LIQUIDITY MISMATCH

MARKUS BRUNNERMEIER, GARY GORTON, and ARVIND KRISHNAMURTHY

PRINCETON and NBER, YALE and NBER, NORTHWESTERN and NBER
Objective

- Measuring and regulating liquidity is widely understood to be an important part of macro-prudential policies
  - Liquidity requirements
  - Liquidity stress-testing
- But ... there is no clear consensus on how to best measure liquidity and liquidity risks.
- Many ideas that are around:
  - “Cash is king;” Treasuries have good liquidity risk
  - Basel 3: LCR and NSFR
  - Liquidity and leverage
  - Maturity transformation and liquidity
Outline

1. What is the right target?
   - What are we trying to measure/regulate? LMI
2. Why is the LMI a good measure?
   - Examples

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Liquidity Creation by Financial Sector

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
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<tbody>
<tr>
<td>$100 Illiquid Long-term Loans</td>
<td>$10 Equity</td>
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<td>$90 Demandable Debt</td>
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- Financial sector transforms illiquid assets into liquid assets
  - Liquid asset = promise of cash redemption
  - Profit = “liquidity premium”

- Subject to aggregate liquidity crises
- Central bank as LLR to backstop private liquidity
  - *Regulation: Control quantity of private liquidity creation*
  - *Regulation: Align private (profit) incentives with social*
Measurement

• Date 0: measurement date
• Date 1: Possible crisis. State $\omega \in \Omega$
• Firm i
  o **(A)ssets**: Securities/loans, derivatives, repo loans, cash
  o **(L)iabilities**: short-term debt, long-term debt, equity
• Measure **liquidity mismatch index** of each firm in each possible state
**Liquidity Mismatch Index (LMI)**

<table>
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<td><strong>Market liquidity</strong></td>
<td><strong>Funding liquidity</strong></td>
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<td>• Can only sell assets at <strong>fire-sale prices</strong></td>
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**Maturity mismatch**

*Brunnermeier, Gorton, Krishnamurthy*
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**Liquidity Mismatch Index** = liquidity of assets minus liquidity promised through liabilities
Liquidity Mismatch Index (LMI)

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<td>Treasuries/cash: λ = 1</td>
<td>Overnight debt: λ = 1</td>
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<td>Overnight repo: λ = .99</td>
<td>Long-term debt: λ = .50</td>
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<td>Agency MBS: λ = .95</td>
<td>Equity: λ = .10</td>
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<td>Private-label MBS: λ = .90</td>
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*Liquidity Mismatch Index* = *liquidity of assets* minus *liquidity promised through liabilities*

Basel 3: Net Stable Funding Ratio, Liquidity Coverage Ratios implicitly assign some λ weights
How to choose $\{\lambda\}$

1. Interest rate spreads on bonds
   - Krishnamurthy-Vissing Jorgenson: Measure the “liquidity convenience” of the asset
2. Repo haircuts
3. Micro-structure measures:
   - Bid-ask spreads
   - Price impact
   - Trading volume or turnover
   - Large empirical finance literature can be used.
Liquidity: $\{\lambda\}$ & Liquidity Risk: $\{\lambda^\omega\}$

- **Example for setting $\{\lambda^\omega\}$**
  - Take a baseline set of $\{\lambda\}$
  - Consider an $\omega$ macro state; We know covariance with aggregate liquidity measure
  - Consider percentage deviations in $\{\lambda^\omega\}$ based on moves of aggregate liquidity measure

- **Empirical finance work has documented time-series variation in aggregate liquidity measures**
  - Bond market liquidity spreads
  - Stock market measures of liquidity
  - Covariances with aggregate risk factors
Liquidity Risk

- \{\lambda^\omega\} for different macro states \(\omega\)
- Firm (or sector) liquidity risk:
  - the vector \{LMI^\omega\} - LMI for each state \(\omega\)
- \{LMI^\omega\} is the liquidity risk taken by the firm
  - Portfolio decision at date 0 is over assets/liabilities
  - Asset/liability choices + realization of uncertainty result in \{LMI^\omega\}
- \(\Delta^{\text{LMI}}\) along different risk factors
Example 1: Liquidity Mismatch

- Bank with $20 of equity and $80 of debt
- Debt: $50 of overnight repo financing; rest is 5-year debt.
- The bank buys one Agency mortgage-backed security for $50 (which is financed via repo at a 0% haircut)
- Loans $50 to a firm for one year.
Example 1: Liquidity Mismatch

- **LMI places a larger weight on repo debt than Agency MBS**
- **This bank’s LMI<0**
Example 1: Liquidity Mismatch

- **Liquidity risk:** What if the firm cannot renew financing?
- **Leverage is a crude measure...**

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- The asset-side is less liquid
- More liquidity mismatch in this example
Example 2: Rehypothecation

- Dealer starts with $10 of equity, invested in $10 of Treasuries
  - Initially no leverage
- Dealer lends $90 to a hedge fund against $90 of MBS collateral in an overnight repo
- Dealer posts $90 of MBS collateral to money market fund and borrows $90 in an overnight repo

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Liquidity Mismatch
Example 2: Leverage Error

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- Leverage = 9X, but little liquidity risk
- LMI nets asset liquidity against liability liquidity
- What if hedge fund loan was 10 days? Liquidity falls...
Example 3: Credit Lines

- Bank with $20 of equity and $80 of debt
- The bank buys $100 of U.S. Treasuries
- Offers a credit line to a firm to access up to $100.
- *Bank has made a contingent commitment of liquidity.*
- *Liquidity risk: $LMI < 0$ in state(s) $\omega \in \Omega$ where credit line is accessed.*
  - *Note: We are most interested in aggregate states $\omega$*
How can you use the LMI?

1. Liquidity aggregation
   - Map, pockets, chains

2. Scenario analysis and liquidity risks
   - $\Delta^{LMI}$ along certain (liquidity) factors

3. Gauging feedbacks and spillovers
   - Liquidity is a general equilibrium phenomenon
Liquidity measures aggregate
- If bank A holds overnight repo on Bank B
  - Bank A is long liquidity, Bank B is short liquidity
  - More generally, there is netting of asset and liability liquidity
- If bank A holds $100 of Treasuries and Bank B holds $100 of Treasuries
  - Total liquidity reflects total holding of $200

Aggregate LMI equals a “liquidity aggregate”
- Analogy to (old days) monetary aggregates
- Monetary aggregation with weights \{\lambda\} along the lines of Barnett

*Note: Measures designed to allow for some cross-checking, like Flow of Funds.*
Liquidity Pockets

- **Sectorial LMI**
  - Guess: Banking sector is net short liquidity
    - But, to whom, how much, etc.
  - Guess: Corporate, household sectors are long liquidity
- **2000 to 2008 build up**
  - Guess: Aggregate liquidity rises (good), but LMI for financial sector is more negative (bad)
- **Identify systemically important institutions**
  - LMI<0 identifies “financial intermediary”
  - Lowest LMIs are the systemically important ones
Liquidity Chains

• Baseline case: Symmetric weights \( \{\lambda\} \)
  - i.e. Asset weights \( \{\lambda\} \) match liability weights \( \{\lambda\} \)

• Consider asymmetric case:
  - Bank A owns $100 short-term repo issued by bank B:
    - Asset weight = 0.95
  - Bank B issues $100 short-term repo:
    - Liability weight = 1

• Measurement: liquidity chains (A owes to B owes to C...) causes a contraction in aggregate liquidity
Summary

• Target – well defined
  ○ Liquidity Mismatch Index
  ○ Captures relevant exposures
  ○ Useful to diagnose systemic liquidity risk

• Relative to Basel III Liquidity Coverage Ratio
  ○ Measure liquidity in $s rather than LCR ratio
  ○ More explicitly capture liquidity risk as a macro-stress event