Liquidity risk in Securities Settlement

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Motivation

- Contagion in SSSs possible (E.g. Sept 11)

- Existing studies of contagion limited
  - Payment systems, not SSSs
  - Actual stress tests in SSSs

- SSSs are different from payment systems
  - Securities leg $\Rightarrow$ -liquidity provision is not enough
  - Settlement lag $\Rightarrow$ -need to form expectations about holdings
    - disruption lasts more than one day
What we do

- Develop a methodology ...
  - Multiple-period model, multiple securities

- to assess the impact of a "stress event" ...
  - Default of the largest participant

- on liquidity risk...

- from a system wide perspective.
  - Look at settlement efficiency and trade volume
Liquidity risk and settlement efficiency

- Liquidity risk
  - "the risk that a counterparty will not settle an obligation for full value when due, but some unspecified date thereafter" (BIS, 1992).

- Settlement efficiency as a proxy for liquidity risk
  - Ratio of trades settled over total trades (in values)

- Also, fall in volume of trades after disruption
Questions addressed

- What are the dynamic effects (direct and contagion) on settlement of a major disruption?

- How does first-day impact compare with impact in subsequent days?

- How many days does it take before settlement efficiency returns to its "normal" level?

- How important is liquidity provision for avoiding problems?
Outline

- Existing literature
- Stylised example
- Model description
- Simulation results
- Conclusions
Existing literature

- Interbank market

- Payment systems
  - Net vs. gross settlement: Kahn, Mcandrews and Roberds (1999), Leinonen and Soramaki (1999)

  Intraday liquidity solves all problems

- Securities settlement
Example: Why are settlement failures possible?

- DVP
- No L&B

\[
\begin{align*}
W & \rightarrow X \\
(10,0) & \rightarrow (3,7) \\
\text{(Security, Cash)} & \rightarrow (10,0)
\end{align*}
\]
Why are settlement failures possible?

- Securities leg
- Settlement lag

Direct effect

Contagion
Model

- N participants; K securities; Gross settlement; Two-day settlement lag
- Quantity and price of each security normalised to 1.
- Initial allocations of securities: two possible schemes
  - "Diversified": Each participant receives 1/N of each security
  - "Concentrated": Entire qty of each security allocated randomly to a participant
- For each scheme: Cash = 5% of total assets
Model: Timing of events on day $t$

- **t-1**
  - Actual holdings observed
  - Expectations formed about holdings for day $t$
  - Expectations from t-2 and t-1 trading
  - Of settled trades from day t-3

- **(i)**
  - Trading (based on exp holdings for $t$)

- **(ii)**

- **(iii)**
  - Settlement
  - Of trades from day t-2.

- **t+1**
"Normal periods" (before default): Participants assume that all previous trades will settle

- No settlement failures occur

"Crisis periods" (after default): Participants reduce expected holdings for day $t$ by $\gamma$ % of failures from settlement on day $t-1$

- Expected holdings ↓ as previous settlement failures ↑
- $0 \leq \gamma$; $\gamma = 0 \Rightarrow$ no adjustment of expected holdings
- $\gamma$ may be $> 1$
Expectations – Trading – Settlement

- Random choice of two counterparties and a security
- Use expected holdings of cash and securities to determine set of feasible trades
- Random draw of a trade from feasible set
- Update expected holdings after each trade
Expectations – Trading – Settlement

- Two-day lag: day $t-2$ trades settled at end of day $t$

- Uses actual asset holdings after day $t-3$ trades
  - Determined by settlement at end of day $t-1$

- Unsettled trades put in a queue

- Credit available during settlement
  - credit line = % initial value of total assets
  - different credit limits in different scenarios
Initial Shock

- Largest participant fails at end of day D
  - CPSS recommendation
  - Practice in real stress tests
- Unsettled trades with defaulter deleted
- Anticipated by other participants during day D
  - Do not trade on day D with defaulting participant
- Participants adjust expected asset holdings
  1. Delete unsettled trades with defaulter (direct effect)
  2. Reduce expected holdings for indirect effects
Settlement efficiency

- **Total settlement efficiency**
  
  \[
  \frac{\text{Value of settled trades}}{\text{Value of total trades}}
  \]

- **Indirect settlement efficiency**
  
  \[
  \frac{\text{Value of settled trades}}{\text{Value of trades excluding defaulter}}
  \]
Simulation results: First day impact

### Settlement efficiency on day D

<table>
<thead>
<tr>
<th>Credit limit (% assets)</th>
<th>Initial allocation</th>
<th>Total settlement efficiency</th>
<th>Indirect settlement efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>concentrated</td>
<td>57.84</td>
<td>75.69</td>
</tr>
<tr>
<td></td>
<td>diversified</td>
<td>70.2</td>
<td>80.95</td>
</tr>
<tr>
<td>50%</td>
<td>concentrated</td>
<td>72.27</td>
<td>94.89</td>
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<tr>
<td></td>
<td>diversified</td>
<td>83.95</td>
<td>96.99</td>
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<tr>
<td>100%</td>
<td>concentrated</td>
<td>72.19</td>
<td>94.926</td>
</tr>
<tr>
<td></td>
<td>diversified</td>
<td>83.99</td>
<td>96.97</td>
</tr>
</tbody>
</table>

Results reported for K=30, N=15
Trade position of defaulter

indirect settlement efficiency
(no credit)

Net sell  Net buy

net trade position defaulter
Trade position of defaulter

indirect settlement efficiency
(no credit)

indirect settlement efficiency
(credit limit=1)
Length of a crisis

- Multiple day crisis
- Largest impact on D+1
- Continuing contagion

- no credit
- no adjustment
Length of a crisis

- high credit
- no adjustment
- no credit
- no adjustment

- Liquidity important
- ... but does not eliminate settlement failures

Liquidity important
Length of a crisis

- Liquidity and expectations: partial substitutes

Liquidity and expectations:
- partial substitutes
- no credit
- no adjustment
- high credit
- no adjustment
Credit use

- Peak usage on D+1
- > 50% assets
- Well above 10% assets for longer period
Trading volume

- Adjustment of trades = turnover ↓

- Credit use (% of securities outstanding)

- Relative turnover

- Turnover relative to pre-default average
Conclusions

- Even with DVP, large settlement failures possible
- Disruptions last longer than a day
  - Crisis worsens before improving
  - Disruption may last longer than the length of the settlement lag
  - Policy makers should not focus only on first-day impact
- Liquidity provision can lower settlement failures
  - *But*, providing enough liquidity may be costly
  - Liquidity cannot eliminate settlement failures
- Liquidity and participants' reduction of trades partial substitutes
  - *But*, reduction of trade volume may cause market liquidity to ↓
Conclusions

- Other options for lowering settlement failures
  - Shortening settlement lag
  - Securities borrowing and lending program

- Improving existing stress tests
  - Multiple days
  - Dynamic (included reactions of participants)
  - System wide perspective
  - Settlement efficiency + turnover