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BIS and FRBNY

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\textsuperscript{1} The views expressed in this paper are those of the authors and do not necessarily reflect those of the Federal Reserve Bank of New York, the Federal Reserve System or Bank for International Settlements.
Reserves balances have exploded in the U.S.

- Driven by liquidity support, QE1, change in reinvestment policy and QE2
- Exit: Might need to drain in order to get better control over the federal funds rate e.g. Bech and Klee (2011)
How to drain?

- Shrink balance sheet
  - Sell assets
    - Long term goal: All treasury balance sheet

- Change composition of balance sheet
  - Reverse repos
    - Counterparties: Primary dealers, MMMFs, DIs or GSEs

- **Term deposits**
  - Deposits that cannot be withdrawn for a period of time (penalties)
  - Key funding source for commercial banks but not CBs

- Other
  - SFP (US Treasury), reserve requirements
Overview of Central Bank Term Deposit Facilities
- Design
- Results

Flavor of our model
- Standard demand for reserves model in corridor system
- Add credit risk
- Add Term Deposit Facility

Validate model using Reserve Bank of Australia data

Conclusion
Term Deposits and Central Banking

- 2004 IMF survey of CB tools:
  - Use of overnight deposit facilities increasing
  - Term deposits only used by a few CBs (emerging or developing)
- Now! Term deposits are in vogue among central banks
  - Sep. 24, 2008: Reserve Bank of Australia
    - Sterilize impact of longer term repo transactions
    - Keep cash rate at target. Discontinued March 2009
  - Dec. 28, 2008: Federal Reserve announcement
    - Exit strategy tool, only small-scale auctions so far
  - May, 17, 2010: European Central Bank
    - Narrow objective: Sterilize impact of Securities Markets Program
  - August 31, 2010: Bank of Korea
    - Market-Friendly Monetary Stabilization Accounts
    - “non-residents’ increased investment in domestic securities”
## Key Features of Term Deposit Facilities

<table>
<thead>
<tr>
<th>Feature</th>
<th>RBA</th>
<th>FED</th>
<th>ECB</th>
<th>BoK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auction Type</td>
<td>Discrimatory</td>
<td>Uniform</td>
<td>Discrimatory</td>
<td>Uniform</td>
</tr>
<tr>
<td>Bid measure</td>
<td>Spread to target</td>
<td>Rate</td>
<td>Rate</td>
<td>Rate</td>
</tr>
<tr>
<td>Max. bid rate</td>
<td>Discretion</td>
<td>Primary Credit</td>
<td>MRO rate</td>
<td>Discretion</td>
</tr>
<tr>
<td>Noncomp. bids</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Max bid amount</td>
<td>100%</td>
<td>25%</td>
<td>100%</td>
<td>Discretion</td>
</tr>
<tr>
<td>Duration</td>
<td>≤26 days</td>
<td>≤84 days</td>
<td>1 week</td>
<td>28 days</td>
</tr>
<tr>
<td>Amount</td>
<td>≤5.5B AUD</td>
<td>≤$5B</td>
<td>Equal to SMP</td>
<td>≤$1.5T KRW</td>
</tr>
<tr>
<td>Settlement</td>
<td>T+1</td>
<td>T+3</td>
<td>T+1</td>
<td>T+0</td>
</tr>
<tr>
<td>Intraday credit</td>
<td>No</td>
<td>Collateral</td>
<td>Collateral</td>
<td>No</td>
</tr>
<tr>
<td>Callable</td>
<td>Penalty</td>
<td>No</td>
<td>No</td>
<td>Discretion</td>
</tr>
</tbody>
</table>

**Notes:** Based on observations as of Mar. 8, 2011, SMP = Securities Market Program

MRO = Marginal Refinancing Operations
RBA: Settlement Balances, Term Deposits and Cash Rate
Weekly data

Bech and Hilton (BIS and FRBNY)
Drain, Baby, Drain
RBA: High, Low and Weighted Avg. Spread to Target
7-day Auctions

Bech and Hilton (BIS and FRBNY)

Drain, Baby, Drain
### Federal Reserve - Small-scale Offerings

<table>
<thead>
<tr>
<th>Auction Date</th>
<th>Term</th>
<th>Competitive. Amount Offered</th>
<th>Non-Comp. Amount Awarded</th>
<th>Bid to Cover Ratio</th>
<th>Stop Out Rate %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jun. 14</td>
<td>14</td>
<td>1</td>
<td>152</td>
<td>6.14</td>
<td>0.270</td>
</tr>
<tr>
<td>Jun. 28</td>
<td>28</td>
<td>2</td>
<td>121</td>
<td>5.57</td>
<td>0.270</td>
</tr>
<tr>
<td>Jul. 12</td>
<td>84</td>
<td>2</td>
<td>199</td>
<td>3.70</td>
<td>0.310</td>
</tr>
<tr>
<td>Oct. 4</td>
<td>28</td>
<td>5</td>
<td>113</td>
<td>2.72</td>
<td>0.269</td>
</tr>
<tr>
<td>Nov. 29</td>
<td>28</td>
<td>5</td>
<td>113</td>
<td>2.93</td>
<td>0.260</td>
</tr>
<tr>
<td>Feb. 7</td>
<td>28</td>
<td>5</td>
<td>70</td>
<td>2.52</td>
<td>0.260</td>
</tr>
<tr>
<td>Apr. 4</td>
<td>28</td>
<td>5</td>
<td>81</td>
<td>2.20</td>
<td>0.260</td>
</tr>
<tr>
<td>May 31</td>
<td>28</td>
<td>5</td>
<td>87</td>
<td>2.17</td>
<td>0.259</td>
</tr>
<tr>
<td>Jul. 25</td>
<td>28</td>
<td>5</td>
<td>88</td>
<td>1.26</td>
<td>0.280</td>
</tr>
<tr>
<td>Sep. 19</td>
<td>28</td>
<td>5</td>
<td>77</td>
<td>2.41</td>
<td>0.265</td>
</tr>
</tbody>
</table>

Source: Federal Reserve

Source: Federal Reserve - (BIS and FRBNY)
Bech and Hilton (BIS and FRBNY)

Drain, Baby, Drain
Modeling Strategy

- Take standard demand for reserves model in a corridor system
- Add credit risk (fit financial crisis)
- Assume an expanded central bank balance sheet
- Add one period auction based "term" deposit facility (TDF)
- Only in paper
  - Add multiple periods [soon!]
  - Look at standing TDF
End of day balance: \( B_i = R_i + \varepsilon_i \) payment shock, \( \varepsilon_i \sim F_i \)

Expected Profit: \( E[\Pi_i(R_i)] = E[r_{ior}B_i1_{B_i>0} + r_{dw}B_i1_{B_i<0} - \rho R_i] \)
- \( 1_x \) is the indicator function, \( \rho \) is the interbank rate.

Key first order condition

\[
\tilde{\rho} = \frac{\rho - r_{ior}}{r_{dw} - r_{ior}} = F_i(-R_i^*)
\]

Woodford (2001): “the demand for [excess reserves is] a function of the location of the overnight rate relative to the [central bank] lending rate and [central bank] deposit rate, but independent of the absolute level of any of these interest rates”.
CB can pin down interbank rate by supplying $R^S = R^T + \nu$ via OMOs.

The inverse demand curve for reserves flattens as the uncertainty increases.
How Crazy is the Model? ECB

- Excess liquidity vs. relative corridor position

![Graph showing ECB excess liquidity and Eonia 5 Day Moving Average over years 2008 to 2011]
Adding Credit Risk

Debelle (2008): “[I]n August 2007, as banks became ... less confident of the credit profile of their counterparties, the inter-bank borrowing markets became quite tight ... the demand curve for ES balances shifted out”
\[ \hat{\rho}_t = (1 + e^{-z_t})^{-1} + u_t \]

\[ z_t = \beta_0 + \beta_1 x_{1t} + \ldots \]

<table>
<thead>
<tr>
<th>Eonia Relative Corridor Position</th>
<th>Daily</th>
<th>Weekly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-1.986</td>
<td>-2.200</td>
</tr>
<tr>
<td></td>
<td>(0.290)</td>
<td>(0.398)</td>
</tr>
<tr>
<td>Excess Reserves</td>
<td>-0.006**</td>
<td>-0.006**</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>CDS/Corridor Width</td>
<td>0.012**</td>
<td>0.014*</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>End of MP</td>
<td>0.662**</td>
<td>0.323**</td>
</tr>
<tr>
<td></td>
<td>(0.111)</td>
<td>(0.115)</td>
</tr>
<tr>
<td>Observations</td>
<td>590</td>
<td>121</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.35</td>
<td>0.36</td>
</tr>
</tbody>
</table>

Notes: Newey-West standard errors in parentheses, MP: Maintenance Period

** and * denotes significance at the 5% and 10% level, respectively.

Bech and Hilton (BIS and FRBNY)
Drain, Baby, Drain
Adding an Auction Based Term Deposit Facility

- **Set up**
  - Assume an expanded CB Balance sheet
  - Banks hold $\tilde{Q}_i$ in CB liabilities. To start with $R_i = \tilde{Q}_i$
  - CB decides to drain $D$ via a TDF. $R^S = \bar{Q} - D$
  - Term = intraday and overnight
  - Auctions conducted and settled at 9:00 am

- **Auction mechanism**
  - Reverse auction: CB is the buyer, banks are sellers
  - Object is the right to supply funds to CB

- The object is divisible and bidders are capacity constrained
  - If $D > \max Q_i$ then at least two banks will have to provide funds
Auction Based Term Deposit Facility

- Banks submit bids in the form of cost schedules $\hat{C}_i(D_i)$.
  - $D_i$ can not be used to offset payment shocks, $\hat{C}_i' \geq 0$.
- Central bank seeks to drain $D$ at least cost, $\min \sum a_i D_i$
  - Design of auction important (ignore here)
- Look at full information case (best case for CB)
  - Banks submit true cost schedules $C_{i}^{true}(D_i)$
  - Banks get no surplus, i.e., $E[\Pi_i(D_i)] - E[\Pi_i(0)] = 0 \Rightarrow$
    $$(a_{i,\min} - \rho(R^S))D_i = -(r_{dw} - r_{ior}) \int_{\bar{Q}_i}^{D_i-\bar{Q}_i} \varepsilon_i f(\varepsilon_i) d\varepsilon_i$$
  - Result: Every (identical) bank
    - supply the same amount, $D_i = \frac{1}{n}D$
    - gets paid the same $a_{i,\min} = a_{\min}$
- Private information $\Rightarrow$ Shading of bids, $\hat{C}_i(D_i) \neq C_{i}^{true}(D_i)$
  $\Rightarrow a_i > a_{\min}$
\[ \tilde{a}_{\text{min}} = \_ \quad \text{and} \quad \tilde{\rho} = \circ, \quad \text{Colors:} \quad \bar{Q} = 1, \quad \bar{Q} = 2 \quad \text{and} \quad \bar{Q} = 4 \]
\[ \tilde{a}_{\text{min}} = \quad \text{and} \quad \tilde{\rho} = \circ, \quad \text{Colors: } \bar{Q}=1, \quad \bar{Q}=2 \quad \text{and} \quad \bar{Q}=4 \]
## RBA Term Deposit Auction Pricing

<table>
<thead>
<tr>
<th>Spread to Target (basis points)</th>
<th>Lowest Accepted</th>
<th>Weighted Average</th>
<th>Highest Accepted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-4.702**</td>
<td>-0.723</td>
<td>1.793*</td>
</tr>
<tr>
<td></td>
<td>(1.141)</td>
<td>(0.761)</td>
<td>(1.006)</td>
</tr>
<tr>
<td>Duration</td>
<td>0.067*</td>
<td>0.075**</td>
<td>0.038</td>
</tr>
<tr>
<td>- days</td>
<td>(0.036)</td>
<td>(0.029)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>Average ANZ and NAB CDS</td>
<td>-0.016**</td>
<td>-0.023**</td>
<td>-0.022**</td>
</tr>
<tr>
<td>- basis points, day of auction</td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>TDs/(TDs+ES Balances)</td>
<td>6.795**</td>
<td>2.821**</td>
<td>0.329</td>
</tr>
<tr>
<td>- week of auction</td>
<td>(1.030)</td>
<td>(0.814)</td>
<td>(1.532)</td>
</tr>
<tr>
<td>Observations</td>
<td>95</td>
<td>95</td>
<td>95</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.41</td>
<td>0.25</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Notes: Newey-West standard errors in parentheses, ** and * denotes significance at the 5% and 10% level, respectively.
Conclusion

- The limited data on TDs auctions consistent with model
  - The more the CB drains the more the CB has to pay (per dollar)
  - Longer term more expensive
  - Credit risk important

- Are lessons valid for the Federal Reserve’s Exit? Yes, but ...
  - The purposes of other CBs different in scale and scope
    - Fed’s operations potentially different orders of magnitude
  - Model does not include non-DIs
    - Reverse repos with MMMF, dealers or GSEs
  - No GSEs in interbank market (Bech and Klee, forthcoming CR/JME)

- Other CBs’ TDFs have some interesting features
  - Callable, spread to target, no limits, discretion, quick settlement

- Caution: ECB and BoK have not always drained desired amount