Liquidity Mismatch

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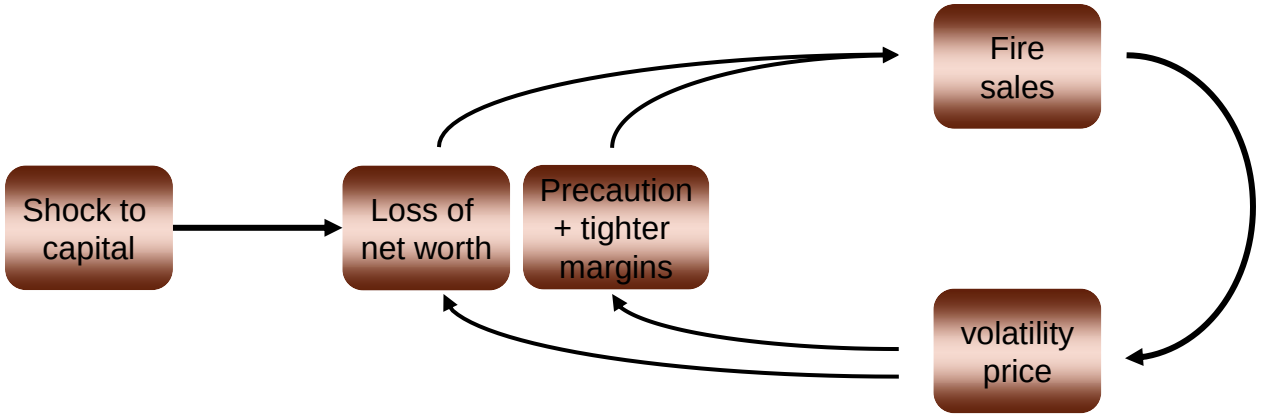
Princeton and NBER, Yale and NBER, Northwestern and NBER

Definition of Systemic risk

- Systemic risk build-up during (credit) bubble
  … and materializes in a crisis
  - "Volatility Paradox" → contemp. measures inappropriate
- Spillovers/contagion – externalities
  - Direct contractual: domino effect (interconnectedness)
  - Indirect: price effect (fire-sale externalities)
    credit crunch, liquidity spirals



- *Adverse GE response* → amplification, persistence

preventive

crisis management

Imbalances and Amplification

- Trigger versus amplification
  - Trigger varies from crisis to crisis and difficult to nail down
  - Amplification effects are similar from crisis to crisis

- Amplification and indirect spillover effects are due to liquidity problems
  - Depends on endogenous response
    - Depends on expectations/beliefs
    - There is hope: "driven by constraints" (rather than maximization)
  - Focus on endogenous response indicator → LMI

position data needed for direct spill-over effects

- General equilibrium phenomenon
  - Risk managers have partial equilibrium perspective
  - Split task

- Shadow banking vs. regulated sector

Data collection (macro-prudentail)

1. Partial equilibrium response to (orthogonal) stress factors
   - In value ΔValue
   - In liquidity mismatch index ΔLMI

financial industry

   - *COLLECT LONG-RUN PANEL DATA SET!*

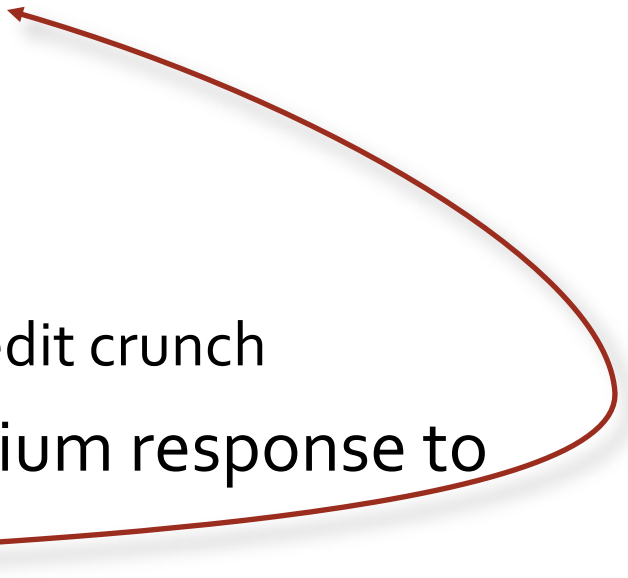
   - … reaction function

2. General equilibrium effects
   - Amplification, persistence

macro-prudential regulators

General equilibrium

- Direct responses to 5%, 10%, 15%,… drop in factor to
  - ΔValue
  - ΔLiquidity Mismatch Index
- Predict response
  - hold out - "fire" sell assets - credit crunch
- Derive likely indirect equilibrium response to
  - this stress factor
  - other factors



Find out whether plans were mutually consistent!
(if not ⟶ tail risk)

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

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 Mismatch Index = liquidity of assets minus liquidity promised through liabilities

Liquidity Mismatch Index (LMI)

A	L
Market liquidity	**Funding liquidity**
▫ Treasuries/cash: λ = 1	▫ Overnight debt: λ = 1
▫ Overnight repo: λ = .99	▫ Long-term debt: λ = .50
▫ Agency MBS: λ = .95	▫ Equity: λ = .10
▫ Private-label MBS: λ = .90	

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

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 o is over assets/liabilities
  - Asset/liability choices + realization of uncertainty result in $\{LMI^{\omega}\}$
- Δ^{LMI} along different risk factors

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
$50 Private-Label-MBS	$30 5-Year debt

- *The asset-side is less liquid (lower liquidity weight)*
- *LMI is more negative*

Example 2: Rehypothecation

- 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

- *LMI>0 because of Treasury holdings*
- *What if hedge fund loan was 10 days? LMI 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.
- *LMI < 0 in state(s)* $\omega \in \Omega$ where credit line is accessed.

Example 4: Derivatives

- Bank with $20 of equity and $80 of debt
- The bank buys $100 of U.S. Treasuries
- Writes protection on a diversified portfolio of 100 investment-grade U.S. corporates, each with a notional amount of $10; so there is a total notional of $1,000.
- *LMI < 0 in state(s) $\omega \in \Omega$ where CDS causes a mark-to-market*

Liquidity Pockets

- Sectorial LMI
  - Guess: Banking sector is net short liquidity
    - But, to whom, how much, etc.
    - LMI of shadow banking
  - 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
  - Asymmetric asset vs. liability λ

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

Stress Testing

- Define $\Lambda = \{\lambda\}$
- Consider stress scenarios as specifying Λ^{ω}
  - Move all $\{\lambda\}$ in a percentage shift
  - Move all λs of MBS in a percentage shift
  - Move all λs of long-term assets in a percentage shift
- Measurement: Identify states of the world where imbalances are high

Liquidity Risk

- $\{LMI^{\omega}\}$ is the *liquidity risk* taken by the firm
  - Portfolio decision at date o is over assets/liabilities
  - Asset/liability choices result in $\{LMI^{\omega}\}$
- Research: Given a time series of $\{LMI^{\omega}\}$, we can build empirical models of firm liquidity choices.
  - Analogy: We use the CEX to model household spending behavior and test asset pricing models.

Example 5: Spillovers

- Many identical banks: $20 equity, $80 debt
- Debt is $40 overnight repo, $50 of 5-year debt.
- Each bank owns $40 of private-MBS, $40 of repo loans (at 0% haircut) to other banks
- Liquidity management: Bank has liquidity to cover losses if MBS prices fall by 5%, but if they fall by more, the bank will not renew its repo loans/raise repo haircuts.

- *Issue: Liquidity management in general equilibrium*

Calibrating Response Function

- In addition, to liquidity, let use measure value (equity or enterprise value) of firm(s) in each state.
- Data presents a history of "date 0"s in varying conditions
  - Each date is a portfolio choice, Δ, as a function of current firm value/liquidity and current state of economy
  - Panel data
  - Estimate/model the portfolio choice of firms.

In sum …

- Risk Topography – 2 step approach
  - 100 factor exposure
    - Value
    - LMI → response indicator
  - General equilibrium amplification
- Liquidity Mismatch replaces Maturity Mismatch
  - Also captures derivatives