LIQUIDITY MISMATCH

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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

Liquidity Creation by Financial Sector

Assets	Liabilities
$100 Illiquid Long-term Loans	$10 Equity
	$90 Demandable Debt

- 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
  - (A)ssets: Securities/loans, derivatives, repo loans, cash
  - (L)iabilities: short-term debt, long-term debt, equity

- Measure liquidity mismatch index of each firm in each possible state

Liquidity Mismatch Index (LMI)

A   L

Market liquidity

- Can only sell assets at **fire-sale prices**

Ease with which one can raise money by selling the asset

Funding liquidity

- Can't **roll over** short term debt
- **Margin**-funding is recalled

Ease with which one can raise money by borrowing using the asset as collateral

Maturity mismatch

Liquidity Mismatch Index (LMI)

A	L
Market liquidity	**Funding liquidity**
• Can only sell assets at **fire-sale prices**	▪ Can't **roll over** short term debt ▪ **Margin**-funding is recalled
Ease with which one can raise money by selling the asset	Ease with which one can raise money by borrowing using the asset as collateral

Liquidity ~~Maturity~~ mismatch

Liquidity Mismatch Index = liquidity of assets minus liquidity promised through liabilities

Liquidity Mismatch Index (LMI)

A	L

Market liquidity

- Treasuries/cash: $\lambda = 1$
- Overnight repo: $\lambda = .99$
- Agency MBS: $\lambda = .95$
- Private-label MBS: $\lambda = .90$

Funding liquidity

- Overnight debt: $\lambda = 1$
- Long-term debt: $\lambda = .50$
- Equity: $\lambda = .10$

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 {λ}

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 ω 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 ω
- Firm (or sector) liquidity risk:
  - the vector $\{LMI^\omega\}$ - LMI for each state ω
- $\{LMI^\omega\}$ 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 $\{LMI^\omega\}$
- Δ^{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 <u>Agency mortgage-backed security</u> for $50 (which is financed via repo at a 0% haircut)
- Loans $50 to a firm for one year.

Example 1: Liquidity Mismatch

Assets	Liabilities
$50 1-Year Loan	$20 Equity
$50 Agency-MBS	$50 Repo debt
	$30 5-Year debt

- *LMI places a larger weight on repo debt than Agency MBS*
- *This bank's LMI<0*

Example 1: Liquidity Mismatch

Assets	Liabilities
$50 1-Year Loan	$20 Equity
$50 Agency-MBS	$50 Repo debt
	$30 5-Year debt

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

Example 1: Liquidity Mismatch

Assets	Liabilities
$50 1-Year Loan	$20 Equity
~~$50 Agency-MBS~~	$50 Repo debt
$50 Private-Label-MBS	$30 5-Year debt

- *The asset-side is less liquid*
- *More <u>liquidity mismatch</u> 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

Assets	Liabilities
$10 Treasuries	$10 Equity
$90 Loan to Hedge Fund	$90 of Repo Debt

Example 2: Leverage Error

- 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

Assets	Liabilities
$10 Treasuries	$10 Equity
$90 Loan to Hedge Fund	$90 of Repo Debt

- *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 ω*

How can you use the LMI?

1. **Liquidity aggregation**
   - Map, pockets, chains

2. **Scenario analysis and liquidity risks**
   - Δ^{LMI} along certain (liquidity) factors

3. **Gauging feedbacks and spillovers**
   - Liquidity is a general equilibrium phenomenon

Liquidity Map

- **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 {λ} 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 {λ}
  - i.e. Asset weights {λ} match liability weights {λ}
- ## 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