The Liquidity Coverage Ratio and Monetary Policy Implementation

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Basel III introduces a framework for **liquidity** regulation

- **objective**: ensure banks hold a more liquid portfolio of assets, limit maturity mismatch

- **Two components**:
  - **Liquidity Coverage Ratio (LCR)**:
    - bank must have sufficient quantity of high-quality liquid assets to survive as 30-day period of market stress
  - **Net Stable Funding Ratio (NSFR)**
    - establishes minimum amount of funding from “stable” sources

- **Scheduled implementation**: Jan 2015 (LCR), Jan 2018 (NSFR)
Definition

\[ LCR = \frac{\text{Stock of unencumbered high-quality liquid assets}}{\text{Net cash outflows in a 30-day stress scenario}} = \frac{HQLA}{NCOF} \]

- **HQLA**: cash, reserves, govt. bonds, certain other securities
- **NCOF Scenario**: partial loss of retail deposits, significant loss of wholesale funding, contractual outflows from a 3-notch ratings downgrade, and substantial calls on off-balance sheet exposures

- Requirement:

  \[ HQLA \geq NCOF \]

  or

  \[ LCR \geq 100\% \]
How might the introduction of an LCR affect monetary policy implementation?

Many central banks target the interest rate on interbank loans ...
... of reserve balances (a high-quality liquid asset)

If the LCR changes the demand for such loans,
- it seems likely to change the structure of market interest rates

Would like to understand:
- how the LCR is likely to affect interbank interest rates
- whether these effects could impair a CB’s ability to move the interest rate to target
Our approach

- Develop a simple model to analyze this issue
  - difficult question; this is a first step
  - goal is to identify possible implications of the LCR
- We start with a standard framework based on Poole (1968), others
  - add an LCR requirement, term interbank lending
- We study a generic operational framework
  - symmetric corridor system; no reserve averaging
  - can be adapted to specific approaches of various central banks
When banks face the possibility of an LCR shortfall:

- the LCR tends to push down the overnight rate
- yield curve becomes steeper at the very short end

Moreover, the form of central bank operations matters (treasury securities vs. other assets; counterparties; purchases vs. repos)

- in some cases, LCR makes overnight rate more responsive to OMOs, but in other cases it becomes less responsive
- in some cases, yield curve steepens as the central bank adds reserves, but in other cases it flattens

Conclude: the LCR will make implementing monetary policy more difficult

- central banks may want to rethink their operational procedures
Review the standard model of monetary policy implementation

Introduce the LCR
- two general results

Effects of open market operations
- examine four different types of operations
- show the outcomes are different in each case

Possible adjustments

Committed credit lines

Conclusions
Each bank begins with:

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loans (L)</td>
<td>Deposits (D - \varepsilon)</td>
</tr>
<tr>
<td>Bonds (B)</td>
<td>Interbank borrowing (\Delta)</td>
</tr>
<tr>
<td>Reserves (R + \Delta - \varepsilon)</td>
<td>Equity (E)</td>
</tr>
</tbody>
</table>

Faces a reserve requirement:

\[
\text{Reserves} \geq K
\]

Can borrow and lend in an overnight interbank market.

After markets close, bank experiences end-of-day payment shock \(\varepsilon\):

- unanticipated late-day customer payment (or deposit inflow)

If \(R + \Delta - \varepsilon < K\), bank must borrow from central bank’s standing facility.
- Bank chooses $\Delta$ to maximize expected profit

$$\Pi = r_LL + r_BB - r_DD + r_{IORR}K - r\Delta + \begin{cases} r_{IOER}(R + \Delta - \varepsilon - K) & \text{if } > 0 \\ r_{DW}(R + \Delta - \varepsilon - K) & \text{if } < 0 \end{cases}$$

- Given $R + \Delta - K$, amount bank must borrow from discount window is: 

- Optimal choice:

$$r = r_{IOER} \times \text{prob}[- \varepsilon < \varepsilon_K] + r_{DW} \times \text{prob}[\varepsilon > \varepsilon_K]$$
Equilibrium

- Net interbank lending $= 0 \Rightarrow \varepsilon_K^*$ is determined by $R - K$

$$r^* = r_{IOER} (\text{prob}[\varepsilon < \varepsilon_K^*]) + r_{DW} (\text{prob}[\varepsilon > \varepsilon_K^*])$$

- Central bank influences $r^*$ through open market operations
  - only the size of the operation ($\Delta R$) matters; not the structure
Our model

- Include both overnight and term loans
  - but still an essentially static framework
- Introduce an LCR requirement:
  \[ LCR = \frac{B + R + \Delta + \Delta_T}{\theta_D D + \Delta} = \frac{HQLA}{NCOF} \]
- Runoff rates for different types of liabilities:
  - deposits: \( \theta_D = 5\% \) or \( 10\% \)
  - overnight borrowing: \( 100\% \)
  - term borrowing: \( 0\% \)
- Banks again begin the period with:

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</tr>
<tr>
<td>Bonds ( B )</td>
<td>Interbank borrowing ( \Delta + \Delta_T )</td>
</tr>
<tr>
<td>Reserves ( R + \Delta + \Delta_T - \varepsilon )</td>
<td>Equity ( E )</td>
</tr>
</tbody>
</table>

- Reserve requirement is still:

\[
\text{Reserves} \geq K
\]

- Borrow and lend in both overnight and term overnight interbank markets

- Both markets close, then bank experiences end-of-day payment shock \( \varepsilon \)
• Bank borrows from CB if needed to meet *either* requirement

• Amount borrowed \((X)\) satisfies both

\[
R + \Delta + \Delta_T - \varepsilon + X \geq K
\]

and

\[
LCR = \frac{B + R + \Delta + \Delta_T - \varepsilon + X}{\theta_D(D - \varepsilon) + \Delta + \theta_{DW}X} \geq 1
\]

• Borrowing from central bank has runoff rate of \(\theta_{DW}\)

  • baseline case: \(\theta_{DW} = 0\%\) (*i.e.*, DW is treated as term funding)
In equilibrium:

\[ r^* = r_{IOER}(\text{prob}[\varepsilon < \hat{\varepsilon}]) + r_{DW} \text{prob}[\varepsilon > \hat{\varepsilon}] \]

\[ r_T^* = r^* + (r_{DW} - r_{IOER})\text{prob}[\varepsilon_C < \varepsilon < \hat{\varepsilon}] \]
If the LCR is a binding concern in some states of nature (that is, if $\varepsilon_C^* < \varepsilon_K^*$):

1. the overnight rate $r^*$ is lower than in the standard model
2. the term rate $r_T^*$ is higher than in the standard model

In addition, open market operations change banks’ LCR position (that is, change $\varepsilon_C^*$)

- direction, size of change depend on how operation is structured

$\Rightarrow$ effect of an operation on $(r^*, r_T^*)$ depends on how it is structured

- next: examine four possibilities
OMOs (1): Purchases of HQLA from banks

- Suppose central bank buys bonds and banks are net sellers
- Operation leaves the LCR of the banking system unchanged:

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\[ LCR_z = \frac{B - z + R + z}{\theta_D D} = LCR_0 \]

- the likelihood of a bank violating its LCR constraint is unchanged
- but the likelihood of violating its reserve requirement falls

⇒ equilibrium term premium must increase
- Start from a situation where the LCR is never a binding concern:

- When central bank buys bonds:

- same $r^*$ as with no LCR
- no term premium

- $r^*$ falls more than in the standard model
- a term premium arises
- Effect of open market operations on equilibrium interest rates

- assuming initial LCR of the banking system is well above 100%

As reserves increase, eventually LCR is a binding concern in some states
If the initial LCR of the banking system is lower:

- Adding reserves tends to create a term premium.
- Overnight rate becomes highly responsive to $z$.
- Term rate becomes unresponsive to $z$.

Results:
- Adding reserves tends to create a term premium.
- Overnight rate becomes highly responsive to $z$.
- Term rate becomes unresponsive to $z$. 

OMOs (2): Purchases of non-HQLA from banks

- Now suppose central bank buys $z$ loans (non-HQLA) from banks
- Operation raises the LCR of the banking system:

\[
\begin{align*}
\text{Assets} & \quad \text{Liabilities} \\
\text{Loans} & \quad L - z \quad \text{Deposits} \quad D \\
\text{Bonds} & \quad B \\
\text{Reserves} & \quad R + z \quad \text{Equity} \quad E \\
\end{align*}
\]

\[
\Rightarrow LCR_z = \frac{B + R + z}{\theta DD} > LCR_0
\]

- likelihood of a bank violating its reserve requirement falls (as before)
- likelihood of violating its LCR requirement falls by more

\[
\Rightarrow \text{equilibrium term premium tends to decrease}
\]
Effect of open market operations on equilibrium interest rates

- assuming initial LCR of the banking system is well above 100%

As reserves decrease, LCR eventually becomes a binding concern in some states.
If the initial LCR of the banking system is lower:

- Results:
  - **draining** reserves tends to create a term premium
  - overnight rate becomes **less** responsive to \( z \)
  - term rate becomes (slightly) **more** responsive to \( z \)
Now suppose central bank buys \( z \) bonds and net sellers are non-banks.

Operation raises the LCR of the banking system:

\[
\begin{array}{c|c|c|c}
\text{Assets} & \text{Liabilities} \\
\hline
\text{Loans} & L & \text{Deposits} & D+z \\
\text{Bonds} & B & \text{Equity} & E \\
\text{Reserves} & R+z & & \\
\end{array}
\]

\[ LCR_z = \frac{B + R + z}{\theta_D (D + z)} > LCR_0 \]

- likelihood of a bank violating both requirements falls (as before)
- relative importance depend on distribution of payment shock

\[ \Rightarrow \text{equilibrium term premium may increase or decrease} \]
Effects of OMOs are a hybrid of the two previous cases:

- Higher initial LCR
- Lower initial LCR

$r^*_D$, $r^*_T$

$r_DW$

$r_{IOER}$

$r^*_T$

$Z$

$Z$

higher initial LCR

lower initial LCR

red: term

blue: overnight
Now suppose central bank conducts repos against HQLA with banks

Operation decreases the LCR of the banking system:

\[
\begin{array}{c|c}
\text{Assets} & \text{Liabilities} \\
\hline
\text{Loans} & \text{Deposits} \\
L & D \\
\text{Bonds} & \text{CB repo} \\
B & z \\
- \text{encumb.} & \frac{z}{1-\alpha} \\
\text{Reserves} & \text{Equity} \\
R + z & E \\
\end{array}
\]

\[
\Rightarrow LCR_z = \frac{B + R - \frac{\alpha}{1-\alpha} z}{\theta_D D} < LCR_0
\]

If haircut (\(\alpha\)) is zero, effect is same as outright purchases

but with a positive haircut …
Effect of open market operations via repos (using HQLA)

- Term premium is larger with repos than with outright purchases
  - difference is increasing in the size of the haircut
Summarizing the results

- An LCR tends to push the **overnight** rate **down** and **term** rate **up**

- The effects of an open market operation depends on the **details** (which were irrelevant in the standard model)
  - in some cases, the overnight rate becomes more responsive to OMOs; in other cases it becomes less responsive
  - in some cases, the term premium widens as reserves are added; in other cases it narrows
  - effects tend to be stronger with repos than with outright purchases/sales
  - some of these factors that may be outside of central bank’s control (i.e., are ultimate counterparties banks or non-banks?)

⇒ Implementing monetary policy may be significantly more difficult
Possible adjustments

- How might a central bank effectively implement monetary policy?
  - Lend assets other than reserves (like TSLF program)
    - separate provision of LCR “liquidity” from discount window
  - Create a committed liquidity facility (CLF)
    - sell committed credit lines; planned in Australia, South Africa
  - Switch to targeting a term rate
  - Allow banks to meet LCR on average over time
- Determining the best approach requires a broader model
  - Need to integrate our analysis with the objectives of the regulation
Committed credit lines

- The LCR rules allow “committed liquidity” to count toward HQLA
  - subject to some rules/restrictions

- In our model:

\[
LCR = \frac{B + R + \Delta + \Delta_T + F}{\theta_D D + \Delta}
\]

where \(F = \) quantity of committed funds

- Let \(\phi = \) price of $1 of committed liquidity
  - no arbitrage \(\Rightarrow\) \(\phi^* = r_T^* - r^*\)
Banks’ demand for committed liquidity in equilibrium:

If committed liquidity can only come from banks:

- equilibrium condition: $F = 0 \implies \phi^*$
- equilibrium term premium unchanged from earlier analysis

Diagram:
- $\phi$ vs $F$ graph with point $\phi^*$
- OMOs shift demand curve right/left.
- If committed liquidity can be supplied from outside the banking system:
  - Mitigates the term premium ...
  - but by moving maturity transformation outside of the banking system
  - OMOs have less impact on term premium, but ... will change $F^*$

Raises financial stability concerns?
- Central bank can create a Committed Liquidity Facility (CLF)

- Can auction a fixed quantity or operate a standing facility
  - Mitigates term premium by moving maturity transformation to the CB
- Would this undermine the purpose of liquidity regulation?
  - Perhaps not (Stein, 2013)
Conclusions

- Analysis is a first step … but offers results that are likely to be general
  - the LCR will tend to push **down** the overnight rate
  - and make the very short end of the yield curve **steeper**
  - both the **structure** and the size of central bank operations matter

**General message:**

- Central banks will likely need to pay attention to the LCR when implementing monetary policy
- More analysis is needed
  - determining more of banks’ portfolio choices within the model
  - tailoring the framework to different operating regimes
Extra Materials
Alternate case: $\theta_{DW} > \theta_D$

- Recall

$$LCR = \frac{B + R + \Delta + \Delta_T - \varepsilon + X}{\theta_D(D - \varepsilon) + \Delta + \theta_{DW}X} \geq 1$$

- LCR rules allow local supervisors to set $\theta_{DW} = 0$ (our baseline case) …
  - … or higher
  - the original LCR rules (in 2010) required $\theta_{DW} \geq 25$

- Analysis above applies to any $\theta_{DW} < \theta_D$

- For $\theta_{DW} < \theta_D$ …
When $\theta_{DW} > \theta_D$

In equilibrium:

$$r^* = r_{IOER} (\text{prob}[\varepsilon < \varepsilon_K] + \text{prob}[\varepsilon > \hat{\varepsilon}]) + r_{DW} \text{prob}[\varepsilon_K < \varepsilon < \hat{\varepsilon}]$$

$$r_T = r^* + \frac{r_{DW} - r_{IOER}}{1 - \theta_{DW}} \text{prob}[\varepsilon > \hat{\varepsilon}]$$

same basic pattern …
Effect of open market operations on equilibrium interest rates

- assuming initial LCR of the banking system is 100%

Effects highlighted above become stronger as $\theta_X$ increases

... but effects are magnified

- Effects highlighted above become stronger as $\theta_X$ increases

$\theta_X > 0$

$\theta_X = 0$
If $\theta_{DW}$ is large enough, the term interest rate can rise above $r_{DW}$:

\[ \frac{1}{1 - \theta_X} > 1 \]

Happens because $1$ of term funding can save a bank from borrowing from the discount window.