Systemic Dynamics in the Federal Funds Market

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Preliminary results from work in progress

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Disclaimer: The opinions presented are those of the authors and not of the Federal Reserve Bank of New or the Federal Reserve System.

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Perspective

- Like any over-the-counter market, the Federal Funds market is subject to allocation frictions.
- Trading is normally conducted through isolated bilateral negotiation.
- Precautionary intra-day control of balances by a given bank is dynamically stabilizing for that bank’s balances, when taking the remainder of the market as given.
- We raise, but do not yet resolve, whether precautionary behavior can be systemically destabilizing in some extreme settings.
Connections with Search-Based Market Theory

• So far, the available theories of trading dynamics in over-the-counter markets are based on search.

• Any trader contacts any other trader randomly over time, with an intensity that may depend on incentives to trade.

• At contact, counterparties negotiate bilaterally, each having the option to search for another counterparty.

• The negotiated price reflects the difficulty with which alternative suitable counterparties can be contacted.

• As search intensities get large, one obtains the effect of efficient-allocation centralized market.
Figure 1: Liquidity shock at time 0.4. Low search intensity $\lambda = 125$; high search intensity $\lambda = 625$. Source: Duffie, Gărleanu, and Pedersen (2005).
Figure 2: Catastrophe risk: premiums and global volume of claims.
Source: Swiss Re
Figure 3: Capital immobility in the Telecom debt market Source: Newman-Rierson (2003).
Figure 4: Cumulative returns for dropped S&P500 stocks.
Figure 5: An over-the-counter market is completely connected, but not transparent. Search and negotiation are crucial.
Figure 6: If search costs are the only market friction, the most efficient market structure is hub-and-spoke, for example an electronic limit-order book, or a single broker.
Figure 7: Because of size differences, the “effective” market structure of over-the-counter markets is a hybrid. See Soromäki, Bech, Arnold, Glass, and Beyeler (2006).
Figure 8: The cross-sectional distribution of fed-funds senders by total volume in December 2005 is more skewed than log-normal.
Figure 9: Stylized “fuzzy” hub-and-spoke market structure.
Figure 10: Sectioning along "size rays."
Figure 11: Trading concentration across two size rays.

<table>
<thead>
<tr>
<th>Sender</th>
<th>Receiver</th>
<th>Median number of receivers</th>
<th>Median monthly volume ($ millions)</th>
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</thead>
<tbody>
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<td>14.4</td>
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<tr>
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<td>Big</td>
<td>7.0</td>
<td>1,487,043</td>
</tr>
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</table>

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Figure 13: How can A, B, and C all send 100 with no initial inventory? One cannot ignore the dynamics.
Figure 14: These trades can be implemented in one round, starting with the circled inventories.
Figure 15: The same trades can also be implemented in many trades from much smaller inventories.
Figure 16: After the first of many trades.
Figure 17: After the second of many trades.
Figure 18: After the third of 300 trades.
Figure 19: Breakdown of largest-by-volume 100 master account types, by number of accounts.
Figure 20: Targeting balances during the crucial 30 minute period: 17:30 to 18:00.
Figure 21: Distribution across lenders of volume of loans, within top 100 accounts.
Over 225 million observations in 2005, top 100 master accounts.

Logit estimator of the probability that $i$ sends (or lends) to $j$ in minute $t$:

$$p_{ij}(t) = L \left( V_i, V_j, \frac{B_i(t)}{V_i}, \frac{B_j(t)}{V_j}, \sigma(t), 1\{t \in [17:30, 18:30]\} \right),$$

where

- $V_i$ is log of monthly volume of bank $i$ during 17:00 to 18:30.
- $B_i(t)$ is the balance of bank $i$ at the beginning of minute $t$ minus median-over-days balance of $i$ at $t$.
- $\sigma(t)$ is the trailing 30-minute historical volatility of the fed funds rate (dollar-weighted across all included transactions).
Preliminary Results

• Transactions show precautionary targeting of balances.

• Loans are far more sensitive to balances than are other transactions.

• Balance targeting is more active when rate volatility is higher.

• Doubling the size of bank $i$ increases the likelihood of a send to bank $j$ by over 50%.

• The 17:30 to 18:00 period is critical.
Special Effects

- On 9-11, drop in dependence on largest banks (BONY?).
- Quarter end: increased sensitivity to balances.
- Notorious 15th-day-of-month effect (due to corporate taxes and GSE interest payments) is not obvious in the data.
- Maintenance effects not apparent. End-of-day balance targeting behavior does not vary markedly within the two-week settlement cycle. From interviews: This may reflect the impact of “sweeps.”
Gridlock?

- Precautionary gridlock: With a low balance, bank $i$ waits for a send from $j$ before processing a send to $k$. Supply shocks could mean that $j$ is meanwhile waiting for a send from $m$, who is waiting for a send from $n$, who is …

- According to interviews: A systemic gridlock was a significant risk on 9/11, when BONY was incapacitated. A concerted effort to provide liquidity by the Federal Reserve and top banks averted an even greater protential problem. See Lacker (2003), McAndrews and Potter (2002).
Figure 22: Probability of lend is more sensitive to balances in the last hour.
Figure 23: Probability of borrow is more sensitive to balances in the last hour.
Figure 24: Loans are 81 times more sensitive to balances than are non-loan sends.
Figure 25: Trailing 30-minute fed funds rate volatility, across 251 business days.
Figure 26: Lend sensitivity to balances increases with volatility.
Figure 27: Borrow sensitivity to balances increases with volatility.
Figure 28: Bank size effect, holding counterparty at mean size.
Figure 29: Bank size effect, increasing both counterparties at the same scale.
• What does it take to cause a gridlock?

• An analysis of the equilibrium transmission of rate shocks through the market.