RISK TOPOGRAPHY
LIQUIDITY MISMATCH

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IMF-Bundesbank Statistics Conference, Nov. 19th, 2015

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Challenges in data collection

- **Existing data sets in US/EU**
  - Flow of funds – Copeland (1947, 1952), Fed
    - Characterizes money flows within economy
  - Call reports – National Bank Act (1863), FDIC
  - SEC filings
- **Problems**
  - "Level focused" not "risk focused"
  - Old days: risky position was association w/ initial cash flow
    Nowadays: risky position is divorced from initial cash flow
  - Leverage is an outdated concept ➡ risk sensitivities
  - Not focused on systemic interactions (direct, price effects)

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The 2 Components of Systemic Risk

1. Systemic risk build-up during (credit) bubble
   … and materializes in a crisis

2. Spillovers/contagion – externalities
   - Direct contractual: domino effect (interconnectedness)
   - Indirect: price effect (fire-sale externalities)
                        credit crunch, liquidity spirals

preventive

crisis management

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The 2 Components of Systemic Risk

1. Systemic risk build-up during (credit) bubble
   ... and materializes in a crisis
   - "dances as long as the music is playing"
     - All are aware that imbalances/bubbles are building up,
     - But going against it alone is risky
     - Everybody is waiting and "riding the bubble" ...

See e.g. "Bubbles and Crashes"
Abreu-Brunnermeier (2003)

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The 2 Components of Systemic Risk

preventive

1. Systemic risk build-up during (credit) bubble
   … and materializes in a crisis
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     - But going against it alone is risky
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   - "Volatility Paradox": Low volatility indicates problems
   - Data implications:
     - Contemporary risk measures are not useful
     - Focus on imbalances, Liquidity mismatch concentrations
     - Low frequency data is sufficient (monthly), debt/maturity level, ….
     - Less granular (e.g. subsector aggregation possible)

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The 2 Components of Systemic Risk

1. Systemic risk build-up during (credit) bubble
   - "Volatility Paradox" ➔ contemp. measures inappropriate
   - Data: Low frequency, debt/maturity level, …

2. Spillovers/contagion – externalities
   - Direct contractual: - domino effect (interconnectedness)
     - Network effects
     - Bankruptcy of bank A leads to default of B
       - 1st, 2nd, 3rd round effects
       - Random recovery rate
     - Data implications:
       - Position data
       - High frequency
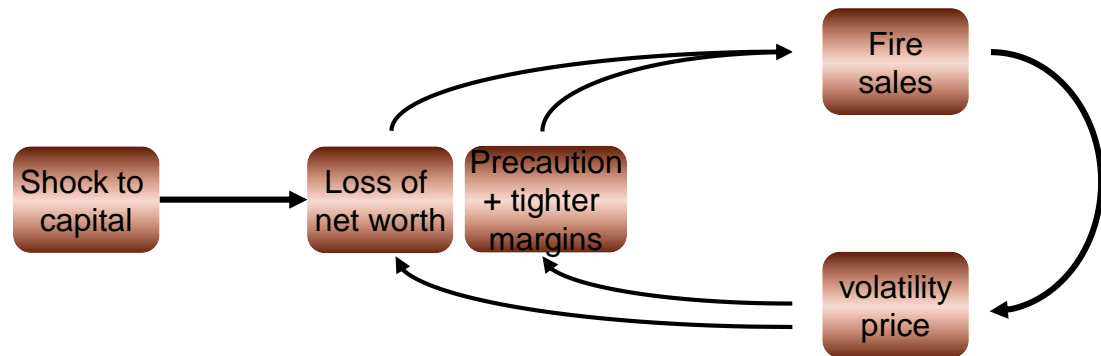   - High granularity
   - Indirect: …
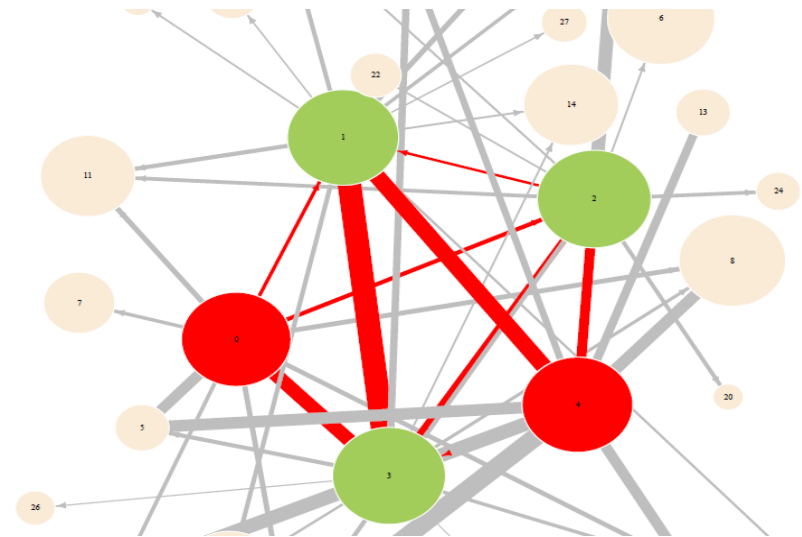
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The 2 Components of Systemic Risk

1. Systemic risk build-up during (credit) bubble
   - "Volatility Paradox" → contemp. measures inappropriate
   - Data: Low frequency, debt/maturity level, …

2. Spillovers/contagion – externalities
   - Direct contractual: - domino effect (interconnectedness)
   - Indirect: - information spillovers
                                      - price effect (fire-sale externalities)
   credit crunch, liquidity spirals

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```
Shock to       →   Loss of   →  Precaution        Fire
capital            net worth    + tighter         sales
                                margins

                                                  volatility
                                                  price
```

Adverse GE response   → amplification, persistence

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Absorber vs. amplifier

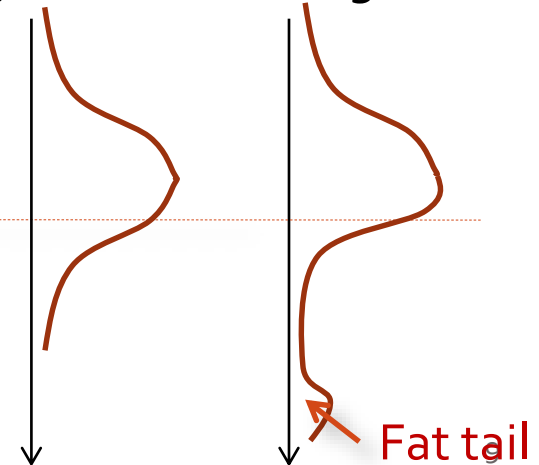| Direct	Indirect
Contractual links	"Virtual links"
Loss through bankruptcy/default	Similar exposure than other levered players
Position data	Response indicator - expectations/ constraints
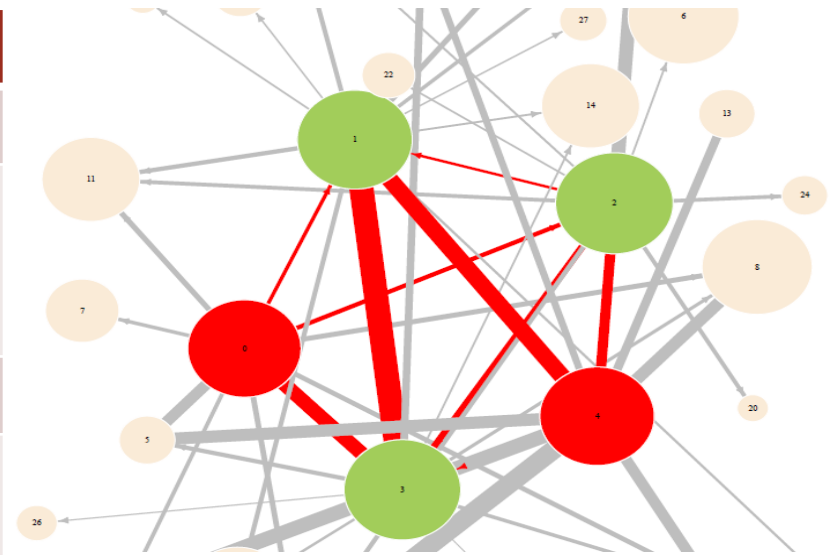
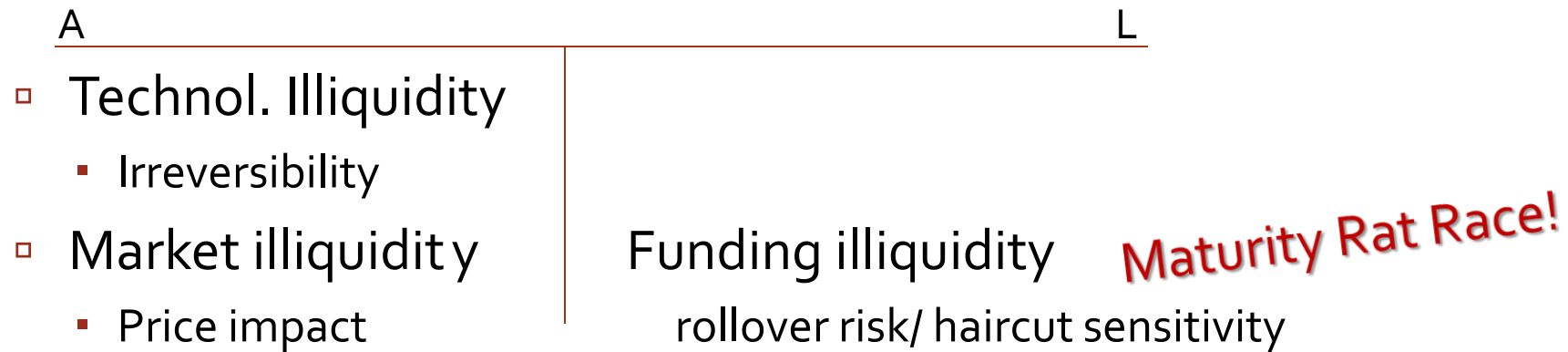Distribution
exogenous   endogenous

- Shock absorber

- Shock amplifier

Fat tail

Absorber vs. amplifier indicator: LMI

- **Liquidity mismatch** – not maturity mismatch

A ————————————————————————————————————— L

- Technol. Illiquidity
  - Irreversibility

- Market illiquidity | Funding illiquidity _Maturity Rat Race!_
  - Price impact | rollover risk/ haircut sensitivity

	Micro-prudential	**Macro-prudential**
Market Illiquidity	exogenous	depends on funding structure of other holders

See Brunnermeier, Gorton & Krishnamurthy 2012

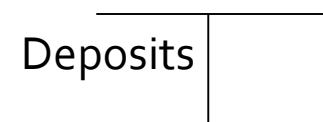Brunnermeier

Liquidity Mismatch: Aggregate & Distribution

1. ## Aggregate

Firms/Households   **Financial sector**   **Households**

Fabric
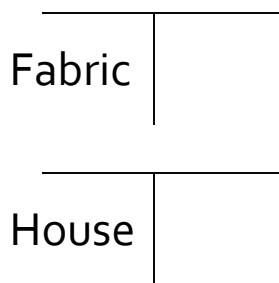
House

....
intermediation
chain/network

Deposits

2. ## Distribution: "Risk pockets" – mutually inconsistent plans

- Risk management strategy/response:
  reduce risk when price moves against them ("cut an run")
  - Example: portfolio insurance in 1987
- Response indicator to differentiate between
  - Deep pocket   rides out liquidity shortage   **Endogenous**
  - Fickle investor   fire-sells   **Response**

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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
Maturity mismatch

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

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Liquidity Mismatch Index (LMI)

A   L

Market liquidity

- Treasuries/bund: $\lambda = 1$
- Overnight repo: $\lambda = .97$
- Agency MBS: $\lambda = .95$
- Private-label MBS: $\lambda = .90$

Funding liquidity

- Overnight debt: $\lambda = 1$
- Long-term debt: $\lambda = .5$
- Equity: $\lambda = .1$

λ are ideally <u>endogenous</u> and time-varying (<u>depend on stress scenario</u>)

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

LMI Map/Topography

- Aggregate perspective
    - Irreversible investment in
        - Firms
        - Housing investment
    - Financed with short-term debt claims held by Households
- Intermediation chain
- Intermediation network – different expertise (e.g. expertise to diversify)
- Identify "shock amplifiers" and "Liquidity SIFIs"

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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

Liquidity: {λ}   &   Liquidity Risk: {λ$^\omega$}

- ■ Example for setting {λ$^\omega$}
  - ▫ Take a baseline set of {λ}
  - ▫ Consider an ω macro state;
    We know covariance with aggregate liquidity measure
  - ▫ Consider percentage deviations in {λ$^\omega$}
    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

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Data collection: 2-Step Approach

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

   - *COLLECT LONG-RUN PANEL DATA SET!*

financial industry collected by micro-prudential regulators

   - ... reaction function

2. General equilibrium effects
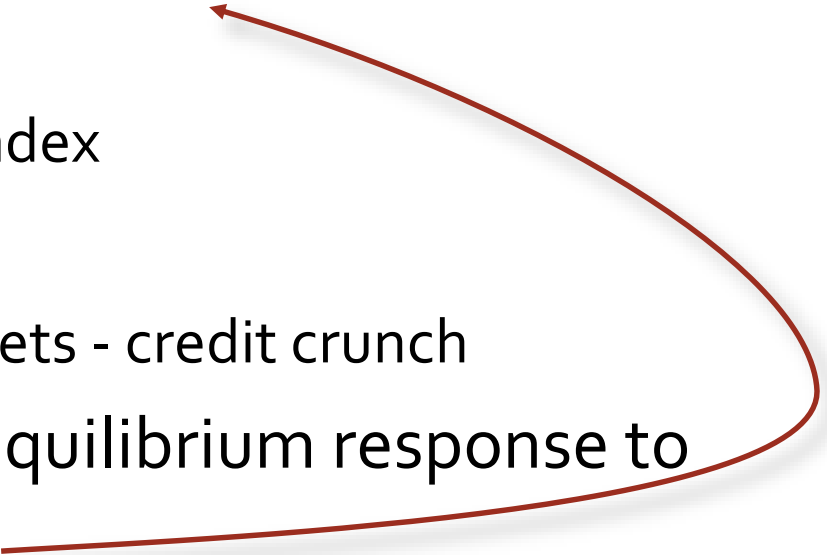   - Amplification, persistence

macro-prudential regulators

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Data collection – an example

- **Direct** responses to 5%, 10%, 15%,… drop in factor to
  - ΔValue
  - ΔLiquidity Mismatch Index

  ~~Liquidity~~ ~~Maturity~~ mismatch

- Predict response
  - hold out
  - "fire" sell assets ⟶ ΔValue
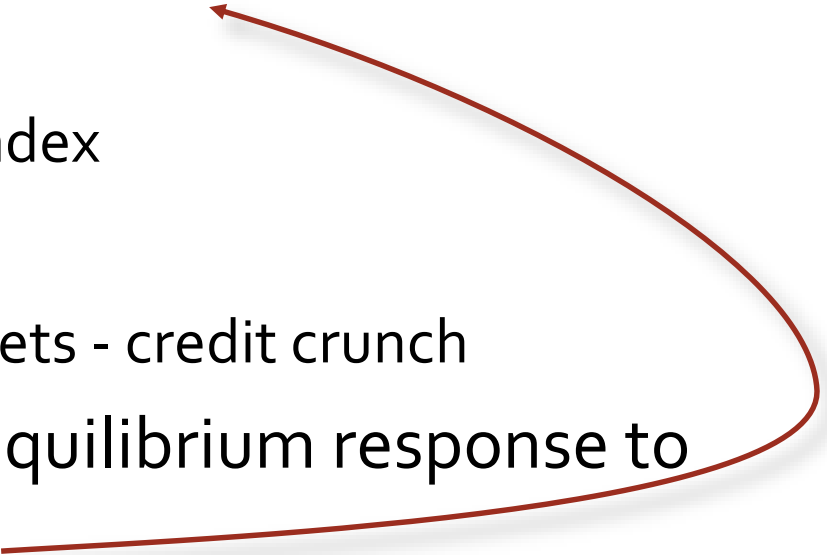 - credit crunch (no new loans) ⟶ ΔLMI

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Data collection: An example

- 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)

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Data collection: An example

- ■ Direct responses to 5%, 10%, 15%,… drop in factor to
  - □ ΔValue
  - □ ΔLiquidity Mismatch Index
- ■ Predict response
  - □ hold out - "fire" sell assets - credit crunch
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  - □ other factors

Non-linearities, externalities, multiple equilibria, amplification, mutually inconsistent planes,…

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

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Choice of stress scenarios

- **Issue 1:** Need core data to form panel data set on which to calibrate response functions
  - Orthogonal stress scenarios on baseline set of factors
  - Repeated observations
- **Issue 2:** Much of the interest at any time t is on special cases
  - Correlated scenarios (cross-scenarios)
  - Tailored scenarios (e.g., Greek default)
- Need both …

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Choice of stress scenarios

- Orthogonal scenarios
  - Market risk scenarios: Interest rate, credit spread, exchange rate, stock price, VIX, commodity prices, commercial and residential real estate
  - Liquidity risk scenarios: Haircut/margin spikes, can't issue debt/sell assets, …
  - Counterparty risk, …

- Cross scenarios
  - Participants repot on combination of factors that lead to worst outcome. "Worst vector in ellipse"
  - Informs stress scenario in next round

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Conclusion

- **2 components of systemic risk**
  - Build-up phase: low frequency, low granularity, LM pockets
  - Crisis/spillover phase:
    - Direct spillovers: granular position data
    - Indirect spillovers: Endogenous response indicator/LMI (not maturity mismatch)
- **Data collection**
  - LMI construction (from balance sheets & market participants)
  - Distribution of liquidity mismatch impacts amplification
  - Put in General Equilibrium model to identify
    - Mutually inconsistent plans
    - GE amplifications through liquidity spirals (λ are a fixed point)

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Difference to repeated stress test

Risk topography

- Response to a list of factors
- GE amplification
- Core stress factors

- "Core stress factors" don't change over time
- **Aim:** create panel data
  - Future research for GE effects
- All financial institutions (including hedge funds, insurance companies, …)

Repeated stress test

- Response to a single stress scenario
- No endogenous amplification
- Interlinked stress scenario
- Stress scenarios change over time
- **Aim:** best stress analysis at each point in time
- Focus on main financial institutions

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Data revelation – "financial stability report"

- **Main tradeoff**
  - Reveal mutually inconsistent plans, help coordinated corrections
  - Outside verification – competition for best model
  - Avoids regulatory capture
  - Creates standard across industry

  - Induce a run "Opacity breeds stability" ?
  - Privacy issues
  - Destroys incentives to create info (Grossman-Stiglitz)

- Scramble data
  - Aggregation
  - Delay

- Data react (form of Lucas critique)

Other issues relevant to data collection

- Cross-checks, verification, sum-up conditions
  - Sectorial Liquidity Mismatch vs. Liquidity Chains
- Horizontal cross-check across institutions
  - Compare valuation models
- Complexity/simplicity
  - Standardization – more correlation
  - Hiding risks
- Snapshots versus average (quarter/year end spikes)

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