Relationships in the Interbank Market

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The views expressed in this paper are not necessarily the views of the Bank of Canada, the European Central Bank or the Bank for International Settlements.
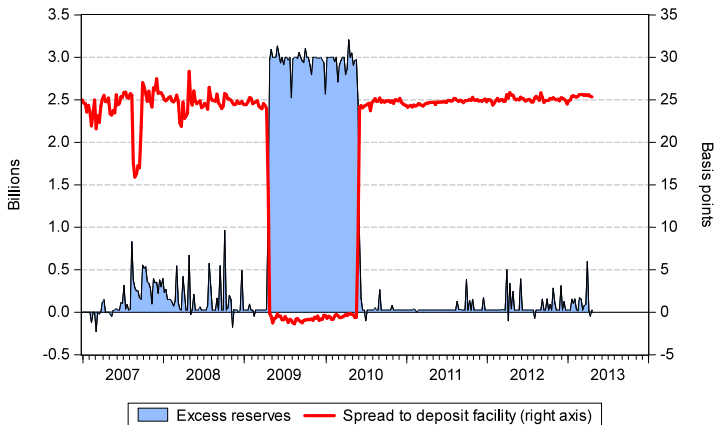
Introduction

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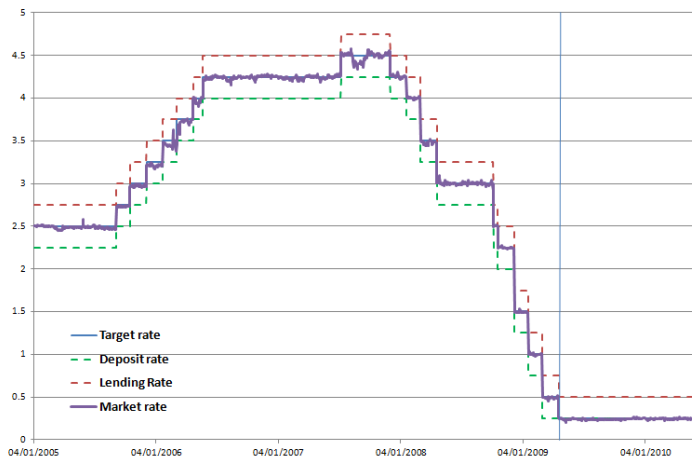
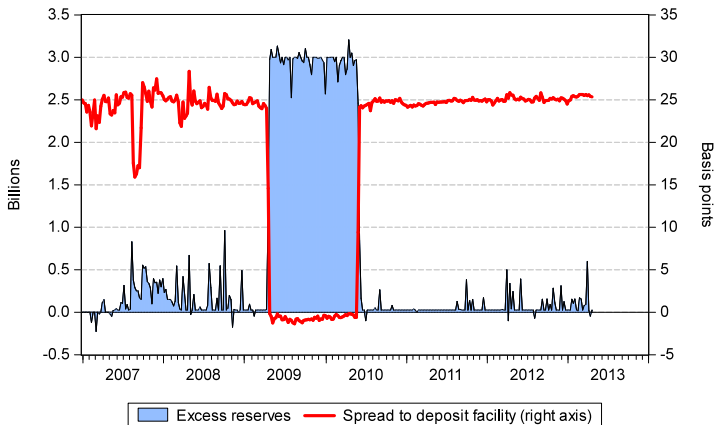# But there are anomalies...

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- Existence of arbitrage opportunities?
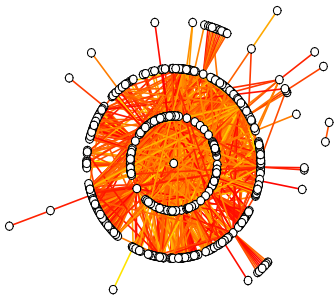- Practitioners: concerns about "relationships"

Structure of the Interbank Market

Interbank markets exhibit a tiered structure (Stigum, 2007):

- ▶ OTC transactions: larger banks acting on their own or a customer's behalf

- ▶ Lending relationships: repeated transactions between small-to-medium sized and larger banks
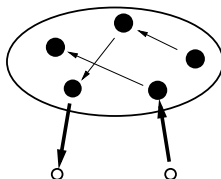
Core-periphery Structure of the Interbank Market

Bech and Atalay (2008)

Related Literature

- ▶ Empirical studies stress the importance of lending relationships
  - ▶ e.g. Afonso, Kovner and Schoar (2014)

    "More than half of the banks form stable and persistent trading relationships."

- ▶ Most models of interbank markets fail to capture
  - ▶ Model it as a frictionless market (e.g. Bech and Keister, 2017), or randomly matched banks conducting "spot" trades (e.g. Afonso and Lagos, 2015)
  - ▶ Exceptions: e.g. Blasques, Brauning, and van Lelyveld (2018)

What We Do

- This paper models trading relationships in the interbank market under a corridor system
  - endogenize network
  - explain the anomalies
  - conduct quantitative exercise based on **MMSR data**

MMSR Data

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▶ Money Market Statistical Reporting (MMSR) dataset allows us to study confirmed transaction data.

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 - cover about 80 percent of Euro Area money market activities

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▶ Large banks (RA) are required to report money market trades
  ▶ cover about 80 percent of Euro Area money market activities

▶ Our sample period: July 1, 2016 to July 1, 2018:
  ▶ deposit facility rate (DFR) was -0.4 %
  ▶ the marginal lending facility rate was 0.25%.

MMSR Data: Number of Trading Partners
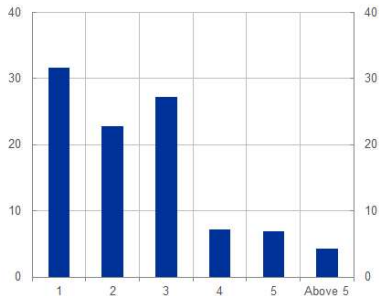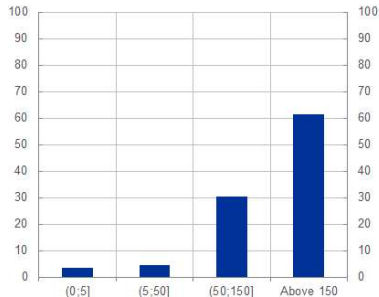
Figure: (a) Share of volume of non-RA by number of RA counterparties,
(b) Share of volume of RA by number of counterparties

MMSR Data: Trading Below the Floor

Among the loans from non-RA to RA, roughly 39% are conducted below the DFR.

Table: Summary Statistics

	Non-RA to RA	RA to non-RA
No. of transactions	10099	146999
Percentage of total	6.43%	93.57%
Average rates	-0.38%	-0.34%
Average size (millions)	53	28
Fraction of trades below DFR	38.83%	0.06%
Average rates below DFR	-0.44%	-0.40%

Road Map

1. Basic model (No relationships)

   ▶ Costless participation and one-shot trade in money market

2. Extend the basic model

   ▶ Costly participation and repeated trade

      ▶ Endogenize tiered structure in the money market
      ▶ Relationship premium for interest rate

3. Quantitive exercise based on MMSR data
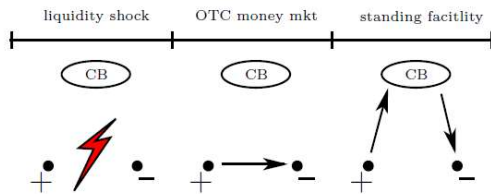
Basic Model (No Relationship)

The Basic Model (no relstionship)

- One period
- A [0,1] continunm of risk neutral, profit maximizing banks
- A liquidity shock $\varepsilon \sim G(.)$
- $\bar{m}$ reserve requirement ($\bar{m} = 0$)
- An interbank market
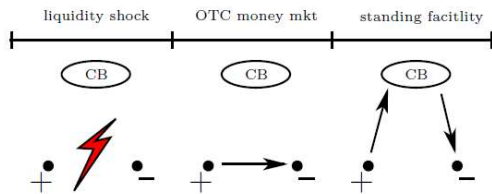- A central bank offering lending (i_L) and deposit (i_D) facility

Sequence of events

1. Liquidity shock: $\varepsilon \sim G(\varepsilon)$
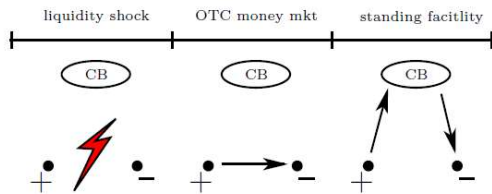
2.

3.

Sequence of events

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3. Standing facilities: deposit if $m > \bar{m}$, borrow if $m < \bar{m}$
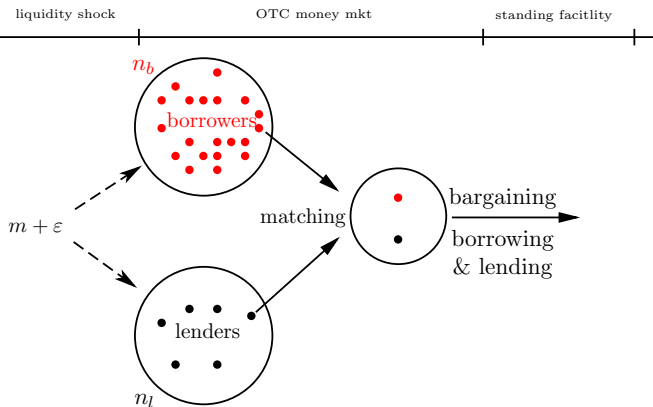   Settlement: $D(1 + i_D)$ or $L(1 + i_L)$

Sequence of events

CB liquidity tender: lend out liquidity at $1 + \bar{i}$

1. Liquidity shock: $\varepsilon \sim G(\varepsilon)$

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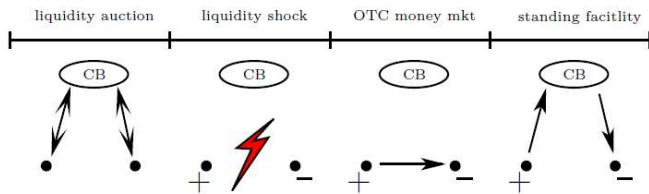
An OTC interbank market with sorting

OTC interbank money market (Cont'd)

- Lender ($m^+ > 0$) and borrower ($m^- < 0$) negotiate an overnight loan (d, ℓ) determined by proportional bargaining:

$$\max_{d,\ell} S^- + S^+,$$

s.t.

$$S^+ = \Theta(S^- + S^+)$$

- borrower's surplus: $S^- = V_3(m^- + d, -\ell) - V_3(m^-, 0)$
- lender's surplus: $S^+ = V_3(m^+ - d, \ell) - V_3(m^+, 0)$
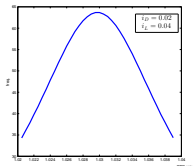
OTC interbank money market (Cont'd)

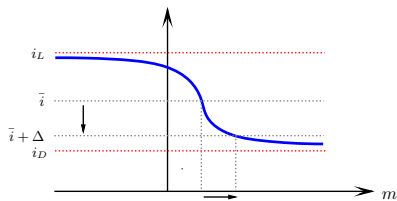▶ Banks split their balances

$$d(m^+, m^-) = \frac{m^+ - m^-}{2}$$

▶ OTC rate is given by

$$
\begin{aligned}
i(m^+, m^-) = {} & \Theta \frac{V_3(m^- + d) - V_3(m^-)}{\beta d} \\
& + (1 - \Theta) \frac{V_3(m^+) - V_3(m^+ - d)}{\beta d} - 1
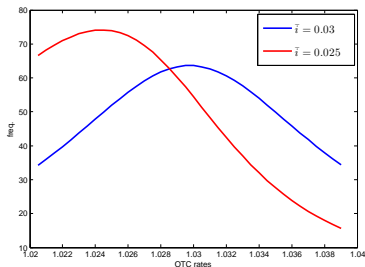\end{aligned}
$$

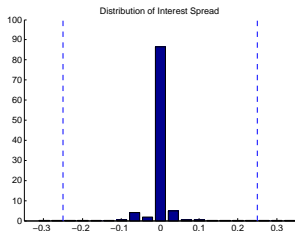▶ OTC rate is always within the corridor
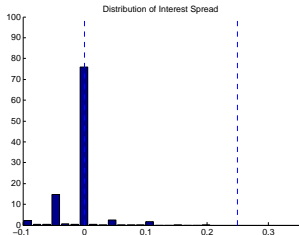
Increase reserve supply

- Skew OTC rate distribution:

Interbank Overnight Rates in Canada

Symmetric corridor

(before 2009)

Floor system

(2009)

Extend the Model

Model

- Infinite horizon: $t = 1, 2, 3...$

- Two types of banks:
    - "large" banks (as in basic model)
    - "small" banks

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    - large banks participate for free (as in basic model)
    - small banks need to pay a cost γ to participate
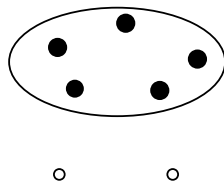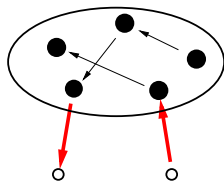
Model

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- Core interbank market:
  - large banks participate for free (as in basic model)
 - small banks need to pay a cost γ to participate
    $\Rightarrow$ incentive to use large banks as a correspondence banks by building a long-term relationship with them

Model (Cont'd)
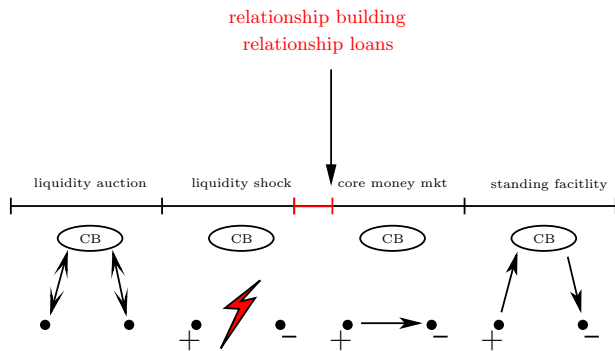
▶ A relationship between a small and a large bank
  ▶ allows them to meet and trade every period before the OTC market opens
  ▶ subject to exogenous separation w.p. σ

▶ To build a relationship
  ▶ find partner in a relationship market
  ▶ single small banks pay κ_S to search
  ▶ single large banks pay κ_L to search
  ▶ subject to random matching
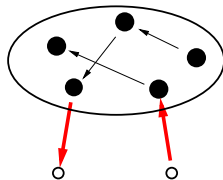
Sequence of events

Relationship Building

A single bank j decides whether to search for a partner:

$$\max\{\underbrace{\Delta\rho_j[V_1^j(1) - V_1^j(0)](1 - \sigma) - \kappa_j}_{\text{search for a partner}}, 0\}$$

where $\Delta\rho_j$ = higher prob. of building a relationship
$V_1^j(1)$ = continuation value with a relationship
$V_1^j(0)$ = continuation value without a relationship
σ = separation rate
κ_j = cost of building relationship

Relationship Loans

- In a relationship, large bank with m_L and small bank with m_S negotiate a loan (d^{REL}, ℓ^{REL}).

- Proportional bargaining:

$$\max_{d,\ell} TS_S + TS_L,$$

s.t.

$$TS_S = \theta(TS_S + TS_L)$$

- large bank's surplus: $TS_L = V_4^L(m_L+d,-\ell,1) - V_4^L(m_L,0,0)$

- small bank's surplus: $TS_S = V_4^S(m_S-d,\ell,1) - V_4^S(m_S,0,0)$

Relationship Premium for Interest Rate

Spot transaction:

$$i(m^+, m^-) = \underbrace{\Theta \frac{V_5(m^- + d) - V_5(m^-)}{\beta d} + (1 - \Theta) \frac{V_5(m^+) - V_5(m^+ - d)}{\beta d}}_{\in [i_D, i_L]} - 1$$

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$$+ \underbrace{\frac{\theta[V_1^L(1) - V_1^L(0)] - (1 - \theta)[V_1^S(1) - V_1^S(0)]}{d}}_{\substack{\text{benefit of borrower + cost of lender of} \\ \text{keeping relationship tomorrow}}} - 1$$

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$$+ \underbrace{\frac{\theta[V_1^L(1) - V_1^L(0)] - (1 - \theta)[V_1^S(1) - V_1^S(0)]}{d}}_{\text{relationship premium} \atop \text{can be +ve or -ve}} - 1$$

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E.g., when θ low, or when small bank values relationship a lot, then the relationship premium
- lowers the rate when large bank borrows,
- raises the rate when large bank lends

Relationship Premium for Interest Rate

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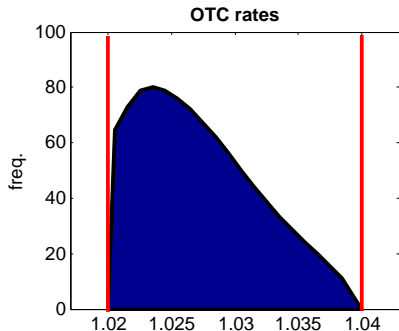
E.g., when θ low, or when small bank values relationship a lot, then the relationship premium
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Consistent with findings in the fed funds market (Ashcraft and Duffie, 2007).
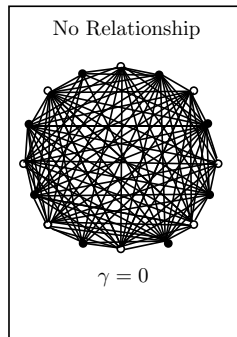
Relationship Premium for Interest Rate (Cont'd)
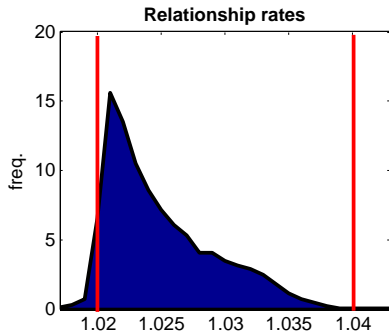
Consistent with experiences in many countries that the deposit rates on reserve do not always provide a lower bound for short-term market rates. (Bowman, Gagnon and Leahy, 2010)

Endogenous Tiered Structure

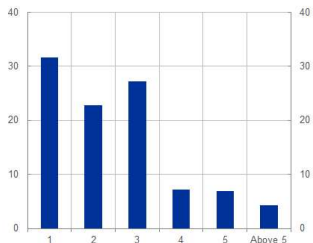Network depends on participation cost and monetary policy
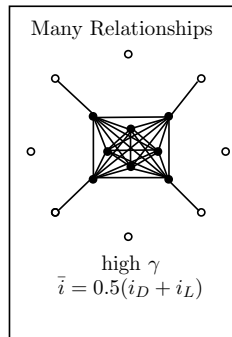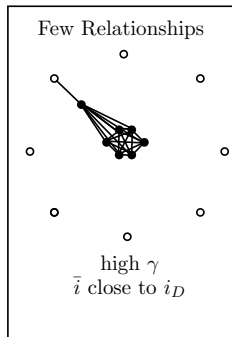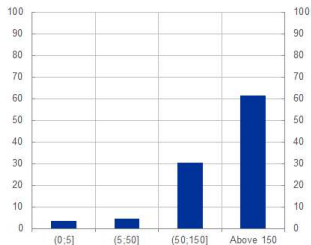
Quantitative Exercise

Recall: Core-periphery Structure

Median numbers of partners:

- Non-RA: 2
- RA: 182

(a) Non RA

(b) RA

Figure: (a) Share of volume of non-RA by number of RA counterparties,
(b) Share of volume of RA by number of counterparties

Recall: Loan Rates Below the Floor

Among the loans from non-RA to RA, roughly 39% are conducted below the DFR.

Table: Summary Statistics

	Non-RA to RA	RA to non-RA
No. of transactions	10099	146999
Percentage of total	6.43%	93.57%
Average rates	-0.38%	-0.34%
Average size (millions)	53	28
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Average rates below DFR	-0.44%	-0.40%

Quantitative Exercise

Parameter	Definition	Value
β	discount factor	0.9999
i_ℓ	lending facility rate	-0.00001
i_d	deposit facility rate	0.0000068
Θ	lender's bargaining power in core market	0.5
θ	S bank's bargaining power in periphery market	0.9
n	measure of L banks	0.1
σ	probability of relationship separation	0.003
γ	core market participation cost	0.0002
κ_S	S bank's costs for building a new relationship	0.00001
κ_L	L bank's costs for building a new relationship	0.00001

Quantitative Exercise (Cont'd)

Table: Implications of Model

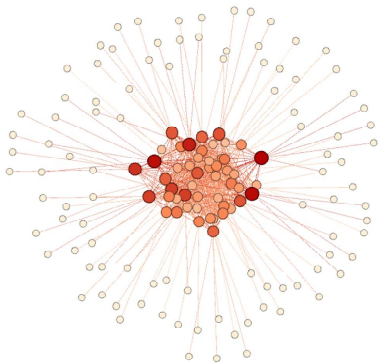|	Data	Model
Fraction of trades where banks L are borrowers	6.43%	6.51%
Median rate when banks L borrow	-0.39%	-0.40%
Median rate when banks L lend	-0.34%	-0.32%
Fraction of loans below i_d when banks L borrow	38.83%	35.00%
Fraction of loans below i_d when banks L lend	0.06%	0.00%
Median no. of relationships of banks S	2	2

Interbank Network

Figure: Simulated Network

Interest Rate Distribution
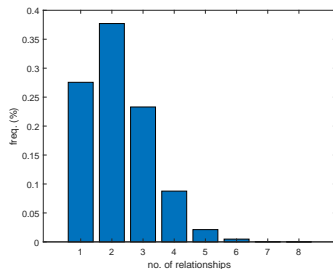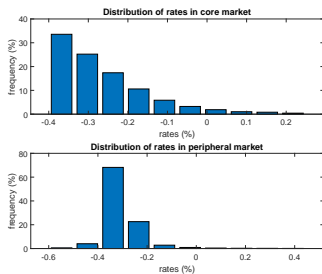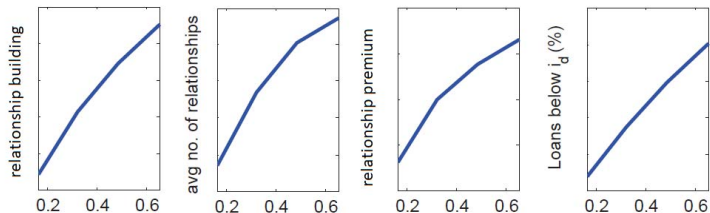

Figure: Interest Rate Distribution Figure: No. of Relationships of S banks

Reduce banks' outside options

- ▶ lending and deposit facilities become less attractive
- ▶ increase the value of a relationship for small banks
- ▶ incresse the number of relationships
- ▶ increase the fraction of loans trading below the floor and the relationship premium
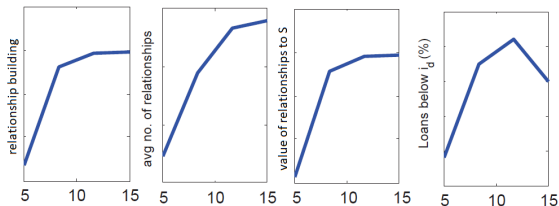
Quantitative Exercise: Increase in small banks' reserve balances
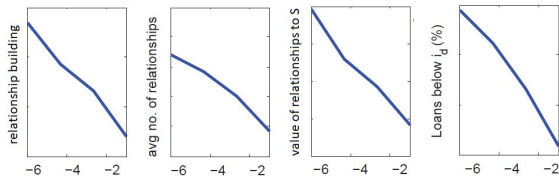

Reduce small banks' need to borrow

- ▶ decrease the value of a relationship to small banks
- ▶ decrease their incentives to build relationships
- ▶ reduce the number of relationships
- ▶ decrease the fraction of loans trading below the floor

Quantitative Exercise: Increase in large banks' reserve balances

- increase the value of a relationship to S
- increase their incentives to build relationships
- increase the number of relationships
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Quantitative Exercise: Increase in reserve balances
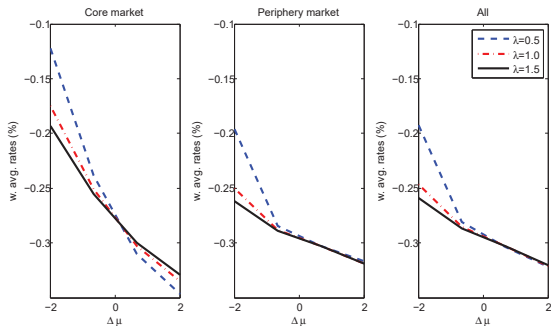
Large banks are more active in the market

- ▶ Increasing the fraction of new reserves allocated to large banks ($\lambda \downarrow$) leads to stronger effects

- ▶ ... because funds can reach the interbank market more directly through L banks

Conclusion

▶ We develop a model of interbank money market featuring costly participation and repeated relationship.

▶ The model helps understand
1. Policy effects on interbank network, relationships and interest rate dispersion
2. Some "anomalies"

Conclusion

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▶ The model helps understand
  1. Policy effects on interbank network, relationships and interest rate dispersion
  2. Some "anomalies"

The model is simple and tractable

▶ Can be used to investigate quantitively the short-run and long-run effects of running and "exiting" the floor system.

▶ Many possible improvements:
  ▶ Secured transactions
  ▶ Credit risk
  ▶ Asset markets