

# Systemic Dynamics in the Federal Funds Market

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## Federal Funds

- Banks are monitored for minimum balances, averaged over two week periods.
- Banks do not receive interest for overnight balances.
- Federal funds is a common interbank medium for settlement, for example of securities and currency trades.
- Intra-day overdrafts are limited and penalized.
- Over-the-counter trading is bilaterally negotiated, largely by telephone.

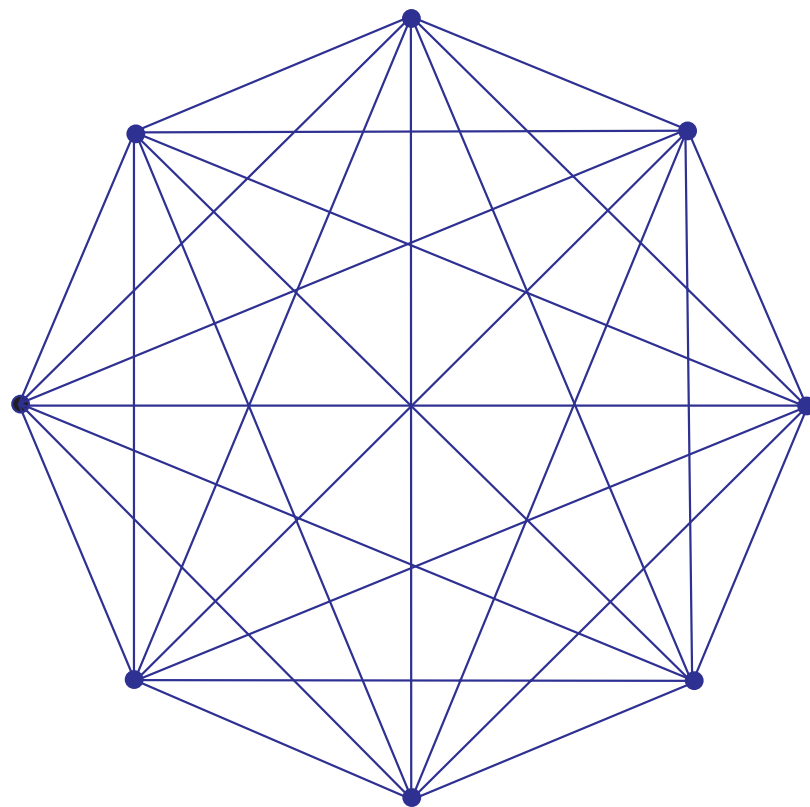


Figure 1: An over-the-counter market is completely connected, but not transparent. Search and negotiation are crucial.

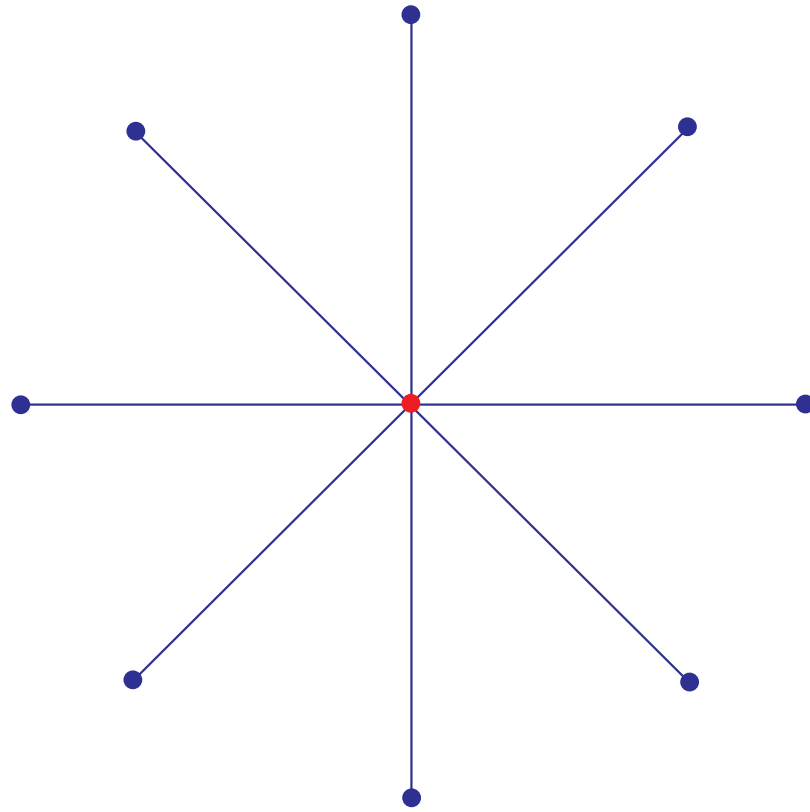


Figure 2: If search costs are the only market friction, the most efficient market structure is hub-and-spoke, for example an electronic limit-order book, or a single broker.

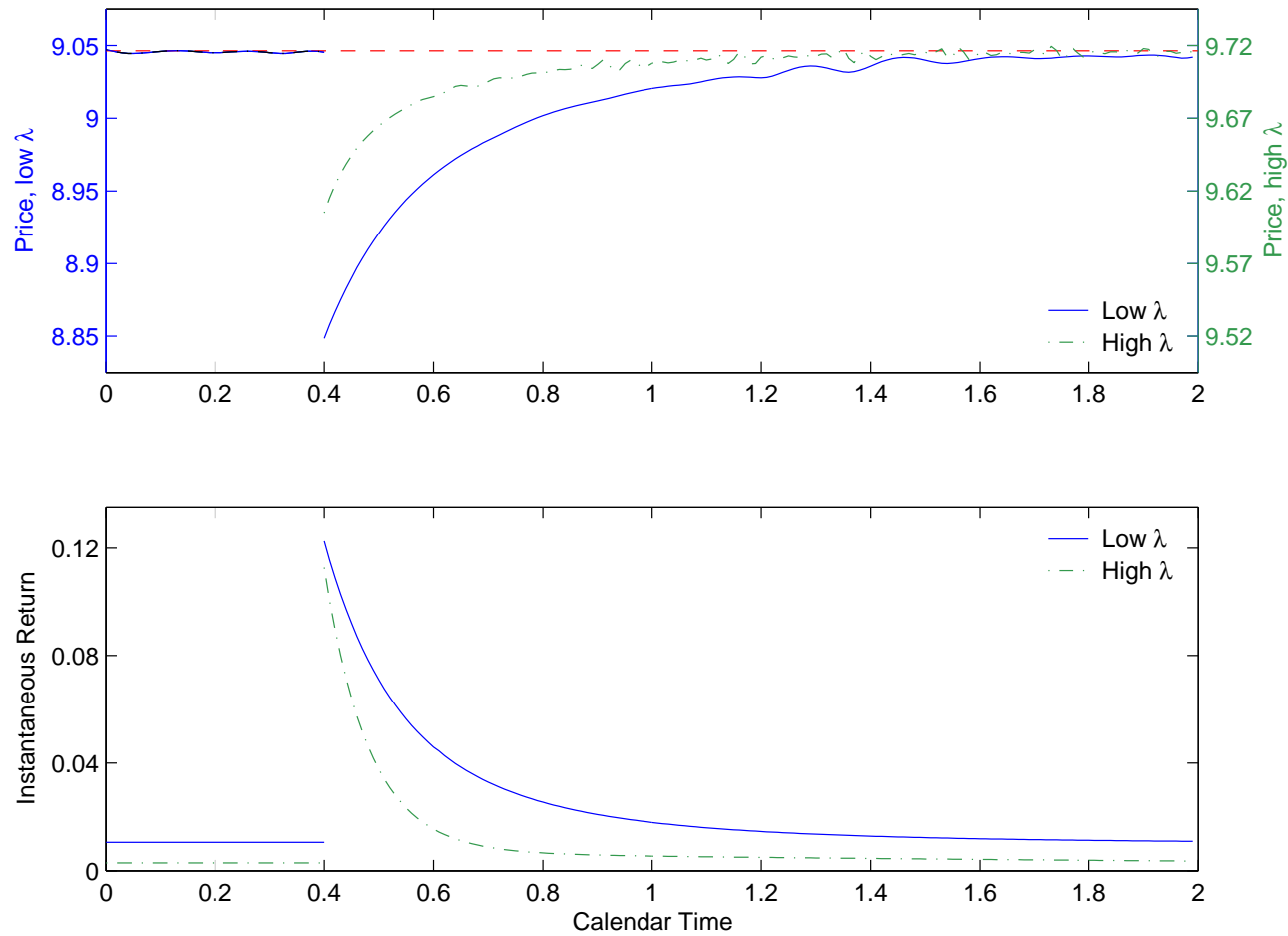


Figure 3: Liquidity shock at time 0.4. Low search intensity  $\lambda = 125$ ; high search intensity  $\lambda = 625$ . Source: Duffie, Gârleanu, and Pedersen (2005).

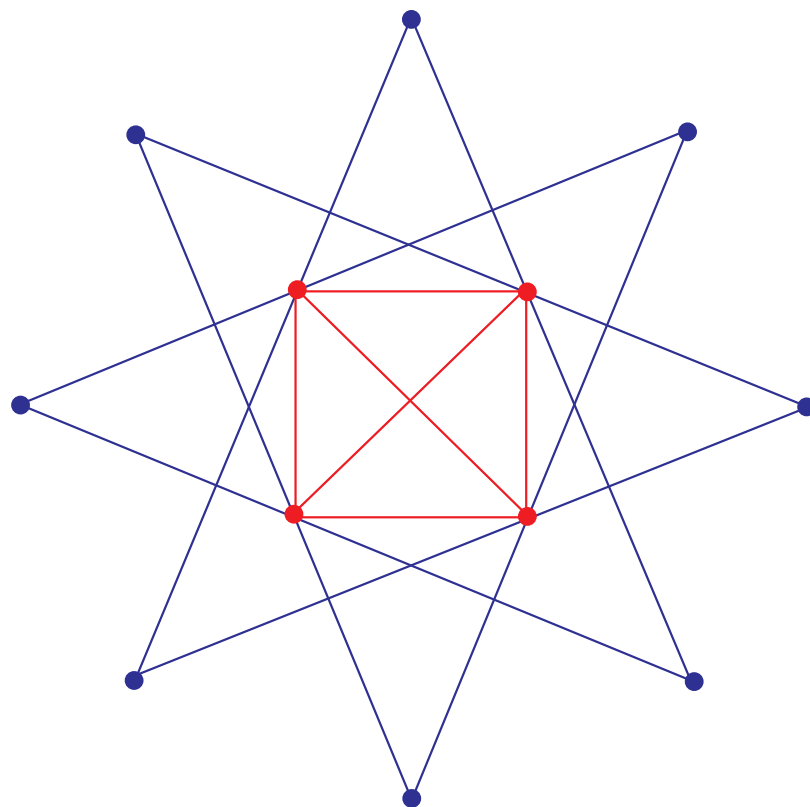


Figure 4: Because of size differences, the “effective” market structure of over-the-counter markets is a hybrid.

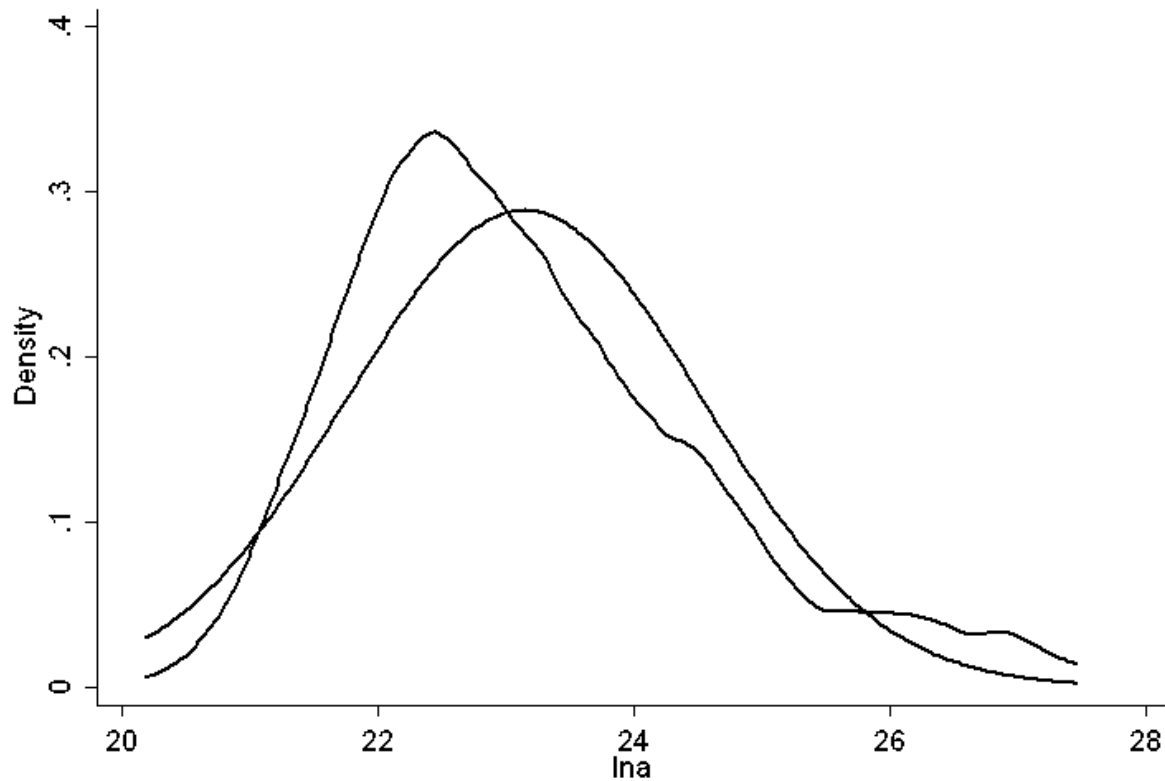


Figure 5: The cross-sectional distribution of fed-funds senders by total volume in December 2005 is more skewed than log-normal.

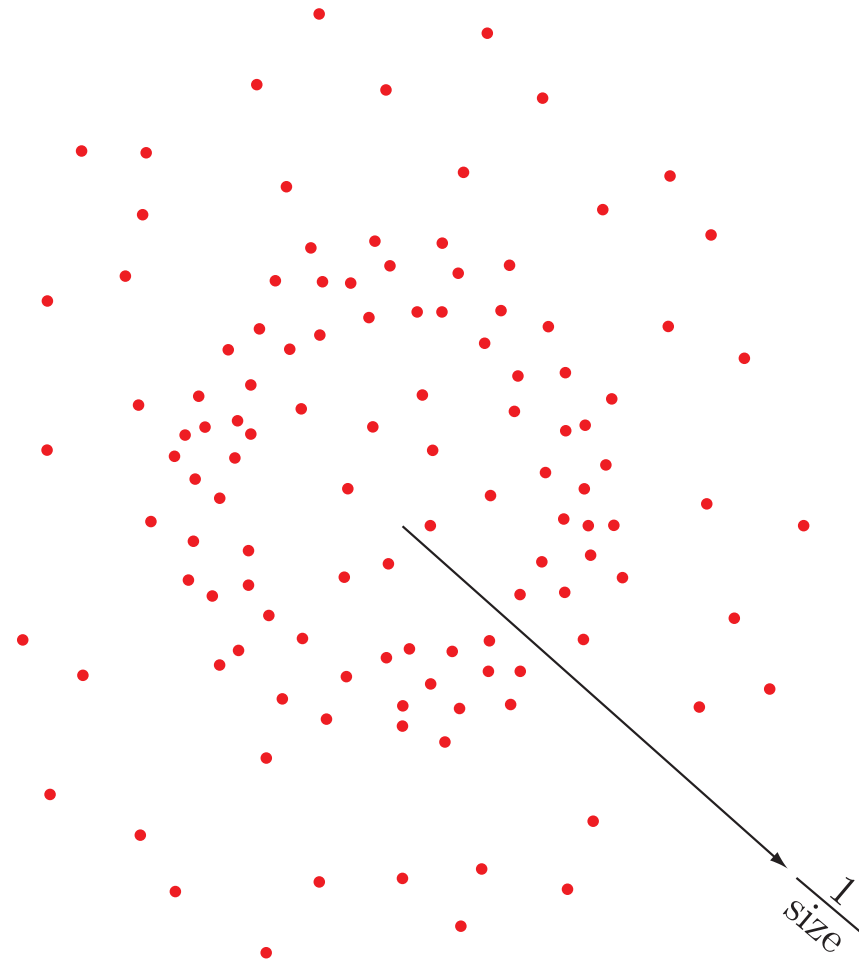


Figure 6: Stylized “fuzzy” hub-and-spoke market structure.

Table 1: Average Behavior of Sends in the Fed Funds Market during December 2005. “Big” means top-ten by volume.

Sender	Receiver	Median number of receivers	Median monthly volume (\$ millions)
Small	Big	3.1	14.4
Small	Small	1.4	2.4
Big	Small	2006.4	645,796
Big	Big	7.0	1,487,043

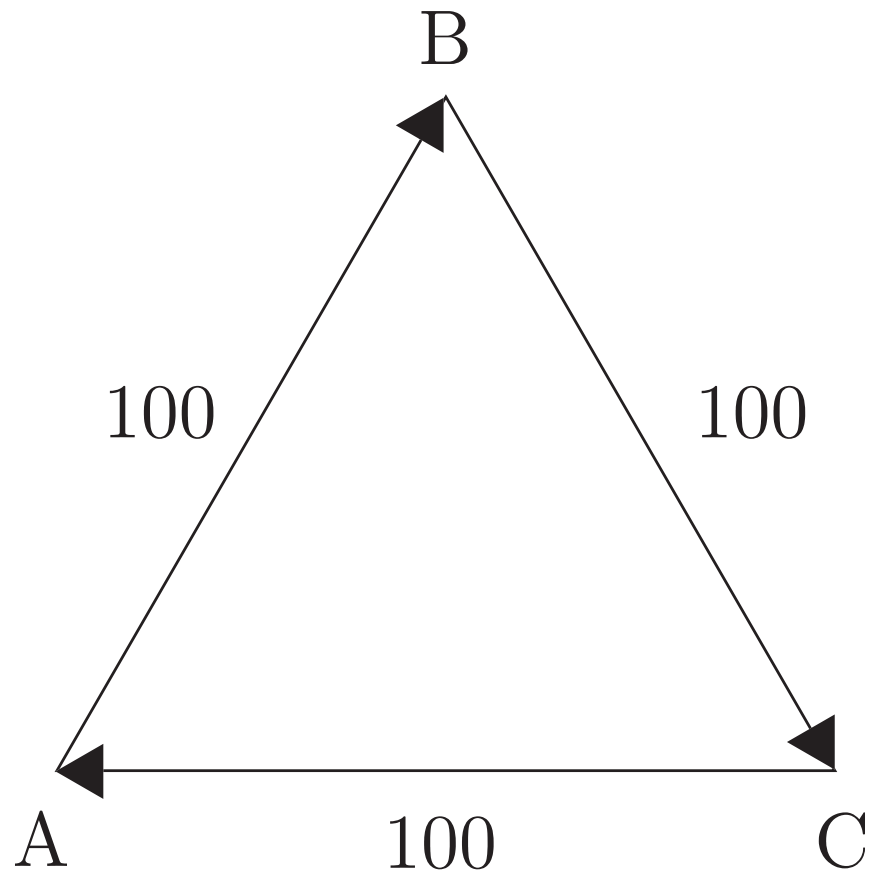


Figure 10: How can A, B, and C all send 100 with no initial inventory? One cannot ignore the dynamics.

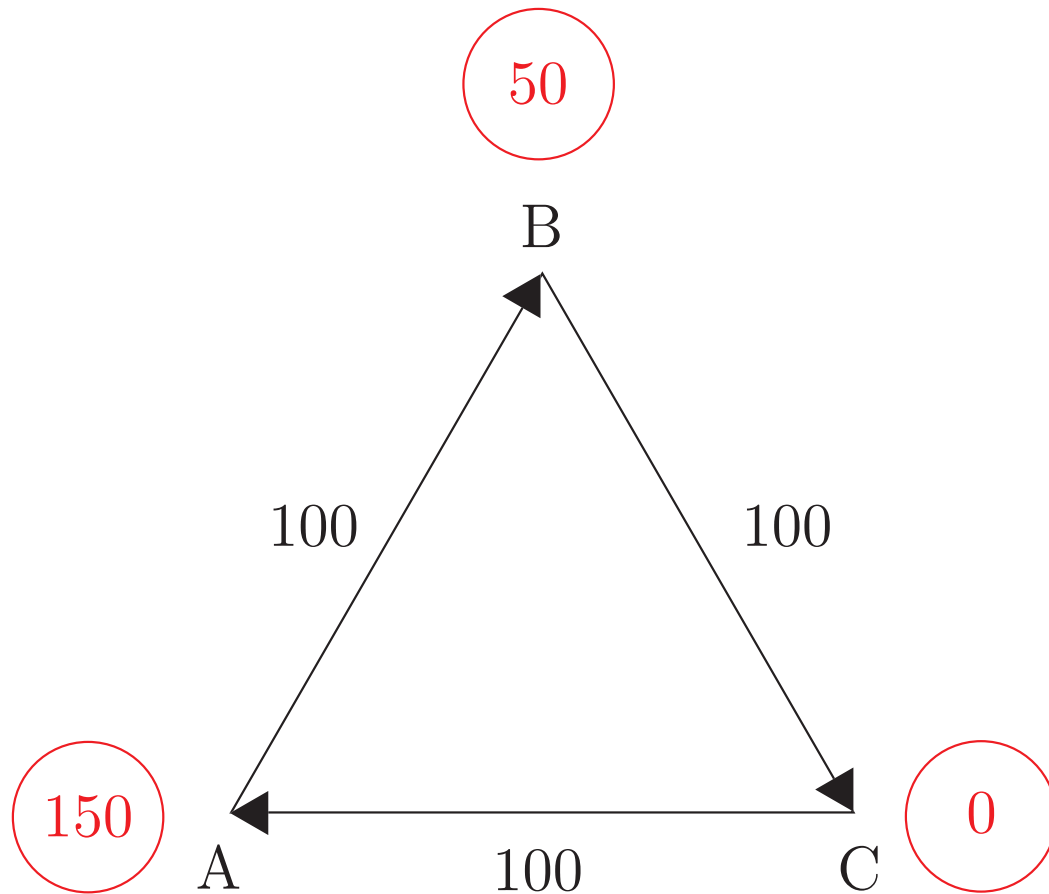


Figure 11: These trades can be implemented in one round, starting with the circled inventories.

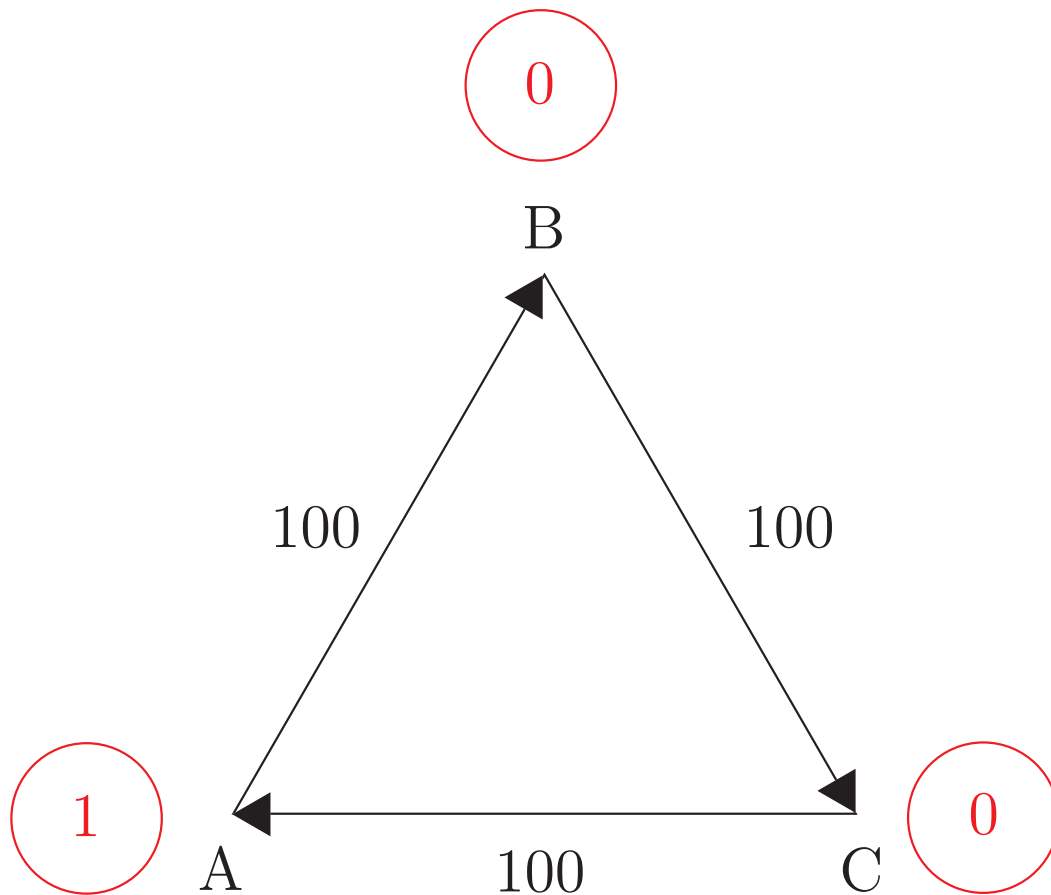


Figure 12: The same trades can also be implemented in many trades from much smaller inventories.

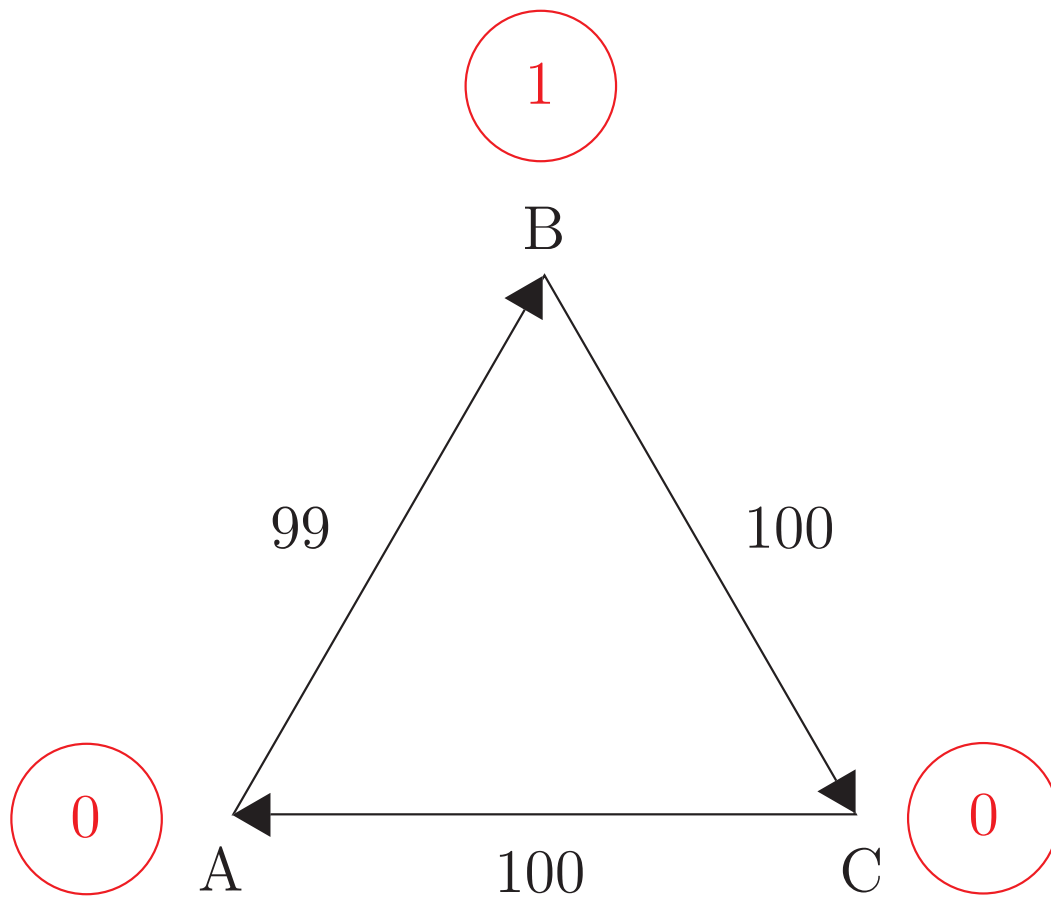


Figure 13: After the first of many trades.

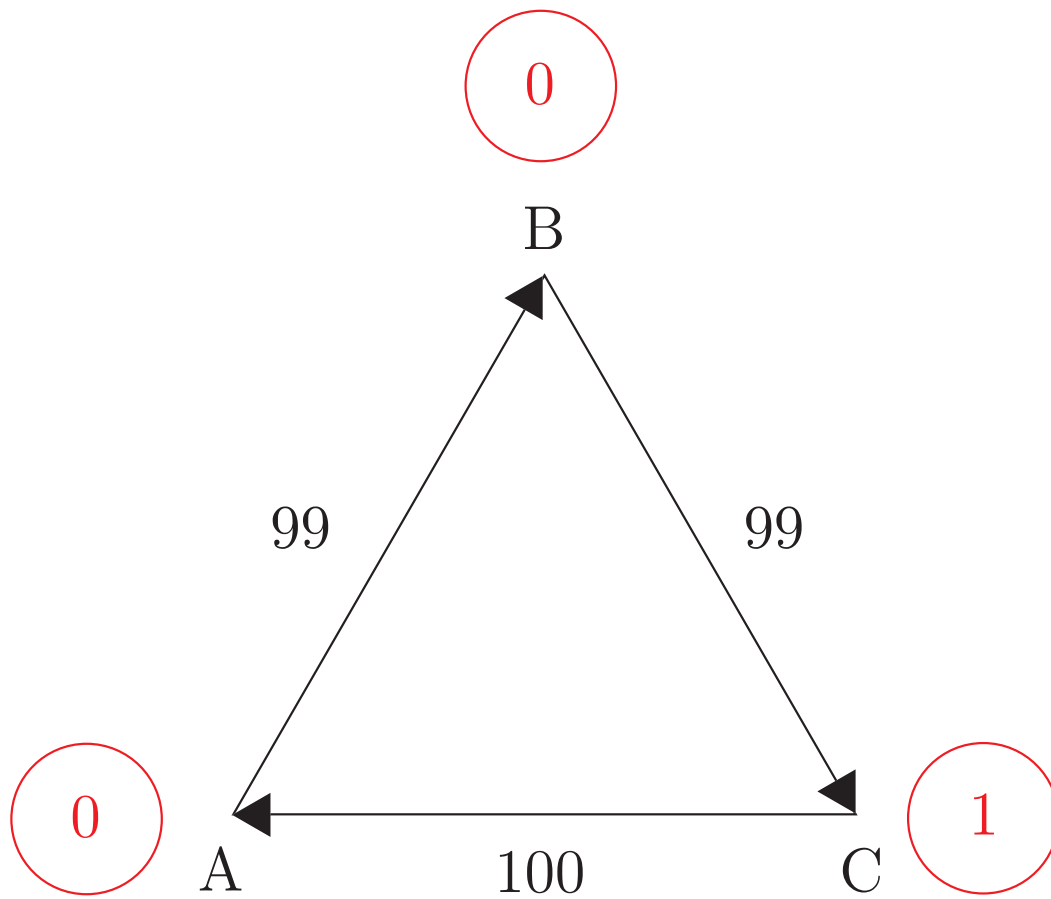


Figure 14: After the second of many trades.

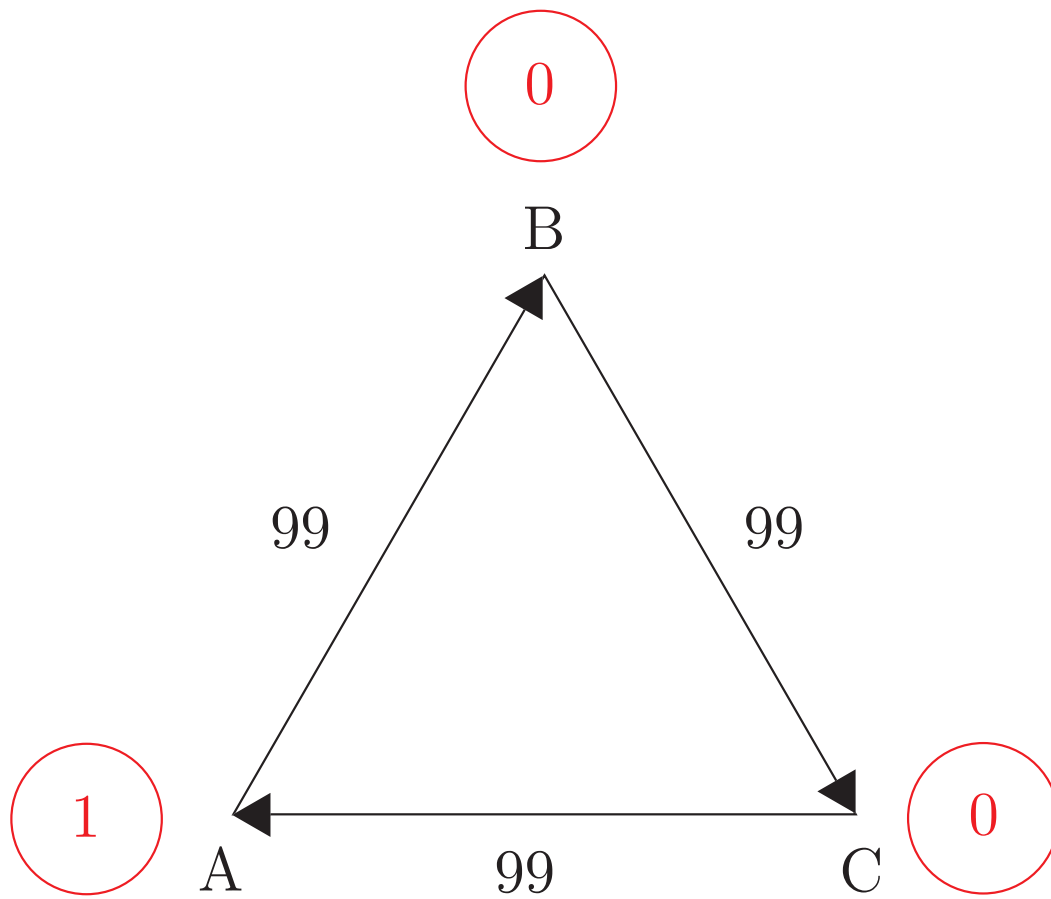


Figure 15: After the third of 300 trades.

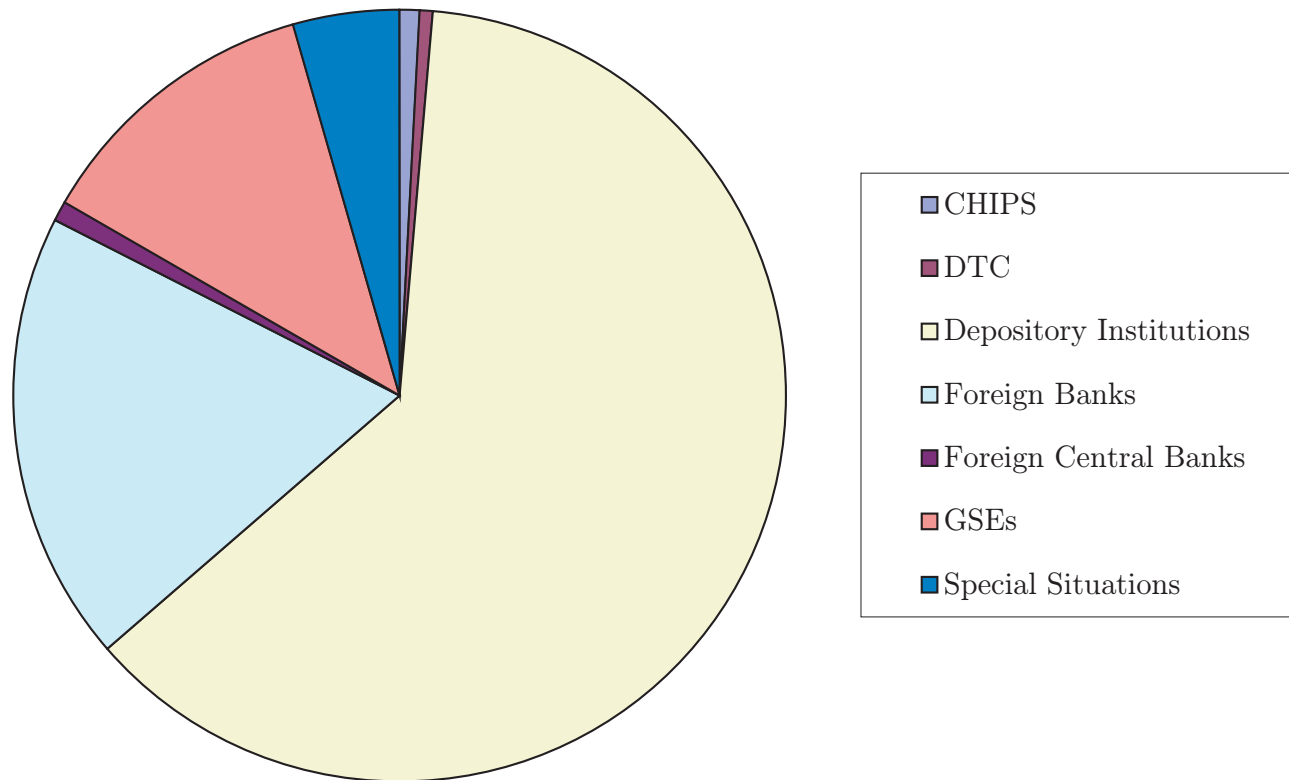


Figure 16: Breakdown of largest-by-volume 100 master account types, by number of accounts.

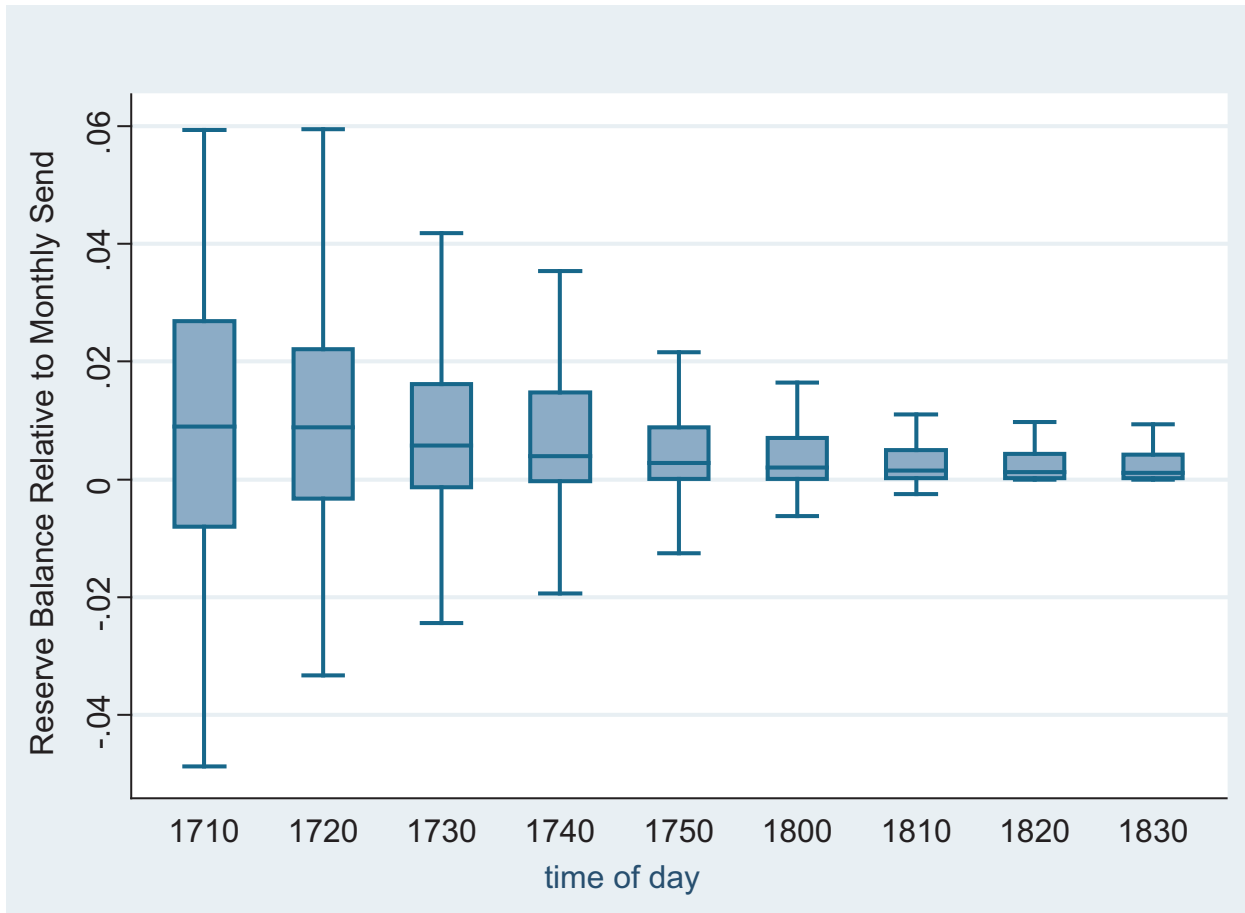


Figure 17: Targeting balances during the crucial 30 minute period: 17:30 to 18:00.

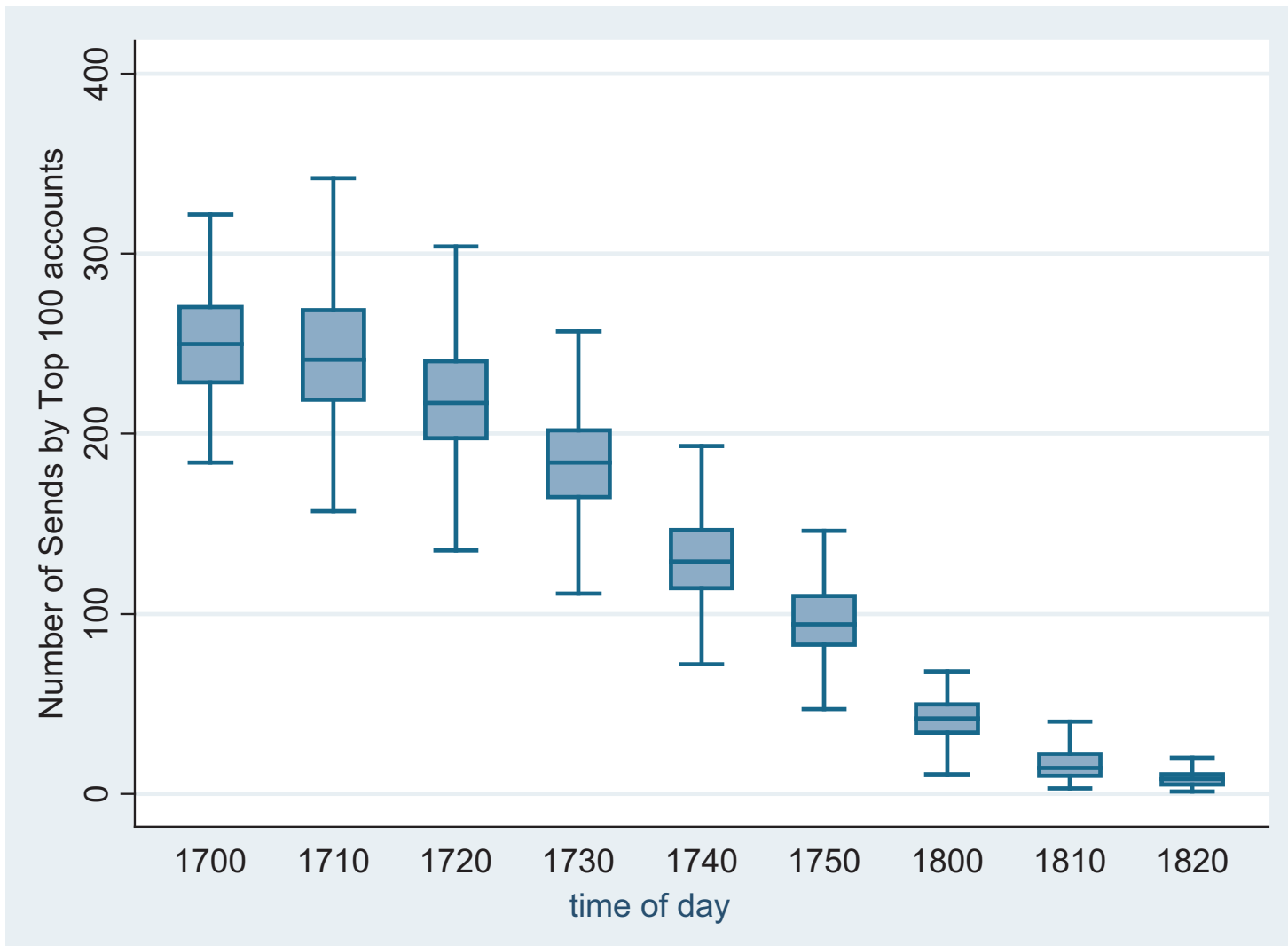




Figure 18: Distribution across lenders of volume of loans, within top 100 accounts.

## Probabilistic model of transactions

- Over 225 million observations in 2005, top 100 master accounts.
- Logit estimator of the probability that  $i$  sends (or lends) to  $j$  in minute  $t$ :

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

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  $t$ .
- $R_{ij}$  is lagged-month  $(i, j)$  trades as a fraction of all trades to  $j$ , plus lagged-month  $(i, j)$  trades as a fraction of all trades from  $i$ .
- $\sigma(t)$  is the trailing 30-minute rate volatility.

## Basic 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%.
- Controlling for prior relationship, size of a counterparty is more predictive of a loan than of a non-loan transaction.
- The 17:30 to 18:30 period is the most critical for balance targeting.

## Special Effects

- September 2001: lower sensitivity to balances after 9-11.
- 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 potential problem. See Lacker (2003), McAndrews and Potter (2002).

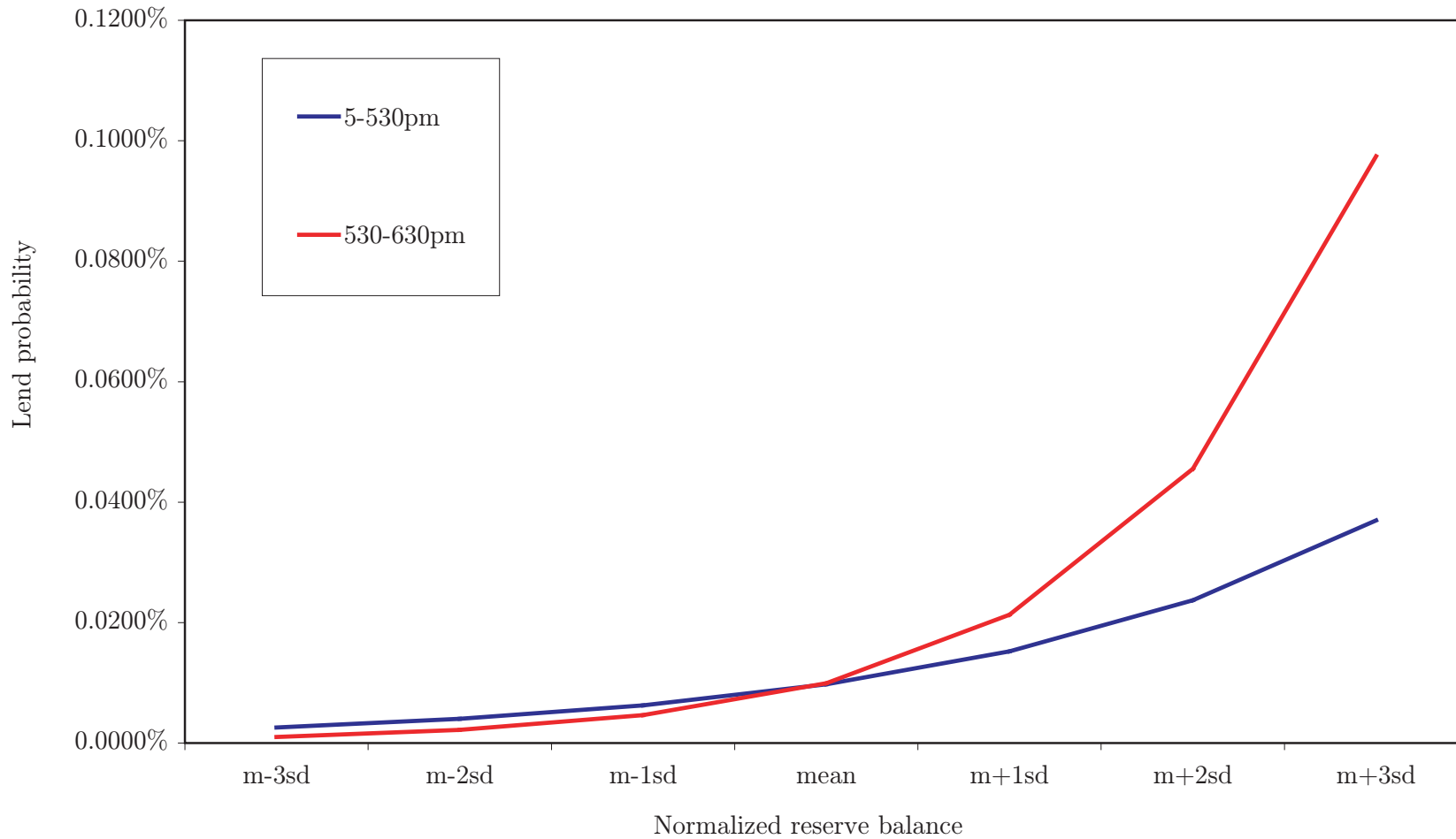


Figure 19: Probability of lend is more sensitive to balances in the last hour.

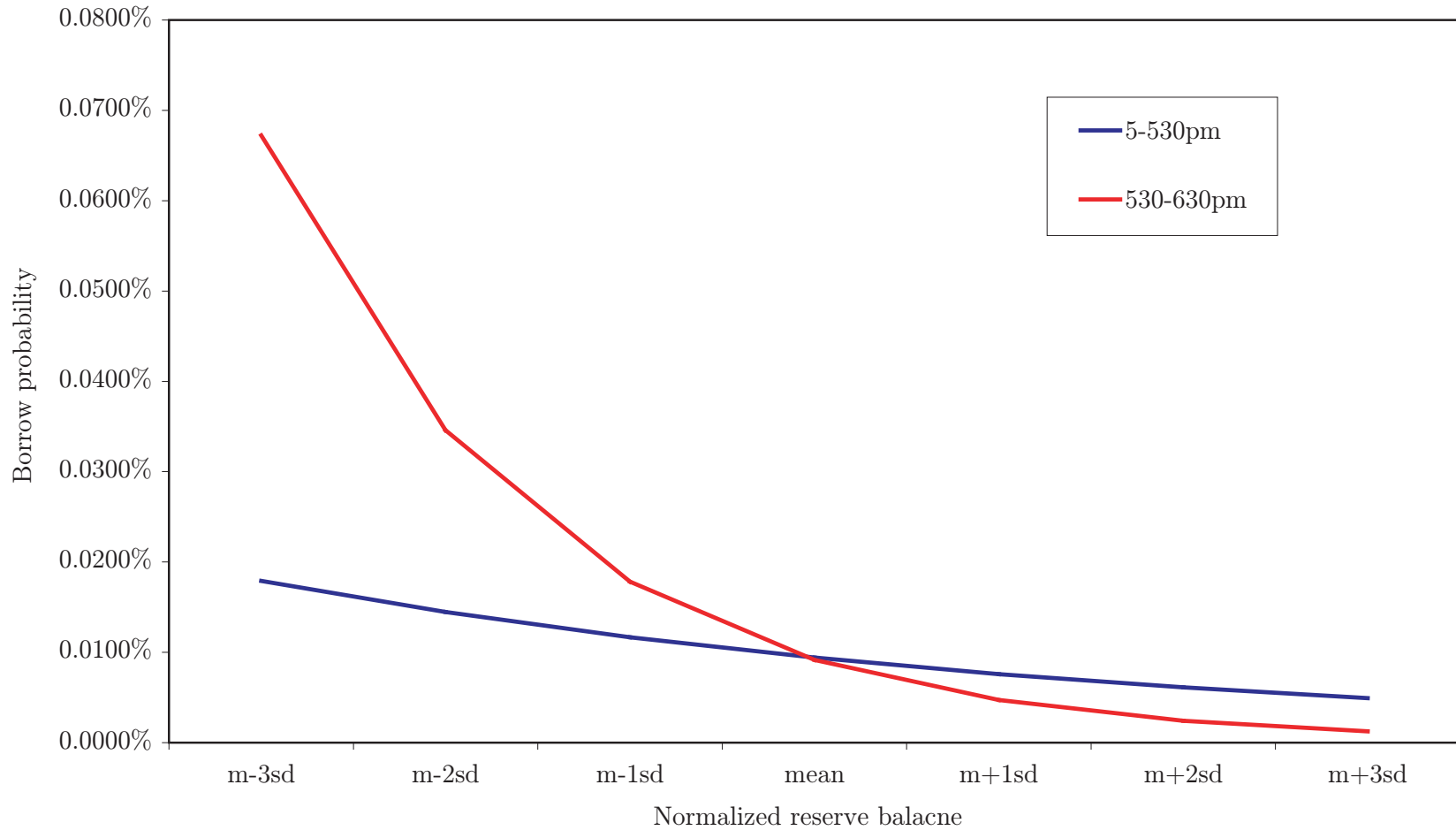


Figure 20: Probability of borrow is more sensitive to balances in the last hour.

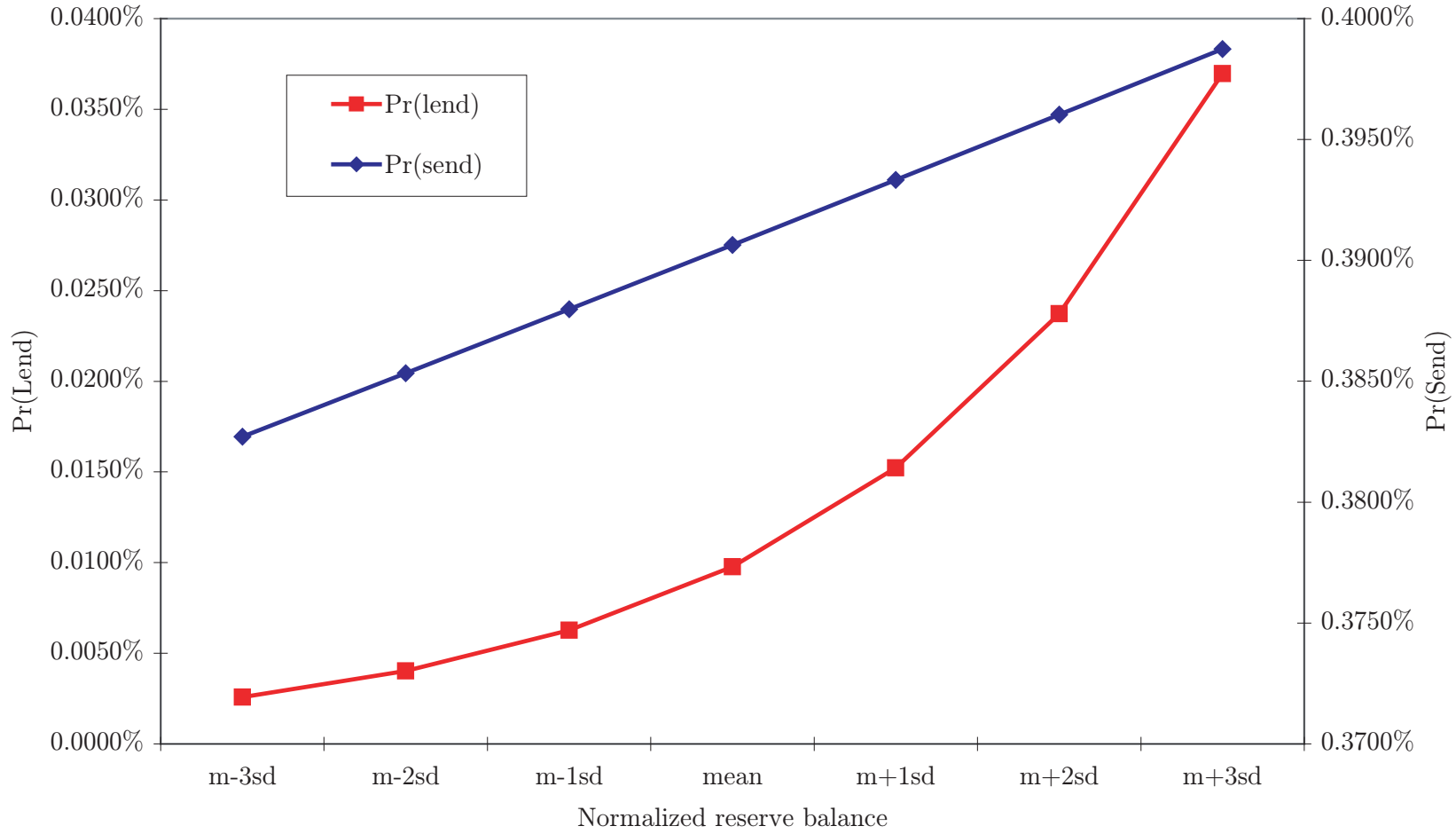


Figure 21: Loans are 81 times more sensitive to balances than are non-loan sends.

Table 2: The interest rate negotiated depends on the excess balances of the borrower and the lender banks. Here is the mean negotiated rate less the average rate in the market at this minute, for banks with low (10%-ile) and high (90%-ile) excess balances.

	Low Borrower	High Borrower
Low-Balance Lender	1.8 basis points	0.2 basis points
High-Balance Lender	1.1 basis points	−2.6 basis points

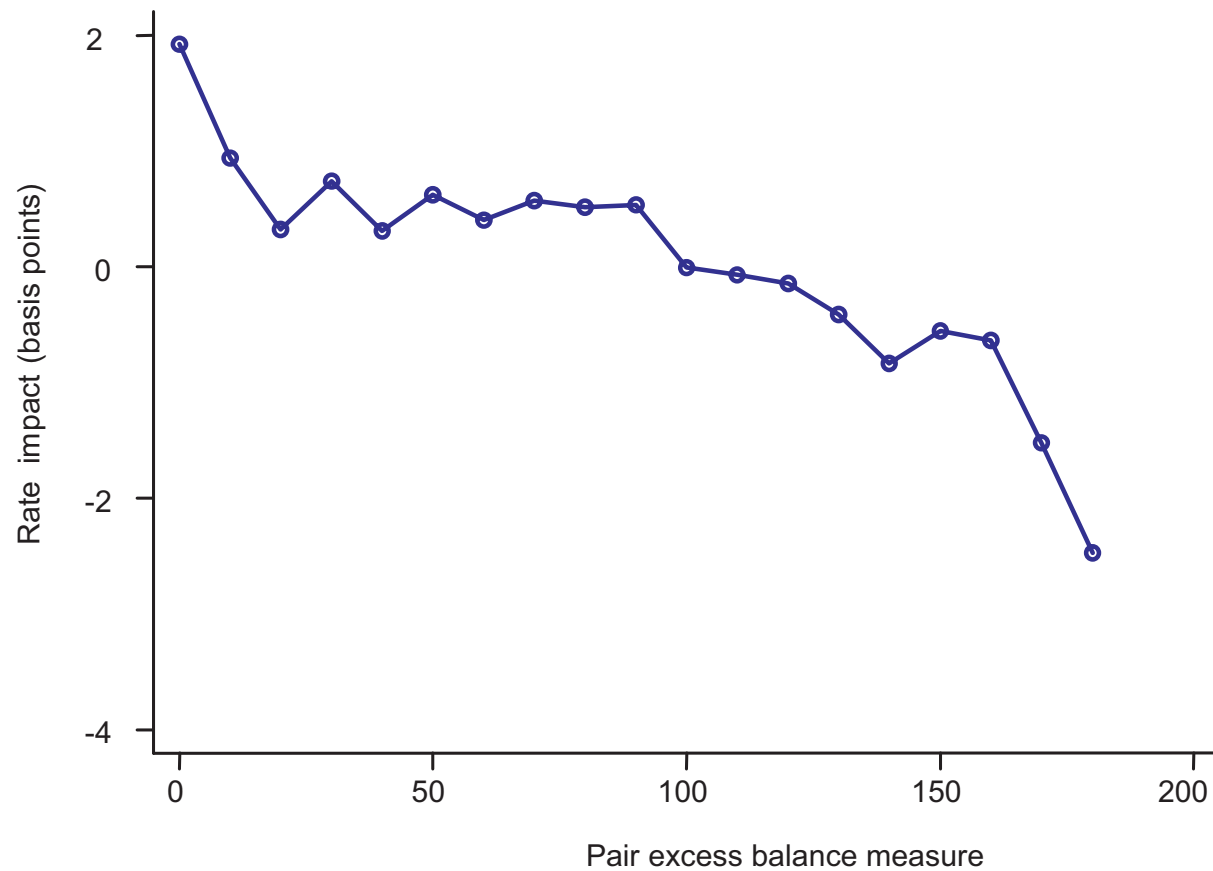


Figure 22: The rate negotiated, relative to the mean market rate at that minute, depending on the sum of the excess-balances percentiles of the borrower and the lender banks.

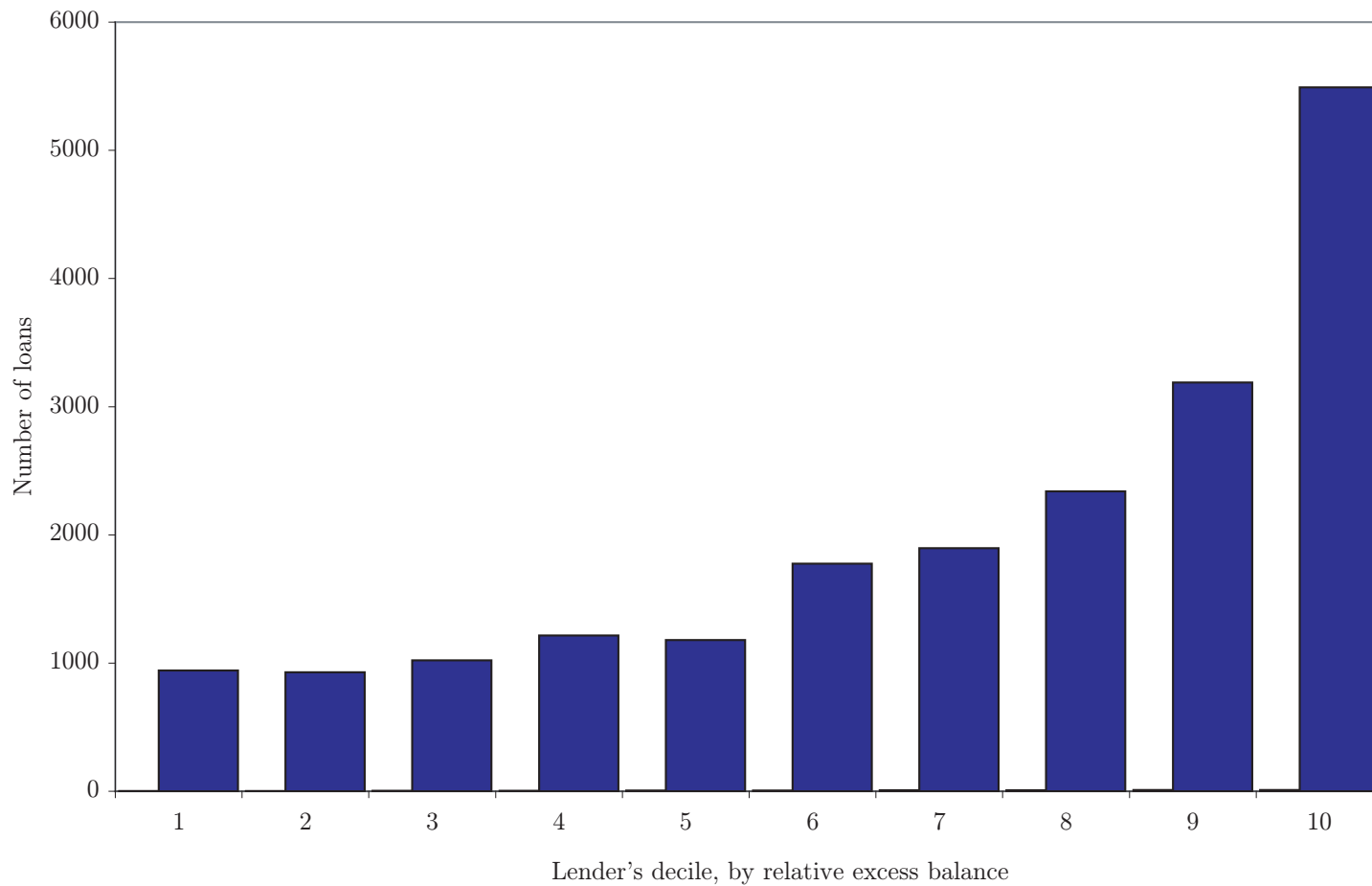


Figure 23: For loans to borrowers most in need of federal funds (the lowest decile by relative excess balances), the number of loans made by each decile of lenders, sorted by the lender's relative excess balances.



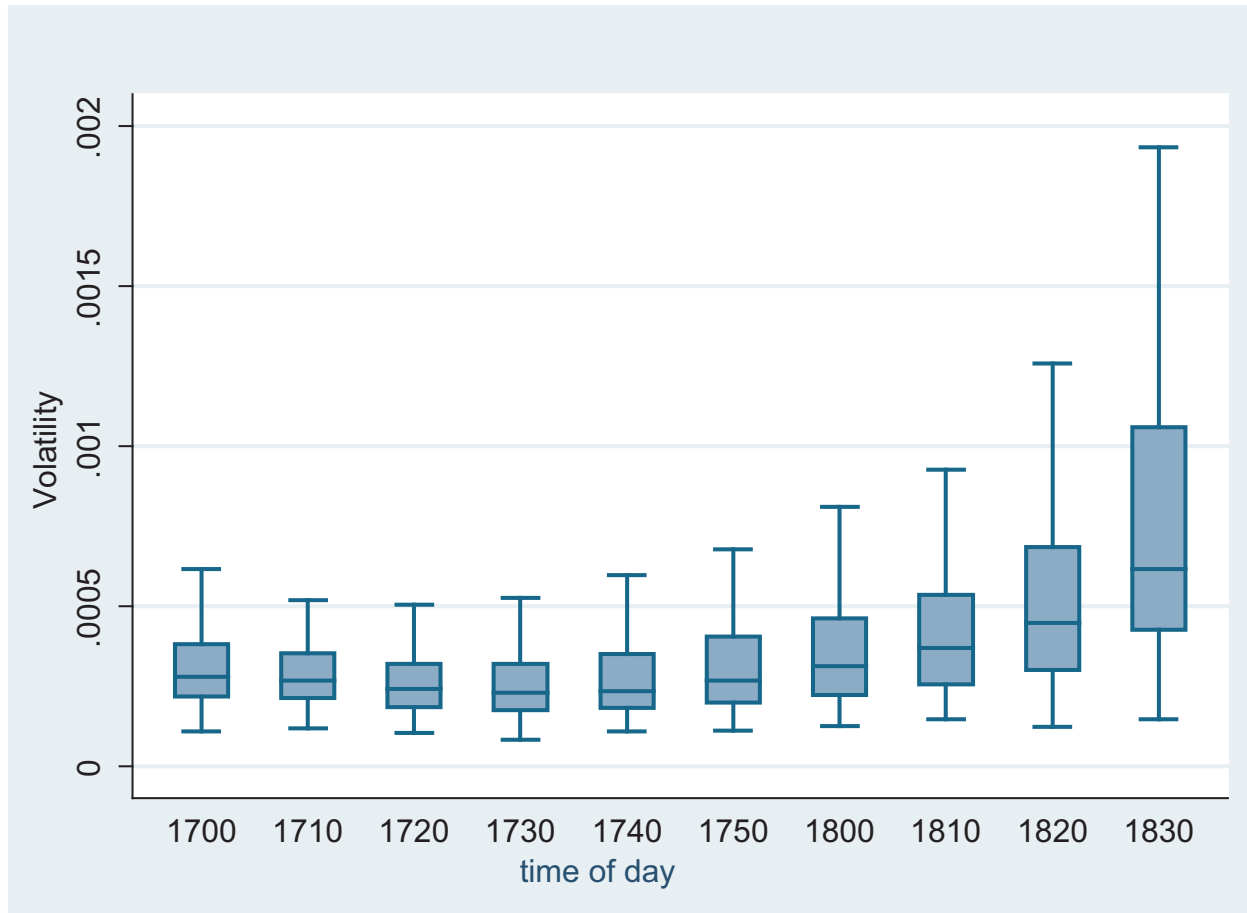


Figure 24: Trailing 30-minute fed funds rate volatility, across 251 business days.

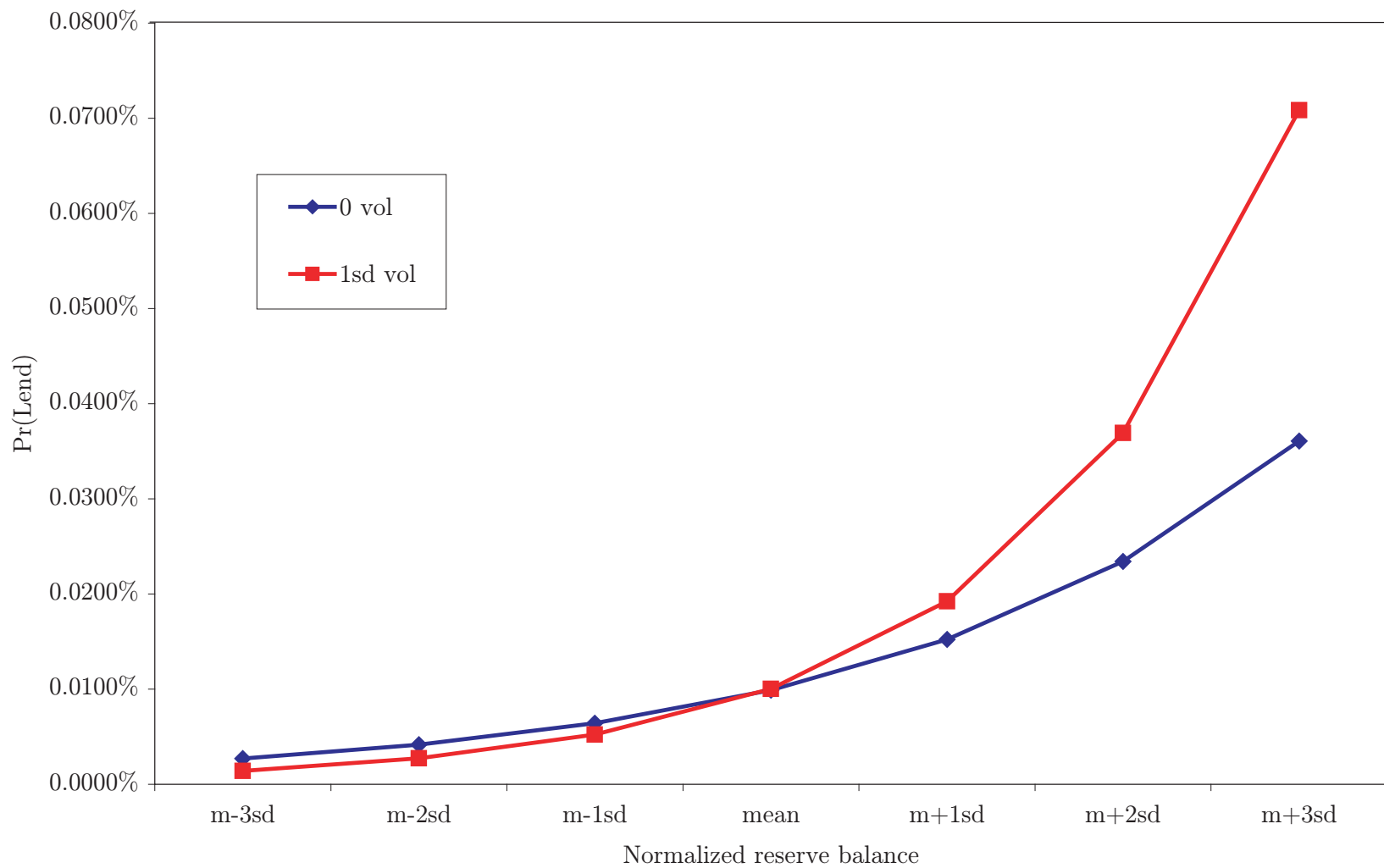


Figure 25: Lend sensitivity to balances increases with volatility.