlement delay due to participants' earlier submission of payments to the central queue?

- Is marginal increase in settlement delay worth reduced T2 collateral requirements (and related costs)?
  - SWP reduced to 0.18, PU ↑ by 0.15% under internal queuing, 0.14% under central queuing
  - Holding BCL values constant, SWP = 0.18 reduces value of aggregate daily T2 collateral requirement by ~$750 million on average, and up to ~$1 billion!
  - Are these benefits worth the (social) cost of increase in settlement delay?

Caveats of (Simulation) Analysis (1 of 2)

- Need for statistical robustness (BMY 2005)
  - Single 3-month sample used to generate results
  - Estimated impact represents R-V that changes with sample used → can use real, artificial data to create empirical distribution of this impact

Plotting Distribution of Settlement Delay Outcomes



Caveats of (Simulation) Analysis (2 of 2)

- Participant behaviour treated as exogenous throughout analysis
  - New theoretical, empirical models capturing underlying factors in participants' payment submission behaviour needed
  - Forthcoming developments in BoF-PSSII needed for quantitative assessment of competing effects

- Estimated tradeoff as a 'lower bound'
  - Increased intraday volatility in payment flows may be causing violation of BCLs
  - Simulator output not yet capable of capturing this additional delay → Estimated tradeoff may represent a 'lower bound'