Liquidity Regulation and Unintended Financial Transformation in China

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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)
What happens?

2. Interbank market tightens
Annualized Interest Rates (%)

- Average WMP Return (Maturity ≤ 1 Yr)
- Average Interbank Repo Rate (Overnight)
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%
The Size of the Shadow Sector

- Regulatory arbitrage (sources of fund)
  - WMPs \( \approx 24\% \) of GDP in 2014 (China Banking Association)
  - Non-guaranteed WMPs \( \approx 15\% \) of GDP in 2014 (WIND)

- A broader definition (uses of fund)
  - Trust loans + Entrusted loans + Undiscounted banker’s acceptances ... \( \approx 35\% \) of GDP in 2014 (NBS)
The Big Four

- Large in size: half of the market share

<table>
<thead>
<tr>
<th>Rank</th>
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<tbody>
<tr>
<td>25th</td>
<td>ICBC</td>
<td>59th</td>
<td>BoC</td>
</tr>
<tr>
<td>38th</td>
<td>CCB</td>
<td>66th</td>
<td>Bank of American</td>
</tr>
<tr>
<td>47th</td>
<td>ABC</td>
<td>77th</td>
<td>HSBC</td>
</tr>
<tr>
<td>57th</td>
<td>JP Morgan Chase</td>
<td>82nd</td>
<td>Citigroup</td>
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- Extensive price and quantity coordination
  - All firmly controlled by the party
  - Job rotation in the big four and regulatory bodies

Large in size: half of the market share
Big Banks: Not Constrained by the Loan-to-Deposit Limit
Big Banks: The Main Liquidity Provider

- Repo Trading Volume (RMB Trillions)
- Net Repo Lending by Big Banks (% of Volume)
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 $j$:
  
  $D_j =$ traditional deposits
  
  $W_j =$ wealth management products (WMPs)
  
  $\tau_j =$ fraction of WMPs sent off-b/s
  
  $R_j =$ reserves

- Bank’s liabilities:
  
  $$D_j + (1 - \tau_j) W_j + \tau_j W_j$$

  on-b/s

  off-b/s

- Bank’s assets:
  
  $$R_j + D_j + (1 - \tau_j) W_j - R_j + \tau_j W_j$$

  reserves

  on-b/s loans

  off-b/s loans

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

- Loans are long-term:

\[
\begin{align*}
    t & = 0 & t & = 1 & t & = 2 \\
    $1 & \rightarrow & $0 & \rightarrow & $ (1 + i_A)
\end{align*}
\]

- Deposits and WMPs are short-term:

\[
\begin{align*}
    t & = 0 & t & = 1 & t & = 2 \\
    $1 & \rightarrow & $(1 + i_B) & \rightarrow & \left\{ \\
        & & & \text{if } D_j & $(1 + i_B)^2 \\
        & & & \text{if } W_j & $(1 + i_B)^2 + \xi_j
    \right. 
\end{align*}
\]

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

1. Fixed $i_A$ and $i_B$

2. Loan-to-deposit limit:

$$\frac{D_j + (1 - \tau_j) W_j - R_j}{D_j + (1 - \tau_j) W_j} \leq (1 - \alpha) \cdot \frac{D_j + (1 - \tau_j) W_j}{D_j + (1 - \tau_j) W_j}$$

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 $D_j$, $W_j$, $\xi_j$, $\tau_j$, 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) [R_j - \bar{\theta} (1 + i_B) (D_j + W_j)]}_{\text{from surplus/shortage of reserves at } t=1}

- \underbrace{(1 - \bar{\theta}) \left[(1 + i_B)^2 (D_j + W_j) + \xi_j W_j\right]}_{\text{final payment to savers at } t=2} - \frac{\phi}{2} \underbrace{(D_j + W_j)^2}_{\text{operational costs}}
$$
Denote $\bar{\xi}$ the average WMP returns. Assume:

$$W_j = \omega \xi_j,$$

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

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

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

$$R_j + \Psi(i_L) = \bar{\theta}(1+i_B)$$

available liquidity \hspace{1cm} \text{required liquidity}

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

$$\bar{\xi}_j = \frac{f(i_L) - \phi}{2(1 - \theta)} \times \rho + \frac{\alpha \mu_j \tau_j}{2(1 - \theta)}$$

  competitive motive for issuing WMPs \hspace{1cm} \text{reg. arbitrage motive}

- Consider low $\rho$ and $\alpha$ to match negligible issuance before 2008
The Benchmark Doesn’t Work!

Proposition:

1. Increasing $\alpha$ above some threshold makes $\tau_j\xi_j$ positive
2. But $i_L$ is highest at zero $\alpha$ (market mechanism at work)
3. Creditshrinks as $\alpha$ 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 \(\xi_k, \xi_j,\) and interbank rate

Allocation of household savings:

\[
D_j + W_j = 1 - \delta + \rho (\xi_j - \xi) + \rho_1 (\xi_j - \xi_k),
\]

\[
D_k + W_k = \delta + \rho_1 (\xi_k - \xi_j).
\]

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, $\bar{\zeta}_j = \bar{\zeta}_j$ and
  - Market clearing when big bank’s withdrawal shock is high:
    \[
    R_j + R_k + \Psi \left( i^h_L \right) = (1 + i_B) \left[ \bar{\theta} (D_j + W_j) + \theta_h (D_k + W_k) \right]
    \]
  - To simplify, $i^l_L = i_B$ when big bank’s withdrawal shock is low

- At $t = 0$, the big bank chooses $\bar{\zeta}_k$, $\tau_k$, and $R_k$ to maximize its expected profit subject to:
  1. Liquidity rule $\lambda_k \geq \alpha$
  2. Small bank optimality conditions for $\zeta_j$, $\tau_j$, and $R_j$
  3. $i^h_L$ 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 \( \alpha \).

- Introduce a regulation of \( \alpha = \bar{\theta} \). Parameters exist such that:
  1. Small banks issue off-b/s WMPs \((\xi_j > 0 \text{ and } \tau_j = 1)\)
  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 $\phi$ 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 ($i^h_L$)
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 $\alpha$):
  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 $\theta$, $\phi_k$, $\omega$, $\delta_1$, $\rho$ to match
  - $\theta$ : The weighted average seven-day interbank repo rate of 3.6%;
  - $\phi_k$ : The loan-to-deposit ratio of 70% for the big four
  - $\omega$, $\delta_1$, $\rho$ : (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 $\alpha$ from 0.25 to 0.14

<table>
<thead>
<tr>
<th></th>
<th>Model $\alpha = 0.14$</th>
<th>Data 2007</th>
<th>Model $\alpha = 0.25$</th>
<th>Data 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interbank Rate</td>
<td>3.4%</td>
<td>3.3%</td>
<td>3.6%</td>
<td>3.6%</td>
</tr>
<tr>
<td>$W_j (W_k)$</td>
<td>0.03 (0.01)</td>
<td>NA</td>
<td>10% (5%)</td>
<td>10% (5%)</td>
</tr>
<tr>
<td>LDR$_k$</td>
<td>57%</td>
<td>62.5%</td>
<td>70%</td>
<td>70%</td>
</tr>
<tr>
<td>MS$_k$</td>
<td>50.5%</td>
<td>55%</td>
<td>43%</td>
<td>43%</td>
</tr>
<tr>
<td>Total Credit</td>
<td>71.6%</td>
<td>65%</td>
<td>75.4%</td>
<td>75%</td>
</tr>
</tbody>
</table>

- A more disciplined central bank (lower $\psi$) 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:
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

Repo Lending by Big Banks and Repo Rate

- JSCB
- Others
- Interest Rate
Liquidity Absorbed by Big Banks

Repo Lending by Policy Banks

- Big
- JSCB
- Other
Interest Rate Spreads

Difference b/w Overnight Lending and Borrowing Rates

- Big Banks
- JSCB
- City


-1 0 1 2 3
Interest Rate Spreads

Interest Rate for JSCBs:
Weighted Average – Policy Bank

- Overnight
- 7 Day
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