Liquidity Regulation and Unintended Financial Transformation in China

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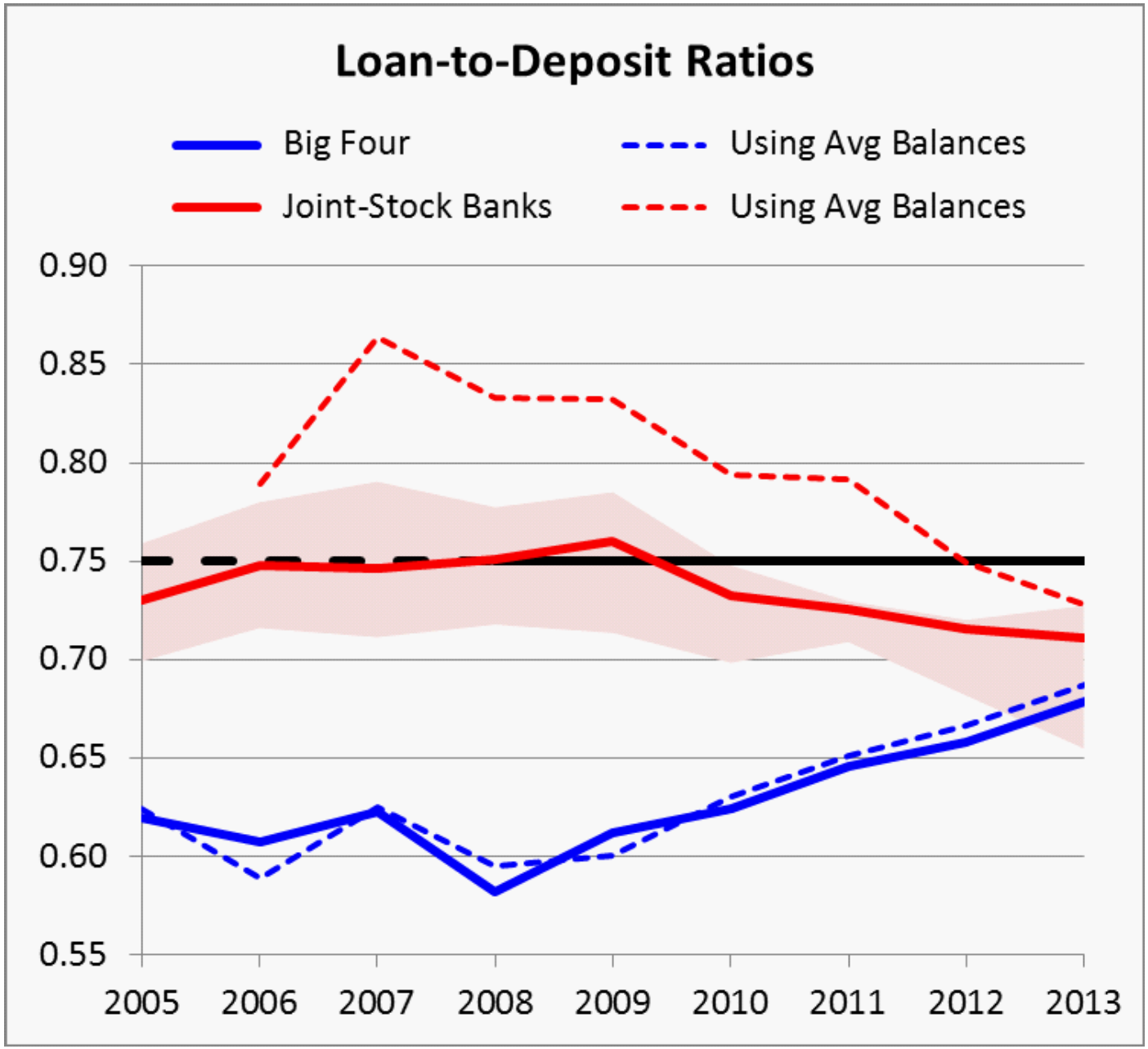
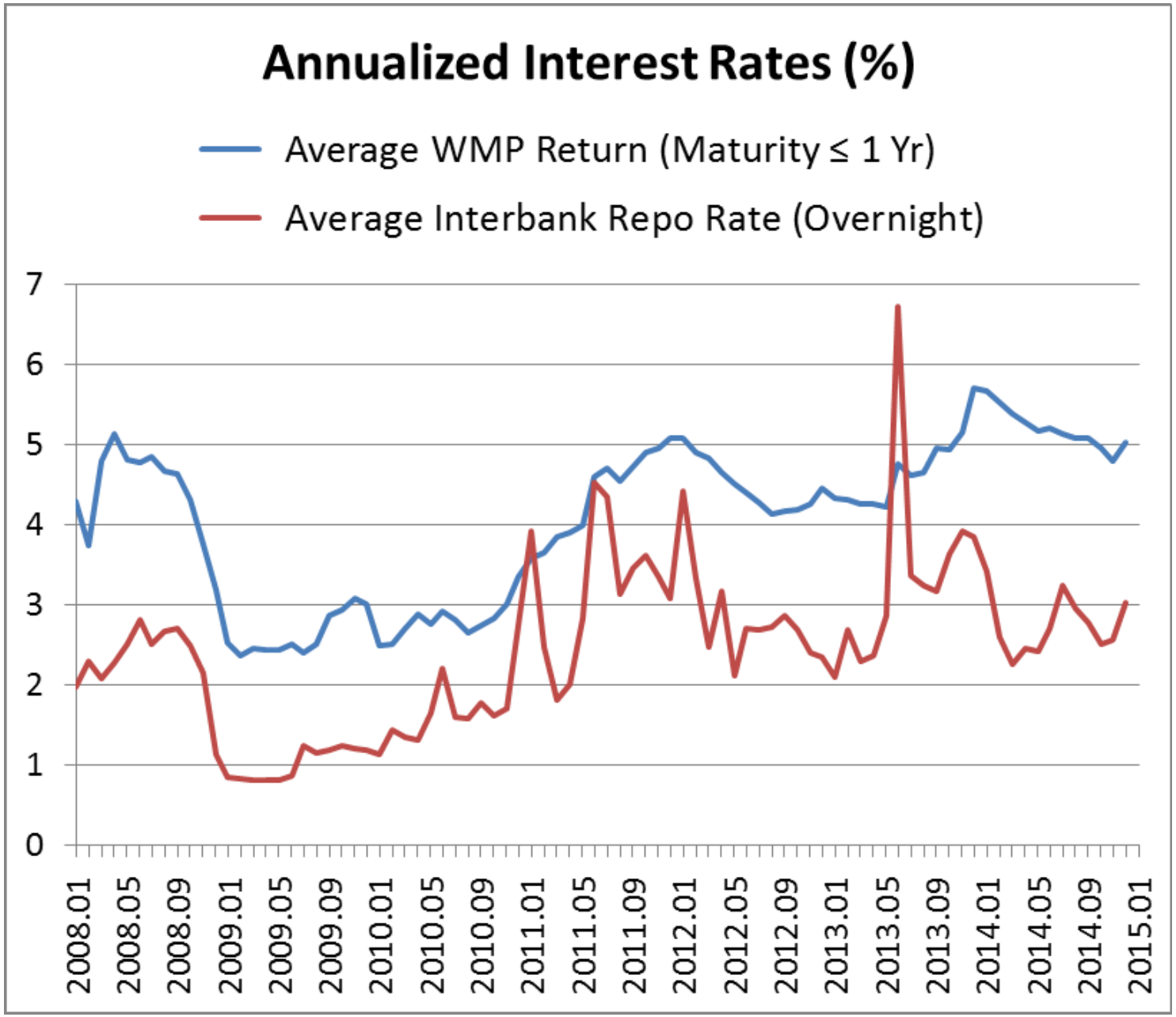
Overviews

- China starts tightening liquidity rules on banks in 2008
  1. The reserve requirement: 11% in 2007 to 21.5% in 2011
  2. Stricter enforcement of the 75% cap on the loan-to-deposit ratio (LDR)


Loan-to-Deposit Ratios
Big Four
Using Avg Balances
Joint-Stock Banks
Using Avg Balances
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.55
2005
2006
2007
2008
2009
2010
2011
2012
2013

Overviews

- What happens?
  1. Credit expands: The Debt-to-GDP ratio nearly doubled in 2008-2014
  2. Interbank market tightens


Annualized Interest Rates (%)
Average WMP Return (Maturity ≤ 1 Yr)
Average Interbank Repo Rate (Overnight)
7
6
5
4
3
2
1
0
2008.01
2008.05
2008.09
2009.01
2009.05
2009.09
2010.01
2010.05
2010.09
2011.01
2011.05
2011.09
2012.01
2012.05
2012.09
2013.01
2013.05
2013.09
2014.01
2014.05
2014.09
2015.01

Our Explanation

- Regulatory arbitrage by small banks leads to shadow banking
- Shadow banking creates competition with big banks
  - Big banks respond by exploiting interbank market power
  - In GE, the regulation has the opposite of its intended effect
- Quantitative significance
  - Accounts for 40% of the recent credit expansion

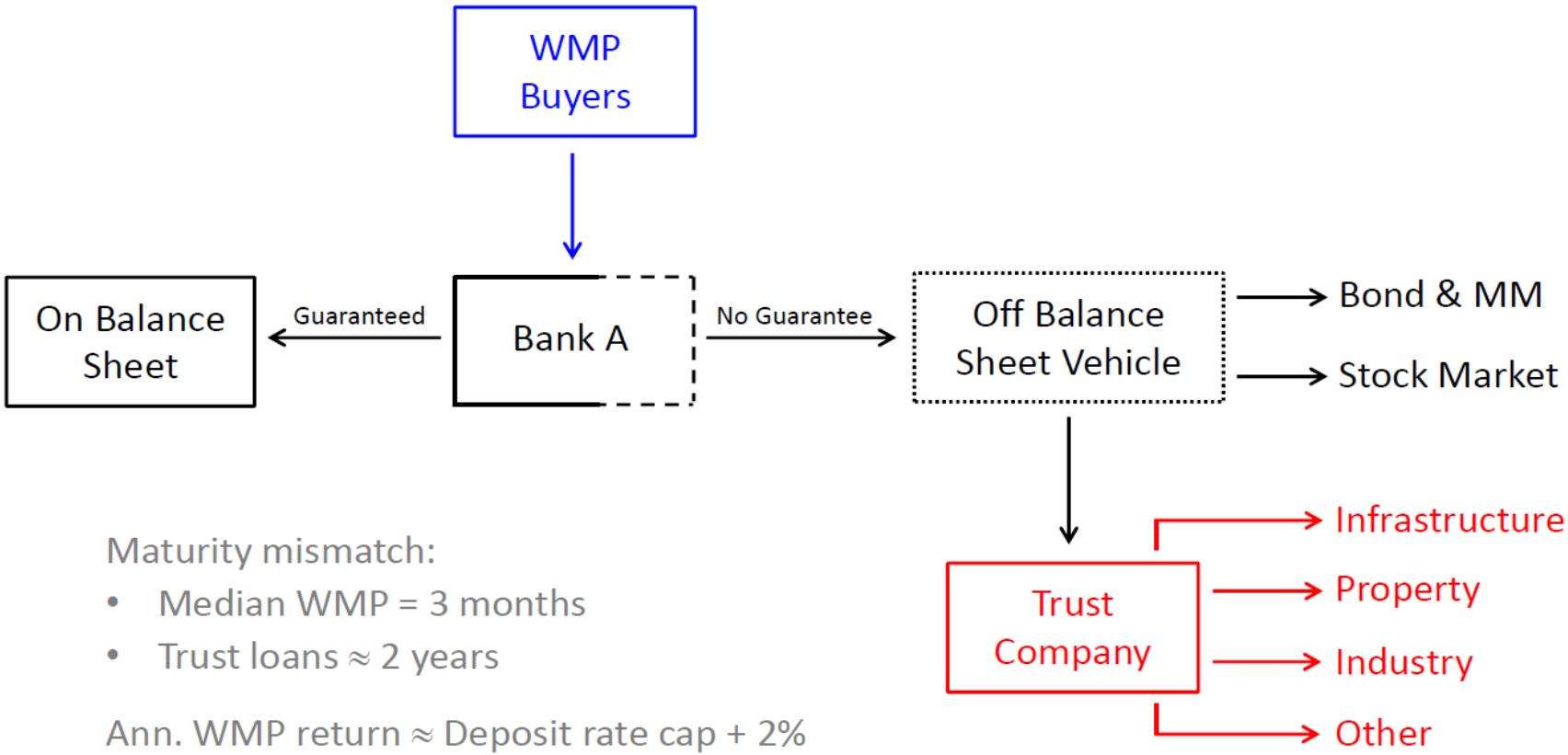
Policy Implications

- The tightening of liquidity rules encourages shadow banking activities
  - Weakens the effect
- Shadow banking with Chinese characteristics
  - **Reverses** the effect

Regulations

- Regulations on interest rates: Cap on deposit rate
- Restrictions on lending: Cap on loan-to-deposit ratio

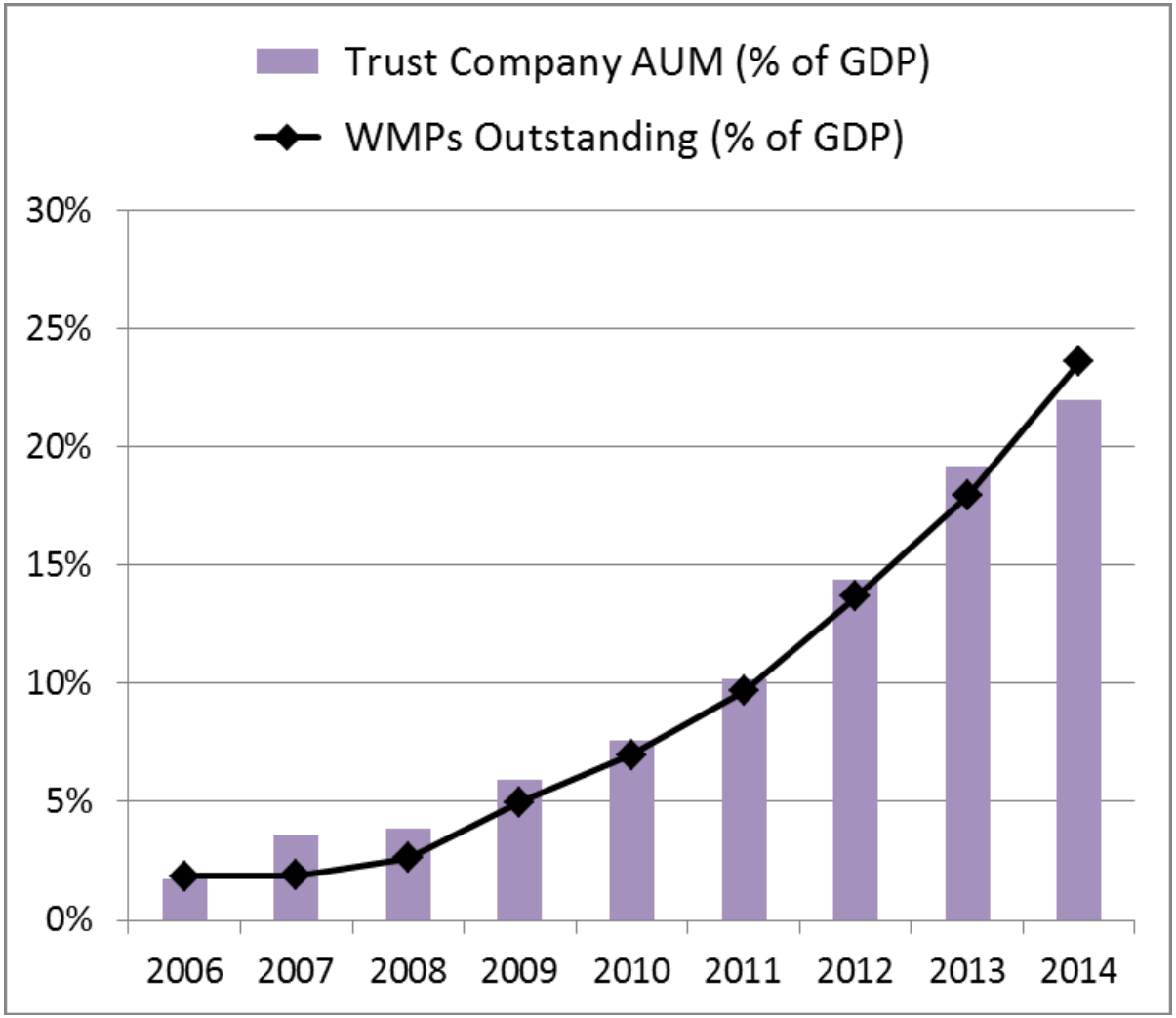
Anatomy of a WMP: The First Wave of China's Shadow Banking



Maturity mismatch:

- Median WMP = 3 months
- Trust loans ≈ 2 years

Ann. WMP return ≈ Deposit rate cap + 2%


Trust Company AUM (% of GDP)
WMPs Outstanding (% of GDP)
30%
25%
20%
15%
10%
5%
0%
2006
2007
2008
2009
2010
2011
2012
2013
2014

The Size of the Shadow Sector

- Regulatory arbitrage (sources of fund)
  - WMPs $\approx$ 24% of GDP in 2014 (China Banking Assocation)
  - Non-guaranteed WMPs $\approx$ 15% of GDP in 2014 (WIND)
- A broader definition (uses of fund)
  - Trust loans + Entrusted loans + Undiscounted banker's accepances ... $\approx$ 35% of GDP in 2014 (NBS)

The Big Four

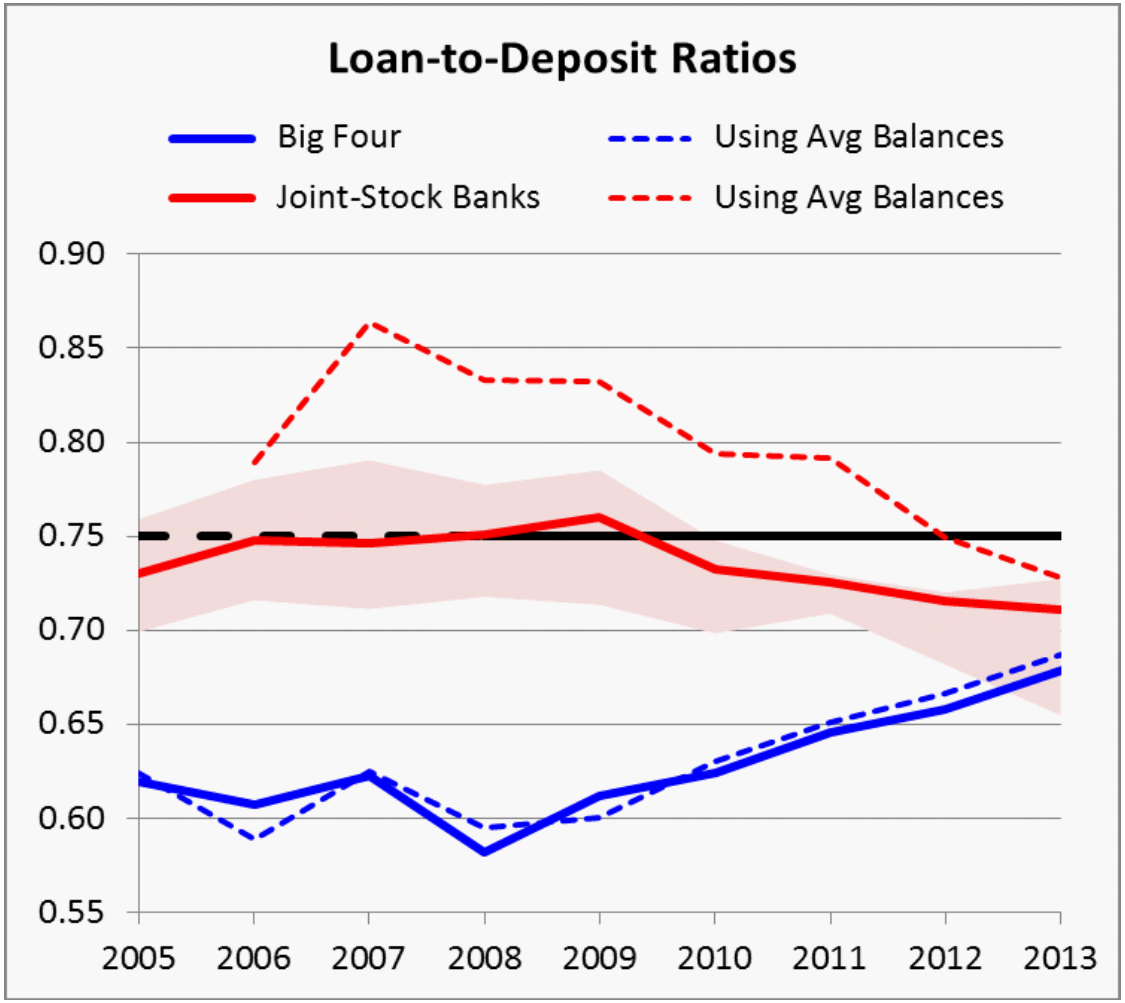
- Large in size: half of the market share

Fortune 500 (2014)

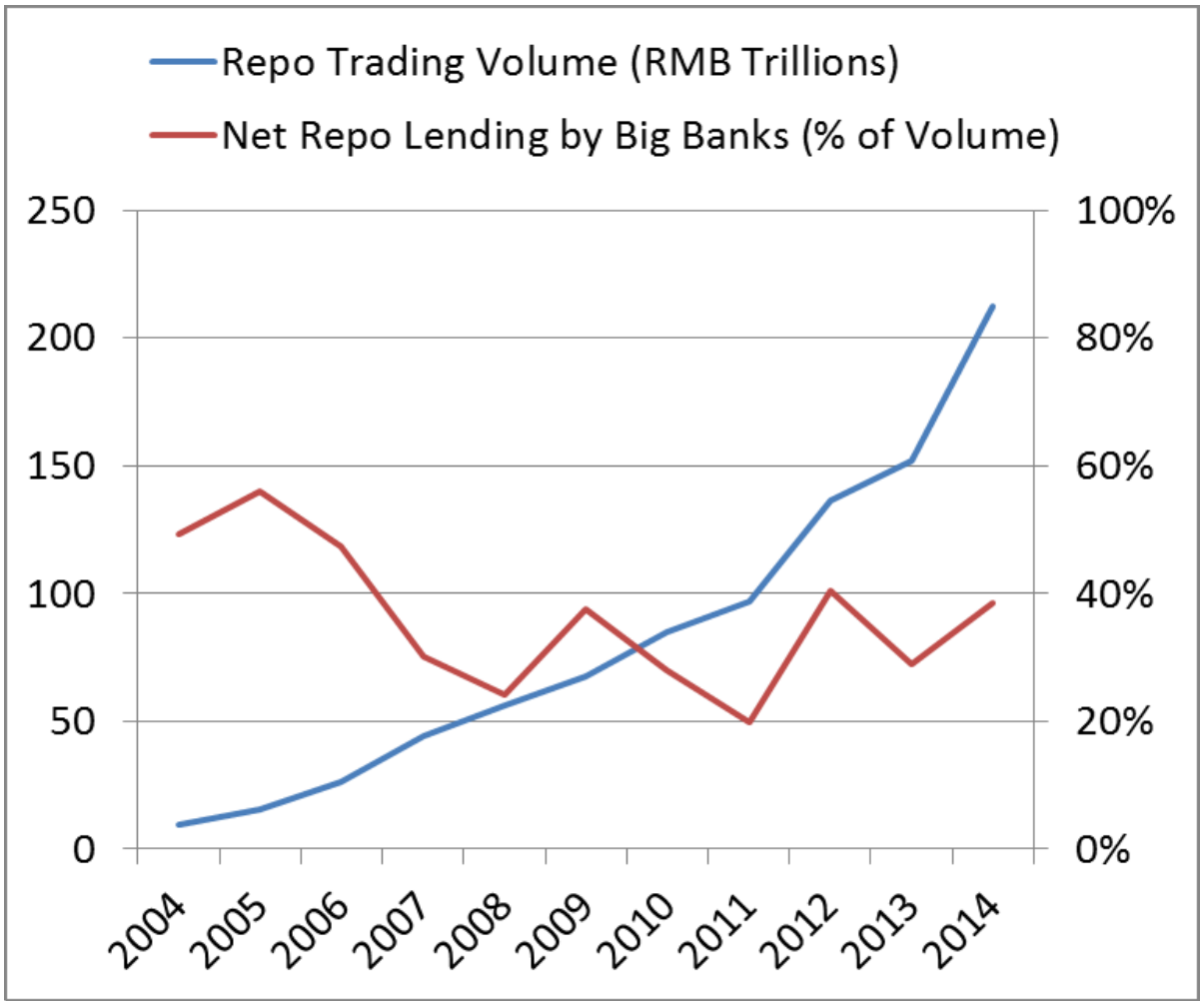
25th	ICBC	59th	BoC
38th	CCB	66th	Bank of American
47th	ABC	77th	HSBC
57th	JP Morgan Chase	82nd	Citigroup

- Extensive price and quantity coordination
  - All firmly controlled by the party
  - Job rotation in the big four and regulatory bodies

Big Banks: Not Constrained by the Loan-to-Deposit Limit



Big Banks: The Main Liquidity Provider



The Model

- The framework
  - Diamond-Dybvig maturity transformation
  - Imperfect substitutability between deposits and WMPs
  - Asymmetric competition in interbank markets
- Analytical and quantitative results ...

Environment

- Notation for bank j:

$$\begin{aligned} D_j &= \text{traditional deposits} \\ W_j &= \text{wealth management products (WMPs)} \\ \tau_j &= \text{fraction of WMPs sent off-b/s} \\ R_j &= \text{reserves} \end{aligned}$$

- Bank's liabilities:

$$\underbrace{D_j + (1-\tau_j)\, W_j}_{\text{on-b/s}} \quad + \quad \underbrace{\tau_j W_j}_{\text{off-b/s}}$$

- Bank's assets:

$$\underbrace{R_j}_{\text{reserves}} \quad + \quad \underbrace{D_j + (1-\tau_j)\, W_j - R_j}_{\text{on-b/s loans}} \quad + \quad \underbrace{\tau_j W_j}_{\text{off-b/s loans}}$$

- Household savings normalized so $\sum_j (D_j + W_j) = 1$.

Diamond-Dybvig Maturity Transformation

- Loans are long-term:

$$\begin{array}{ccccc} \underline{t=0} & & \underline{t=1} & & \underline{t=2} \\ \$1 & \longrightarrow & \$0 & \longrightarrow & \$\left(1+i_A\right) \end{array}$$

- Deposits and WMPs are short-term:

$$\begin{array}{ccccc} \underline{t=0} & & \underline{t=1} & & \underline{t=2} \\ \$1 & \longrightarrow & \$\left(1+i_B\right) & \longrightarrow & \begin{cases} \$\left(1+i_B\right)^2 & \text{if } D_j \\ \$\left(1+i_B\right)^2+\xi_j & \text{if } W_j \end{cases} \end{array}$$

- Idiosyncratic withdrawals of deposits and WMPs:
  - With probability π, fraction θ_ℓ withdrawn at $t=1$ ("state ℓ")
  - With probability $1-\pi$, fraction is $\theta_h > \theta_\ell$ ("state h")

Regulations

1. Fixed i_A and i_B
2. Loan-to-deposit limit:

$$\underbrace{D_j + (1-\tau_j)\, W_j - R_j}_{\text{on-b/s loans}} \leq \underbrace{(1-\alpha)}_{\text{limit}} \cdot \underbrace{[D_j + (1-\tau_j)\, W_j]}_{\text{on-b/s deposits}}$$

Rewrite limit as reserve requirement:

$$\lambda_j \equiv \frac{R_j}{D_j + (1-\tau_j)\, W_j} \geq \alpha$$

Benchmark: Small Banks Only

- Unit mass of ex ante identical small banks
- Each is a price-taker on the interbank market
- At $t = 0$, the representative bank chooses D_j, W_j, ξ_j, τ_j, and R_j to maximize expected profit subject to $\lambda_j \geq \alpha$
- Objective function:

$$\underbrace{(1+i_A)(D_j+W_j-R_j)}_{\text{from loans}} + \underbrace{(1+i_L)\left[R_j-\overline{\theta}(1+i_B)(D_j+W_j)\right]}_{\text{from surplus/shortage of reserves at } t=1}$$

$$- \underbrace{(1-\overline{\theta})\left[(1+i_B)^2(D_j+W_j)+\xi_j W_j\right]}_{\text{final payment to savers at } t=2} - \underbrace{\frac{\phi}{2}(D_j+W_j)^2}_{\text{operational costs}}$$

Competition

- Denote $\overline{\xi}$ the average WMP returns. Assume:

$$W_j = \omega \xi_j,$$

$$D_j + W_j = 1 + \rho \left(\xi_j - \overline{\xi} \right).$$

1. Each bank takes $\overline{\xi}$ as given.
2. Competitive motive is captured by $\rho > 0$.

Equilibrium

- In symmetric equilibrium, $\xi_j = \overline{\xi}$ and interbank market clears:

$$\underbrace{R_j + \Psi\left(i_L\right)}_{\text{available liquidity}} = \underbrace{\overline{\theta}\left(1 + i_B\right)}_{\text{required liquidity}}$$

- Shadow cost of liquidity rule ($\lambda_j \geq \alpha$) is $\mu_j \equiv i_A - i_L$.
  - $\tau_j = 1$ if $\mu_j > 0$
  - ξ_j:

$$\xi_j = \underbrace{\frac{f\left(i_L\right) - \phi}{2\left(1 - \overline{\theta}\right)} \times \rho}_{\substack{\text{competitive motive} \\ \text{for issuing WMPs}}} + \underbrace{\frac{\alpha \mu_j \tau_j}{2\left(1 - \overline{\theta}\right)}}_{\substack{\text{reg. arbitrage} \\ \text{motive}}}$$

- Consider low ρ and α to match negligible issuance before 2008

The Benchmark Doesn't Work!

- **Proposition**:
  1. Increasing α above some threshold makes $\tau_j \xi_j$ positive
  2. But i_L is highest at zero α (market mechanism at work)
  3. Credit shrinks as α increases

- So cannot explain all the facts with only interbank price-takers

Introducing the Big Bank

- Big bank (k) internalizes its effect on all endogenous variables
  - Small banks take as given ξ_k, $\overline{\xi_j}$, and interbank rate

- Allocation of household savings:

$$D_j + W_j = 1 - \delta + \rho\left(\xi_j - \overline{\xi_j}\right) + \rho_1\left(\xi_j - \xi_k\right),$$

$$D_k + W_k = \delta + \rho_1\left(\xi_k - \overline{\xi_j}\right).$$

- Can consider three cases:
  1. $\rho_1 = 0$ and $\rho = 0$: no bank has a competitive motive
  2. $\rho_1 > 0$ and $\rho = -\rho_1$: big bank has a competitive motive
  3. $\rho_1 > 0$ and $\rho > -\rho_1$: all banks have a competitive motive

Market Clearing and the Big Bank's Choices

- In equilibrium, $\xi_j = \overline{\xi_j}$ and
  - Market clearing when big bank's withdrawal shock is high:

$$R_j + R_k + \Psi\left(i_L^h\right) = (1 + i_B)\left[\overline{\theta}\left(D_j + W_j\right) + \theta_h\left(D_k + W_k\right)\right]$$

  - To simplify, $i_L^\ell = i_B$ when big bank's withdrawal shock is low

- At $t = 0$, the big bank chooses ξ_k, τ_k, and R_k to maximize its expected profit subject to:
  1. Liquidity rule $\lambda_k \geq \alpha$
  2. Small bank optimality conditions for ξ_j, τ_j, and R_j
  3. i_L^h from interbank market clearing equation

Case 1: No Competitive Motive

- $\rho = \rho_1 = 0$
  1. If $\alpha = 0$, then $\xi_j = 0$.
  2. $\xi_k = 0$ even for positive α.

- Introduce a regulation of $\alpha = \overline{\theta}$. Parameters exist such that:
  1. Small banks issue off-b/s WMPs ($\xi_j > 0$ and $\tau_j = 1$)
  2. Big bank Internalizes the benefit of the stricter rule by making more loans ($\lambda_k \downarrow$):
  3. Interbank rate (i_L^h) increases
  4. Total credit ($1 - R_j - R_k$) increases

Case 2: Big Bank Has a Competitive Motive

- $\rho_1 > 0$ and $\rho = -\rho_1$:
  1. If $\alpha = 0$, then $\xi_j = 0$.
  2. Set ϕ so $\xi_k = 0$ at $\alpha = 0$.

- Introduce a regulation of $\alpha = \bar{\theta}$. There are parameters that deliver the same effects as Case 1 along with:
  1. On-b/s WMPs by big bank ($\xi_j > \xi_k > 0$ and $\tau_k = 0$)
  2. A bigger increase in the interbank rate (i_L^h)

Our Story in Words

- Stricter liquidity rule pushes small banks off-balance-sheet:
  - Benefit is no regulation, cost is higher interest rate to savers
  - High-return WMPs by small poach savings from big
  - Poached savings become trust loans instead of reserves
- Big bank fights back:
  - Internalize the benefit of the stricter rule by making more loans
  - Can hit small by moving from interbank to loans (competitive motive)
- Implications:
  - Stricter liquidity rule $\Rightarrow$ credit expansion and interbank tightness
  - Things that undermine manipulation of interbank market by big banks will intensify competition on WMP returns (e.g., $\uparrow \psi$)

Main Predictions

- General equilibrium effects of stricter liquidity rule (higher α):
  1. Converging LDRs
  2. More lending and higher fraction done off-balance-sheet
  3. Higher interbank rate

Calibration

- Calibrating i_B, i_D and i_A to match the interest rates in 2014.
- Calibrating θ, ϕ_k, ω, δ_1, ρ to match
  - θ : The weighted average seven-day interbank repo rate of 3.6%;
  - ϕ_k : The loan-to-deposit ratio of 70% for the big four
  - ω, δ_1, ρ : (i) WMPs of 10% and 5% of the total savings for the small and big banks; (ii) Market share of 43% for the big four

Counterfactuals

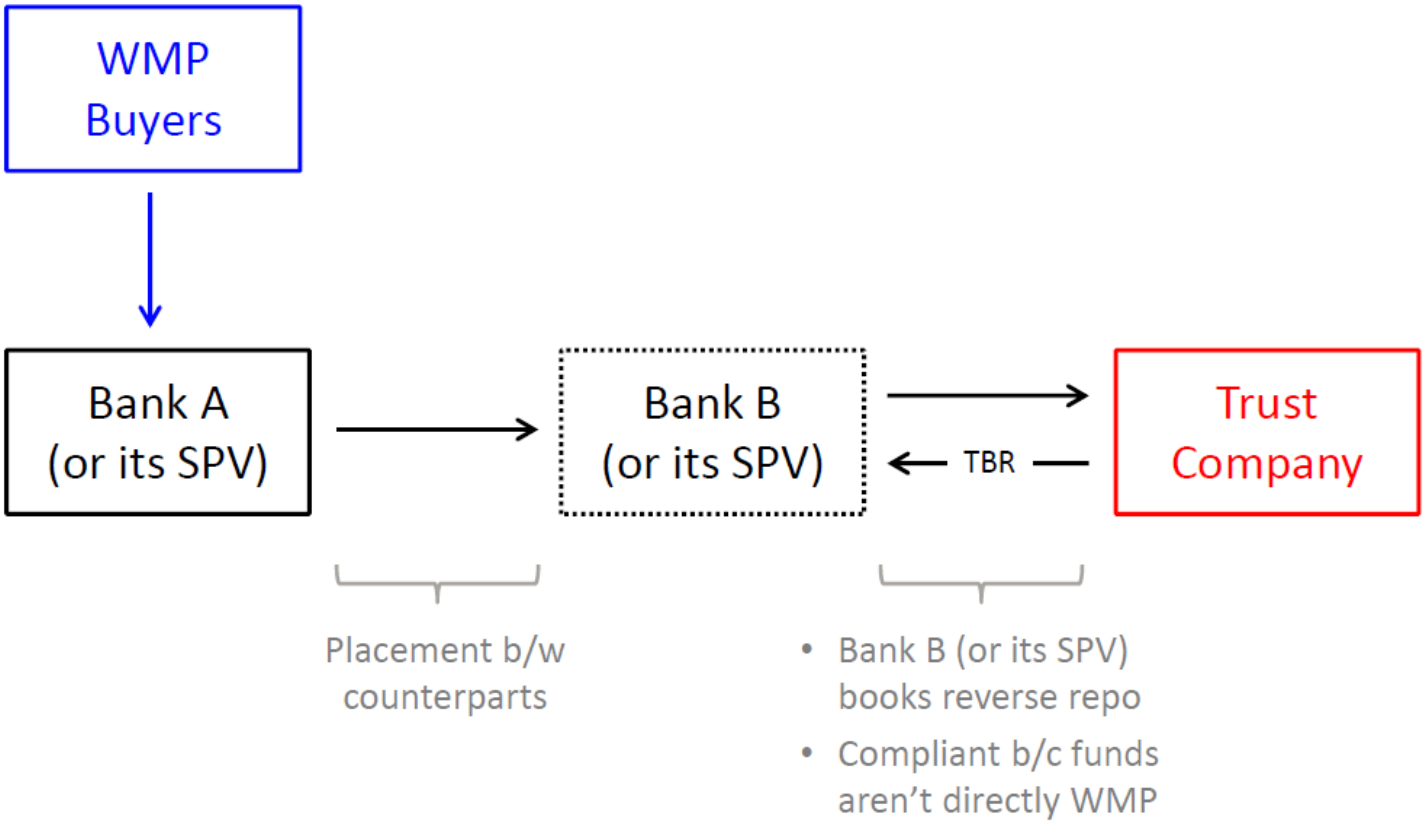
- Lowering α from 0.25 to 0.14

	Model $\alpha = 0.14$	Data 2007	Model $\alpha = 0.25$	Data 2014
Interbank Rate	3.4%	3.3%	3.6%	3.6%
W_j (W_k)	0.03 (0.01)	NA	10% (5%)	10% (5%)
LDR_k	57%	62.5%	70%	70%
MS_k	50.5%	55%	43%	43%
Total Credit	71.6%	65%	75.4%	75%

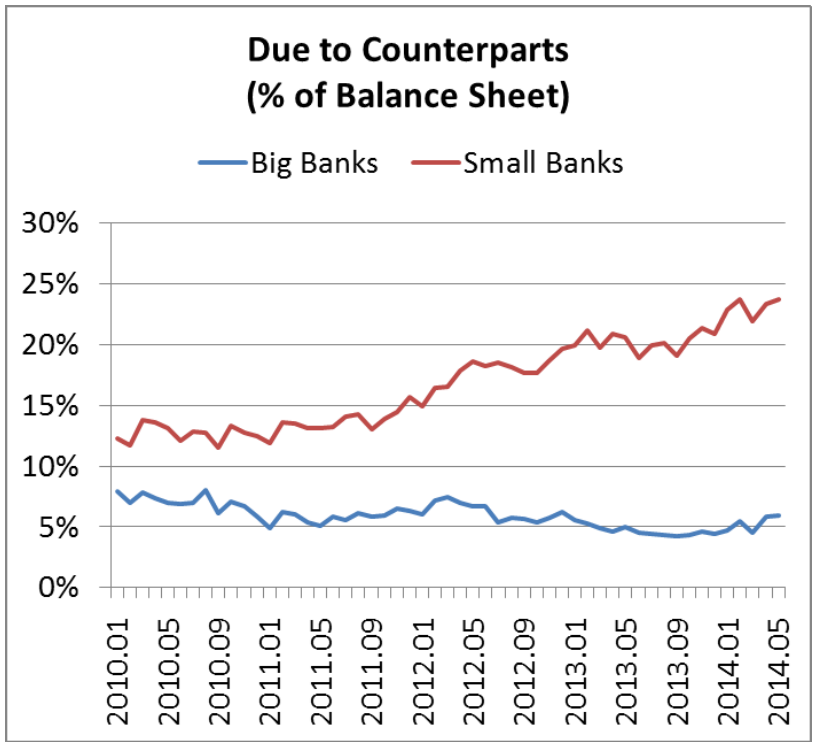
- A more disciplined central bank (lower ψ) can dampen the rise of WMPs and the expansion of total credit

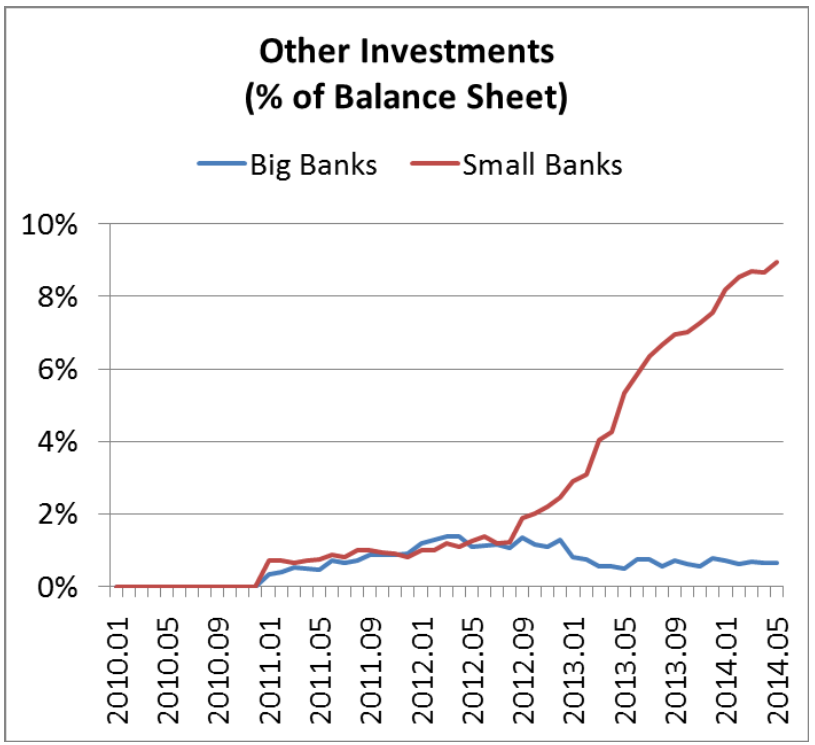
A New Wave of Shadow Banking

- Recent regulatory crackdown on bank-trust cooperation
- New way to connect WMPs with trusts:



Big vs. Small

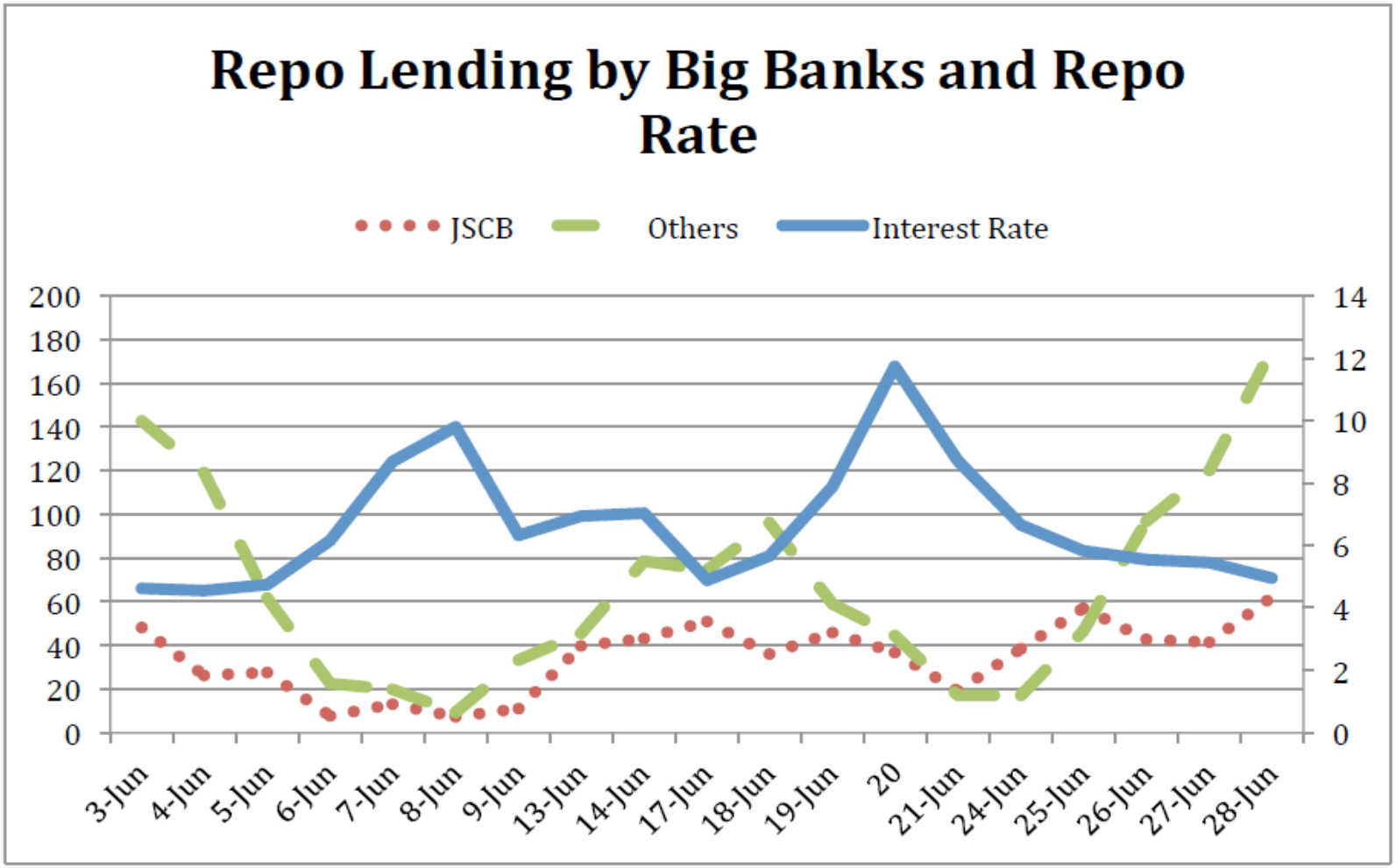

Due to Counterparts
(% of Balance Sheet)
Big Banks
Small Banks
30%
25%
20%
15%
10%
5%
0%
2010.01
2010.05
2010.09
2011.01
2011.05
2011.09
2012.01
2012.05
2012.09
2013.01
2013.05
2013.09
2014.01
2014.05


Other Investments
(% of Balance Sheet)
Big Banks
Small Banks
10%
8%
6%
4%
2%
0%
2010.01
2010.05
2010.09
2011.01
2011.05
2011.09
2012.01
2012.05
2012.09
2013.01
2013.05
2013.09
2014.01
2014.05

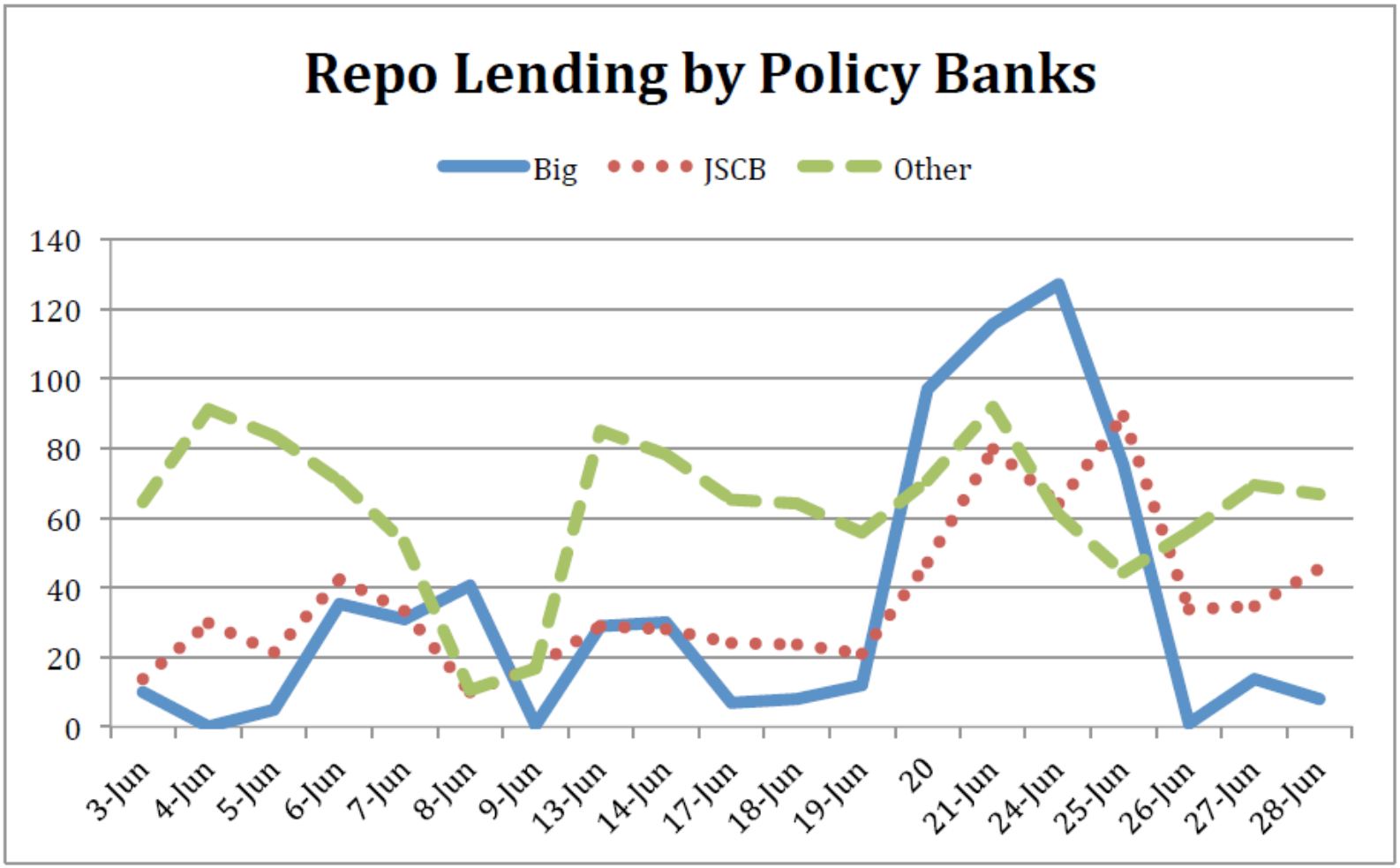
Supportive Evidence

- WMPs issued by small banks Granger-cause WMPs issued by big banks
- Big banks offer lower returns to WMPs and are less involved in non-guaranteed WMP issuance
- The 20th of June: A day of liquidity crisis

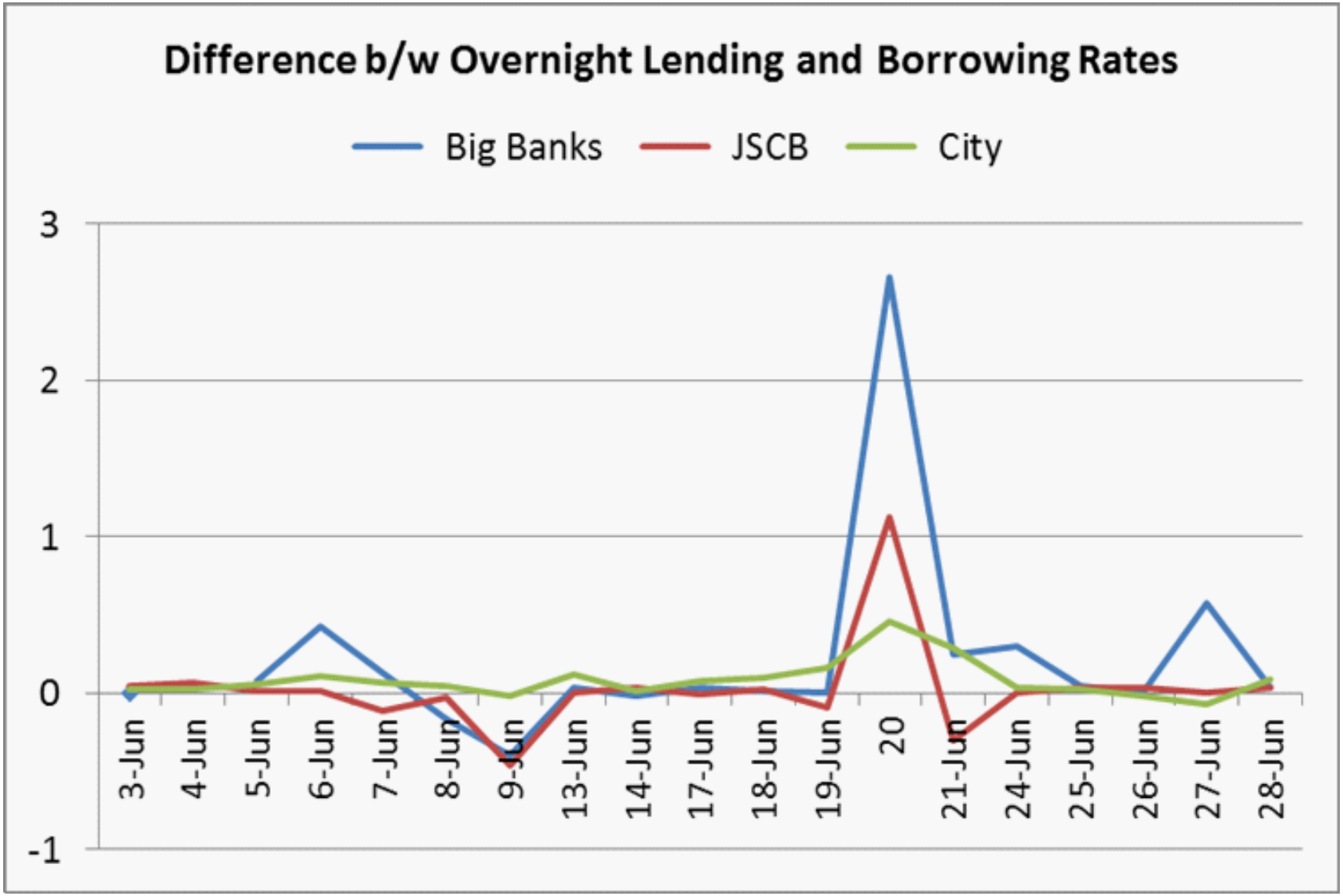
Repo Lending by Big Banks



Liquidity Absorbed by Big Banks



Interest Rate Spreads



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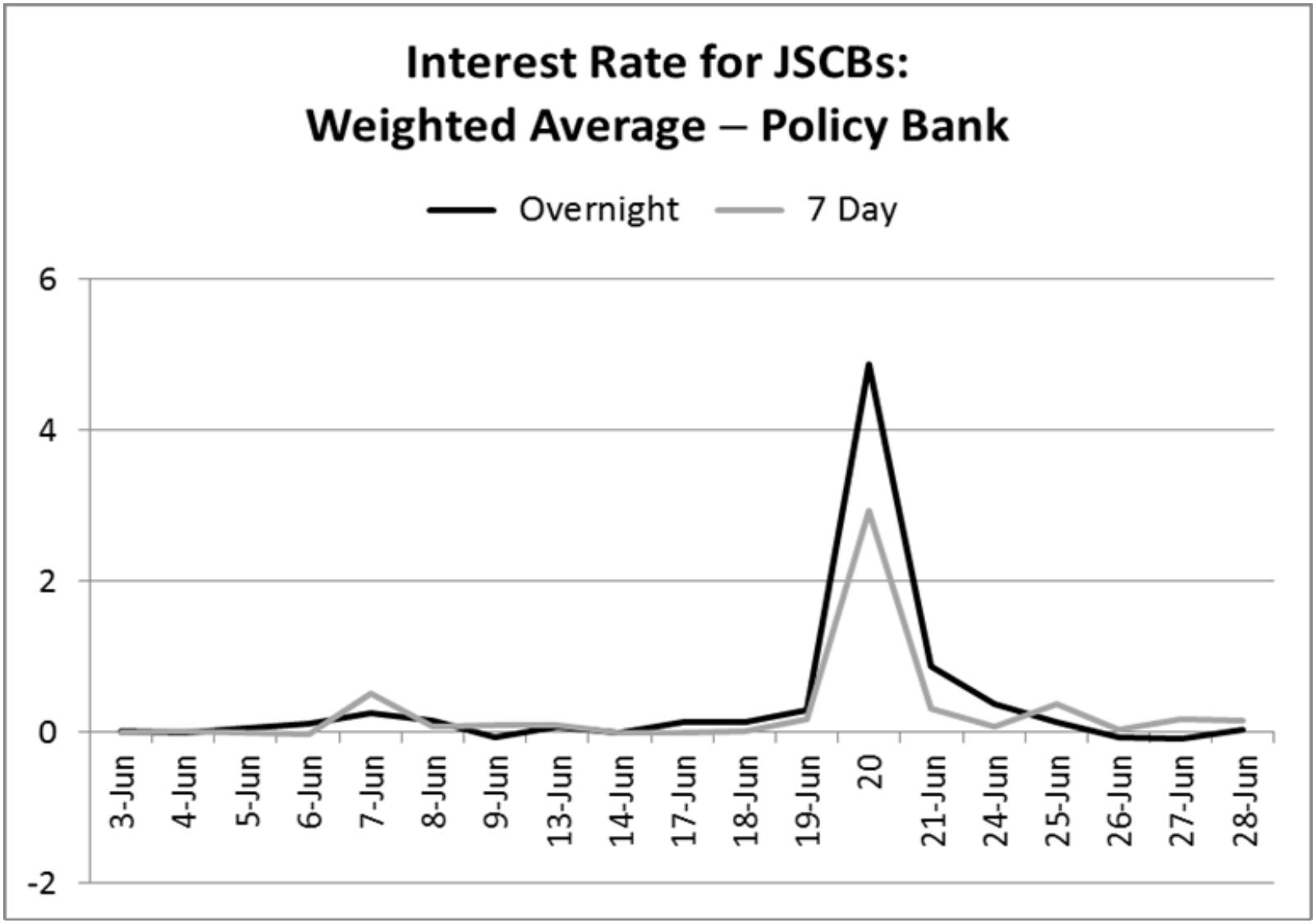

Conclusion

- Combining market structure and banking
  - helps explain the facts
  - might reverse the effect of liquidity rule
- The calibrated model can explain a third of the observed increase in total credit (a "supply-side" story)
- Future work: More on the demand side