Financial stability analytics

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Financial Stability

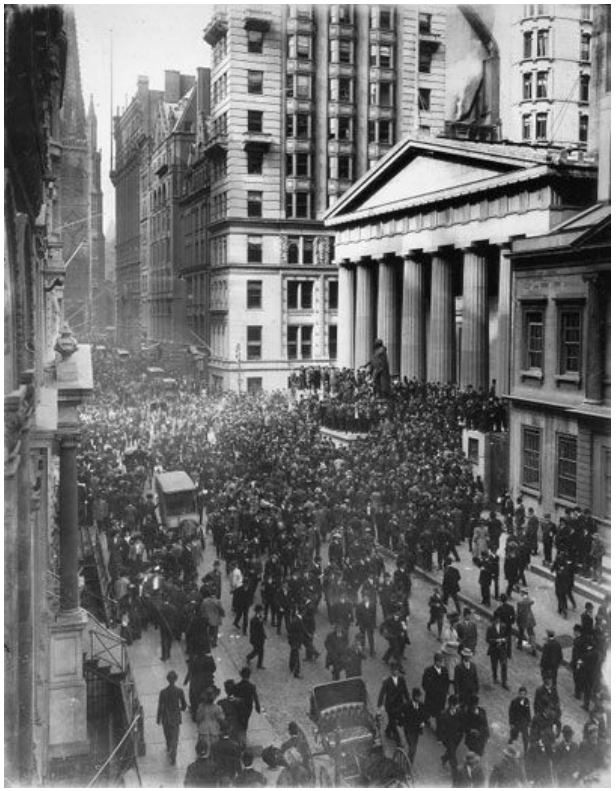
Financial stability as a public good

- Liquidity as an emergent phenomenon
- Risk management fallacy of composition
- Deadweight costs of bankruptcy

Crises and lessons learned – Flood (2014)

- Panic of 1907 → Federal Reserve
- Great Depression → FDIC
- Great Depression → SEC
- Great Depression → Bank of Canada
- Global Financial Crisis → FSOC
- Global Financial Crisis → OFR
- Global Financial Crisis → FCA (U.K.)

Panic of 1907 on Wall St.



Plus ça change …

- The Panic of 2007 as an old-fashioned (shadow) bank run – Gorton (2010)
- This Time is Different – Reinhart and Rogoff (2009)

Image: Smithsonian

What is systemic risk?

- **Two general approaches to a definition**
  - **Focus on the real economy**
    - Systemic risk is a threat to financial stability **"so widespread that it impairs the functioning of a financial system to the point where economic growth and welfare suffer materially"**
      - **European Central Bank (2010, p.138)**
  - **Focus on the financial sector**
    - Systemic risk is **"the potential for widespread financial externalities—whether from corrections in asset valuations, asset fire sales, or other forms of contagion—to amplify financial shocks and in extreme cases disrupt financial intermediation"**
      - **Adrian, Covitz and Liang (2015)**

What is systemic risk?

- **Mechanisms** of systemic risk
  - Global imbalances
    - Caballero and Krishnamurthy (2009)
  - Correlated exposures
    - Acharya, Pedersen, Philippon, and Richardson (2017)
  - Spillovers to the real economy
    - Group of Ten (2001)
  - Information disruptions
    - Mishkin (2007)
  - Feedback behavior
    - Kapadia, Drehmann, Elliott, and Sterne (2009)
  - Asset bubbles
    - Brunnermeier, Rother and Schnabel (2019)
  - Contagion
    - Martínez-Jaramillo, Pérez Pérez, Avila Embriz, and López Gallo Dey (2010)
  - Negative externalities
    - Financial Stability Board (2009)

Diversity of the problem

- **Sources**
  - **Securitization / shadow banking (**2007-09 Financial Crisis**)**
  - **Sovereign debt (**1997 Asian crisis**)**
  - **Equity market bubble (**1999 tech bubble**)**
- **Crisis mechanisms**
  - **Credit surprise (**1998 Russian bond default, LTCM**)**
  - **Market risk (**1973 oil price shock**)**
  - **Operational event (**2010 flash crash**)**
  - **Clearing crisis (**1974 Herstatt crisis**)**
- **Policy responses**
  - **More capital (**Basel III – Common Equity Tier 1**)**
  - **Liquidity reserves (**Basel III – NSFR, HQLA**)**
  - **Greater disclosure (**CCAR/DFAST stress-test data**)**
  - **Rapid resolution (**Qualified Financial Contracts, living wills**)**

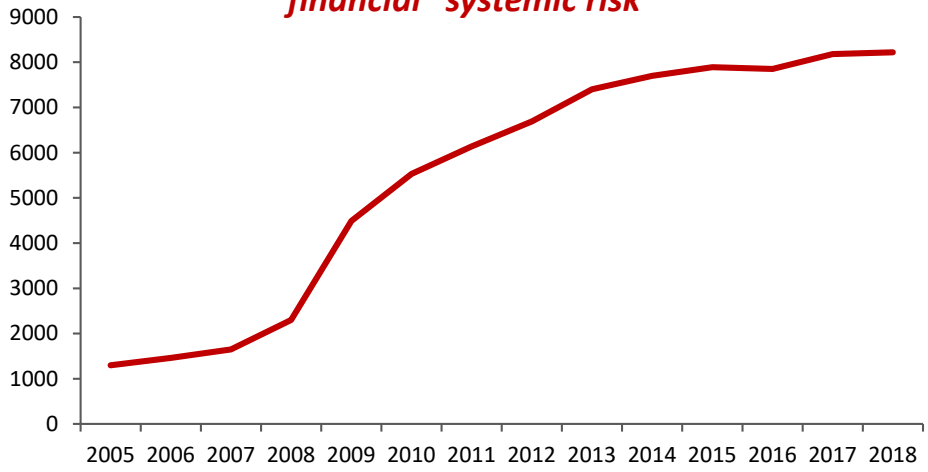
All models are wrong, but some are useful…

Classifying the literature – Four taxonomies – Bisias, et al. (2012)

- **Supervisory scope**
  - Microprudential
    - Securities & commodities
    - Banking & housing
    - Insurance & pensions
    - General applications
  - Macroprudential
- **Research method**
  - Probability-distribution measures
  - Contingent claims and default measures
  - Illiquidity
  - Network analysis
  - Macroeconomic measures
- **Data requirements**
  - Macroeconomic measures
  - Granular foundations and network measures
  - Forward-looking risk measures
  - Stress-test measures
  - Cross-sectional measures
  - Illiquidity and insolvency

Annual scholarly publications, 2005-2018

financial "systemic risk"



- **Event / decision time horizon**
  - Ex-ante
    - Early warning
    - Counterfactual simulation & stress testing
  - Contemporaneous
    - Fragility
    - Crisis monitoring
  - Ex-post
    - Forensic
    - Orderly resolution

Policy implications

Statistical challenges

- **Very** noisy signal environment
  - "Are Home Prices the Next Bubble?" – McCarthy and Peach (2004)

    "… market fundamentals are strong enough to explain the recent path of home prices and that no bubble exists"
  - Fed Bluebook forecast of real GDP as of June 2008 – FOMC (2008)

    +2.0 to +2.8% annually

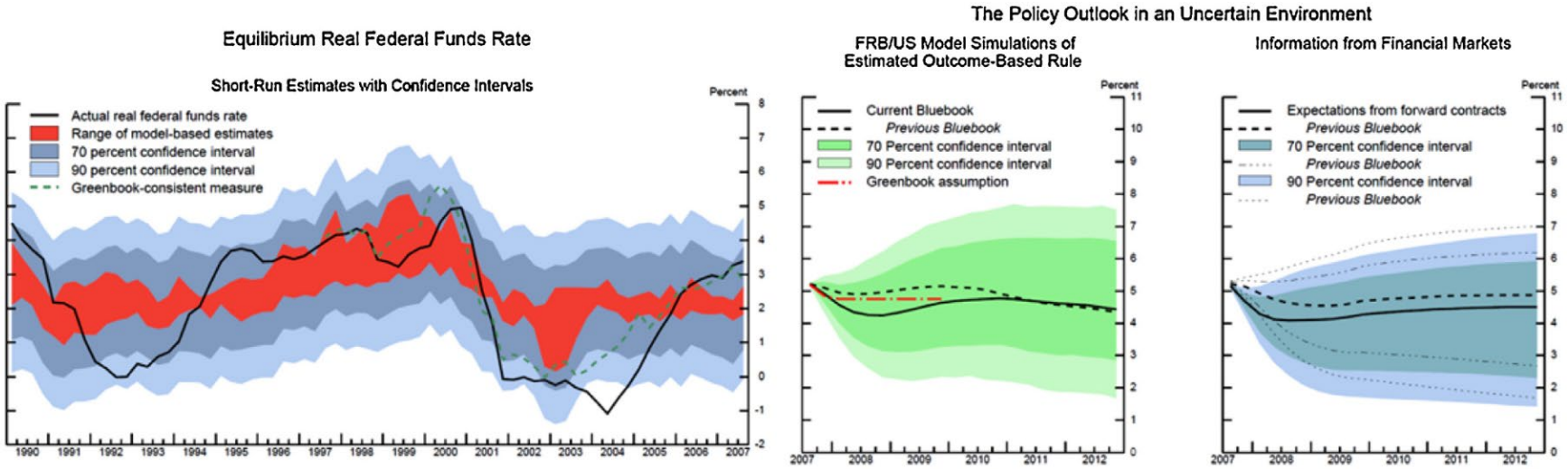


Image: Federal Reserve

Policy implications

Statistical challenges

- **Endogenous policy response to systemic developments**
  - **"Greenspan Put" (asymmetric liquidity provision in response to stress)**
  - **Counterfactuals are not measurable**
- **And endogenous systemic response to policy developments:**
  - ***"Any observed statistical regularity will tend to collapse once pressure is placed upon it for control purposes"*** **– Goodhart's Law (1975)**
  - ***"Any change in policy will systematically alter the structure of econometric models"*** **– Lucas Critique (1976)**
- **"Maginot" problem:**
  - **No single measure is sufficient**
- **Nonstationarity in the statistical regime**
  - **Crisis correlations**
    - **Flight to quality forces ρ≈1.0**
  - **Volatility paradox**
    - **Low market volatility masks risk accumulation**
  - **Revealed loss surprises**
    - **Ex ante, crisis is a low probability event**

Volatility Paradox

S&P 500 Index 90-day Realized Volatility

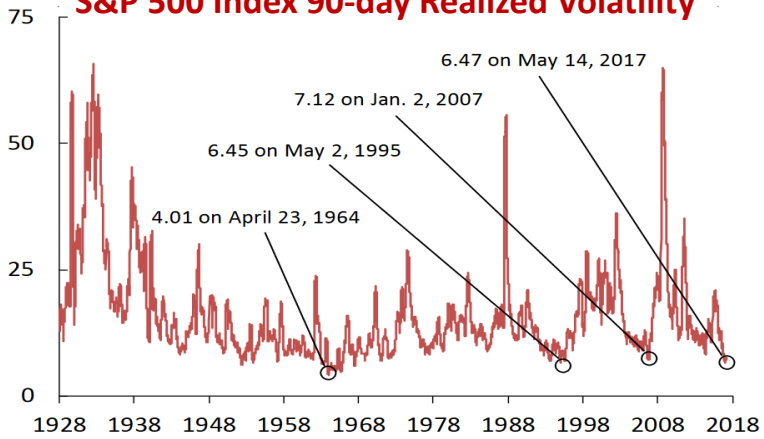


Image: OFR

The big (data) picture

Rise of shadow banking

- Traditional intermediation (banking) drops in half 1950–2018
  - Introduction of option pricing in the 1970s
  - Introduction of collateralized mortgage obligations (CMOs) in the 1980s

Bank-centric blind spots

- Banks are only half the story
- Shadow banking is the rest

Accounting blind spots

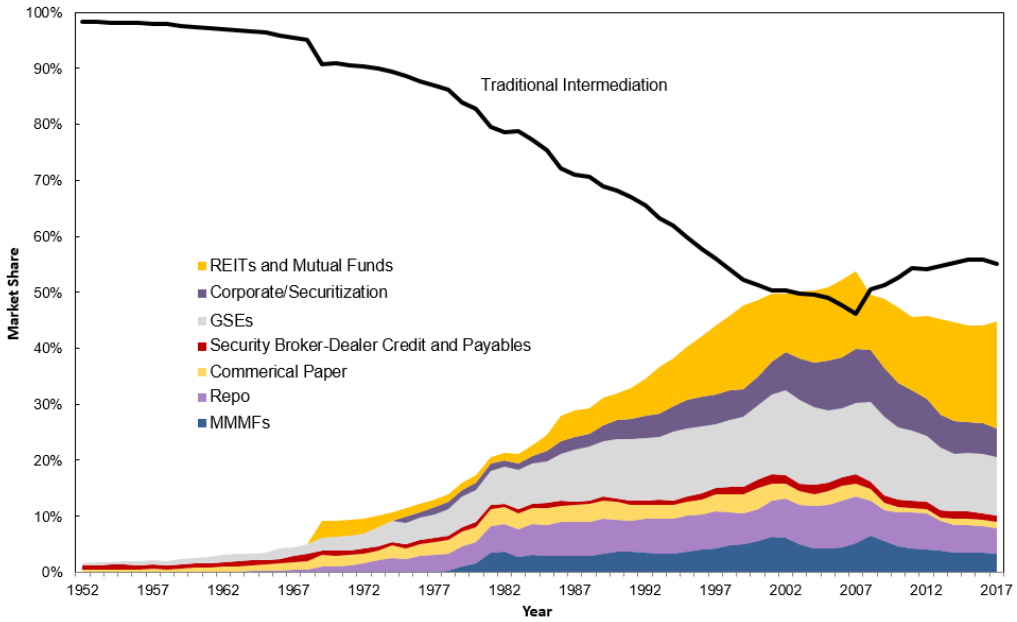
- Historical view
- Monovalent metrics

Contract (network) focus

- Interactions and contagion
- Risk diversity

Data scalability

- Rise of fintech



Trends in credit intermediation, 1952–2017

Big data and financial stability monitoring

Big data is a *scalability problem*

- **Fundamentally issues of implementation**
  "You can't solve exponential problems with linear solutions"
  – Prof. Banny Banerjee

- **Problem contains seeds of its own solution**
  Fight computation with computation

The Four Vs of big-data scalability challenges

- **Volume – sentiment analysis**
- **Velocity – high-frequency trading**
- **Variety – legal entity identifier**
- **Veracity – raw quote/transaction feeds**

Big data and financial stability monitoring

Five Tasks – Flood, Jagadish and Raschid (2016)

1. **System Instrumentation and Data Acquisition**
2. **Data Cleaning and Data Quality**
3. **Data Integration and Representation**
4. **Data Modeling and Analysis**
5. **Data Sharing and Transparency**

Systems Instrumentation and Data Acquisition

Resolution enhancement in four dimensions

- **Coverage** – where are our blind spots?
  - Example: G20 Data Gaps Initiative, FSB-IMF (2015)
- **Frequency** – temporal resolution requirements and limits
  - Example: High frequency trading time stamps, Lombardi (2015)
- **Granularity** – aggregation level (over database rows)
  - Example: Bucketing portfolio risk exposures, Flood & Monin (2016)
- **Detail** – measured and derived attributes (database columns)
  - Example: Fat regression problem (P >> N), Donoho & Stodden (2006)

Information acquisition granularity – Example

Risk-measurement bucketing

- Form PF records risk exposures for private funds (e.g., hedge funds)
- Risk statistics for various sub-portfolios

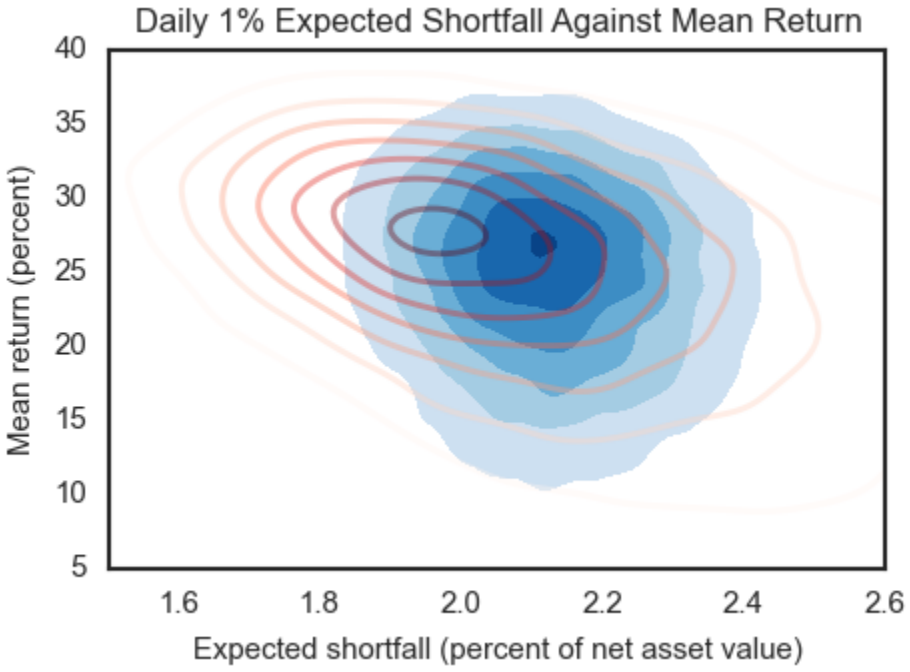


Image: Flood and Monin (2016)

Is the bucketing too coarse?

Measure a vector of risk attributes:

$$R = [\, R_{PF} \mid R^{+} \,]$$

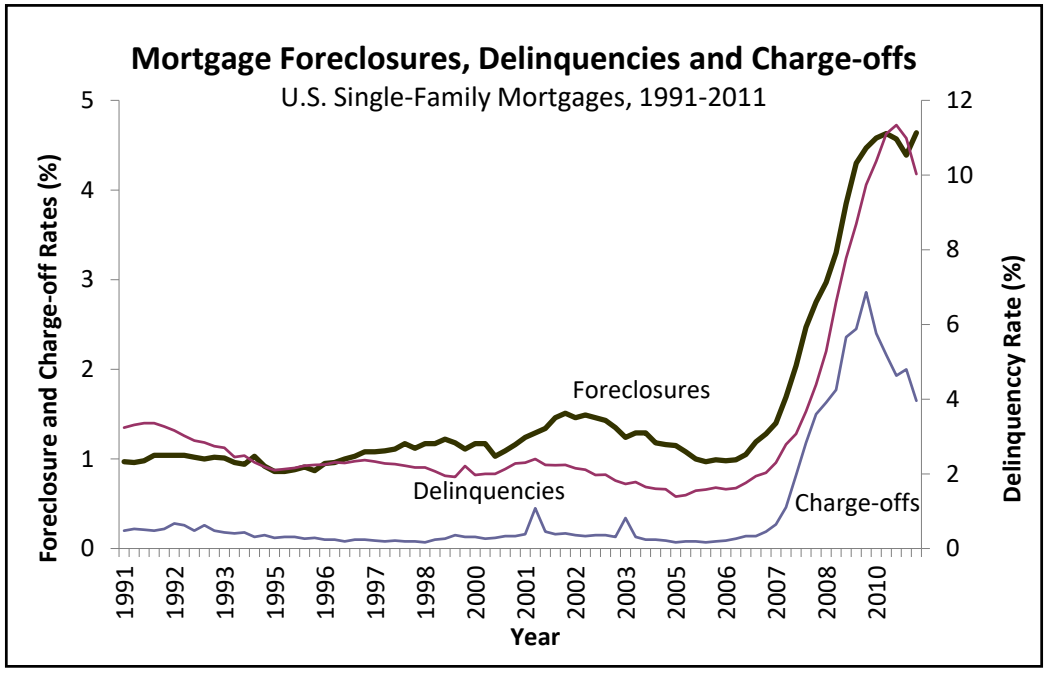
- R = everything you want to know
- R_{PF} = captured on Form PF
- R^{+} = everything else (unmeasured)

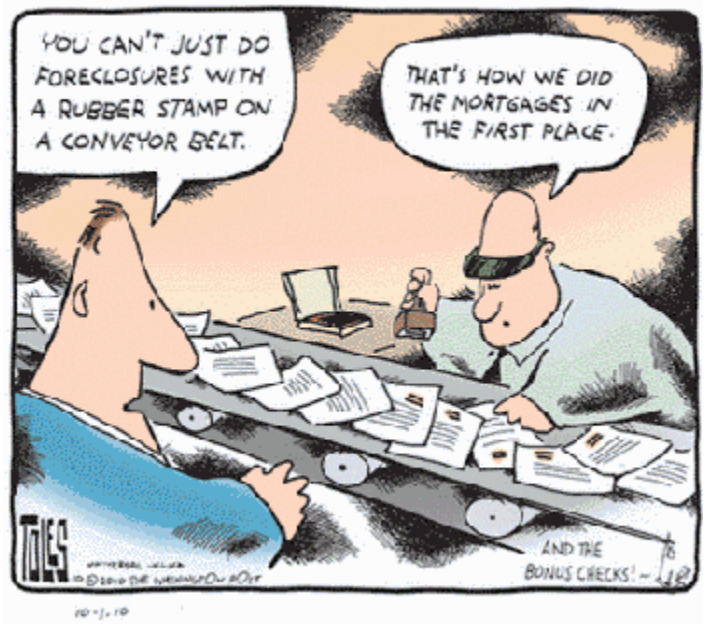
Fully granular transparency can reveal a very different risk picture

Data cleaning/quality – Example

Mortgage foreclosure scandal

- **Post-crisis explosion of foreclosures**



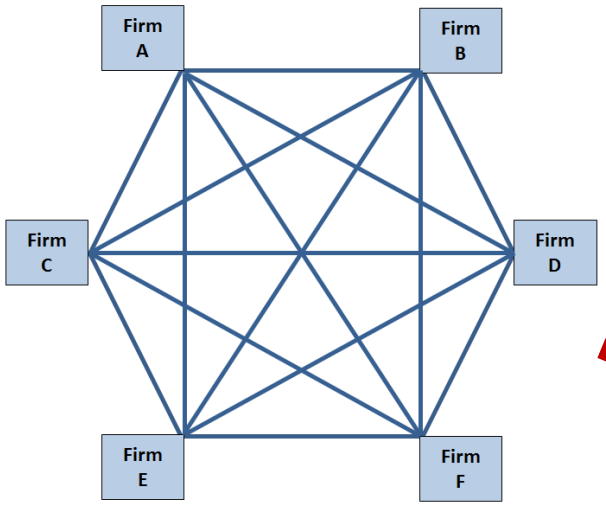


Overwhelmed financial processes in history

- **Civil War Greenbacks, 1863**
- **Paperwork Crisis of 1968**
- **CDS backlog of 2005**

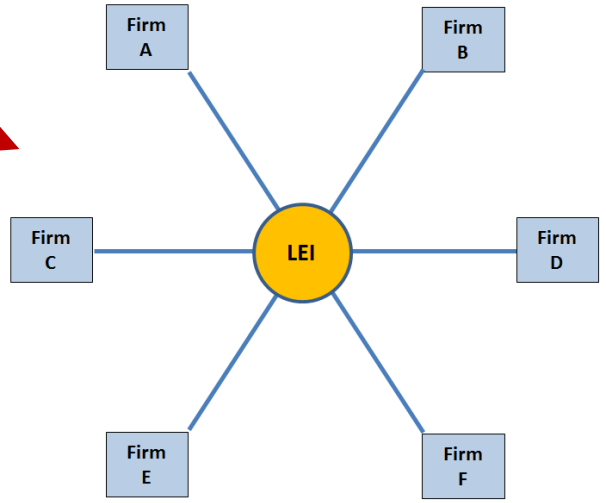
Images: Toles, Washington Post; Flood, Mendelowitz and Nichols (2013)

Data Integration – Example



The global legal entity identifier (LEI) minimizes confusion:

- **Centralizes basic public facts**
- **Standardizes the representation**



OFR and NIST funded a set of public challenges:

- **Financial Entity Identification and Information Integration (FEIII)**

Traditional risk measurement

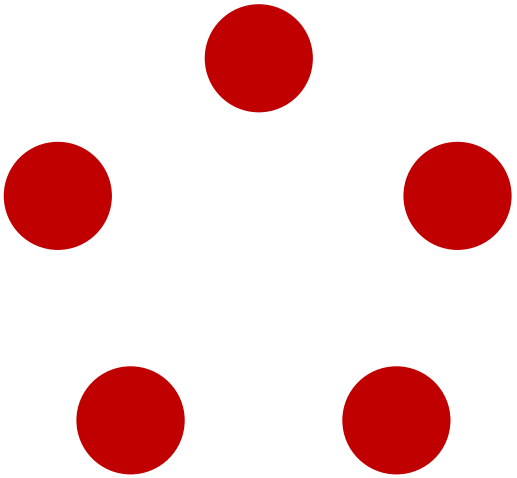
Firm accounting statements

Highly standardized

- FASB
- GAAP
- Basel capital rules

Backward looking

- Historical/fair value
- Monovalent



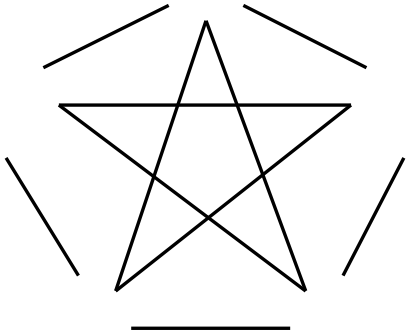
Market transaction data

Pre-trade transparency

- Quotes and spreads
- Limit orders

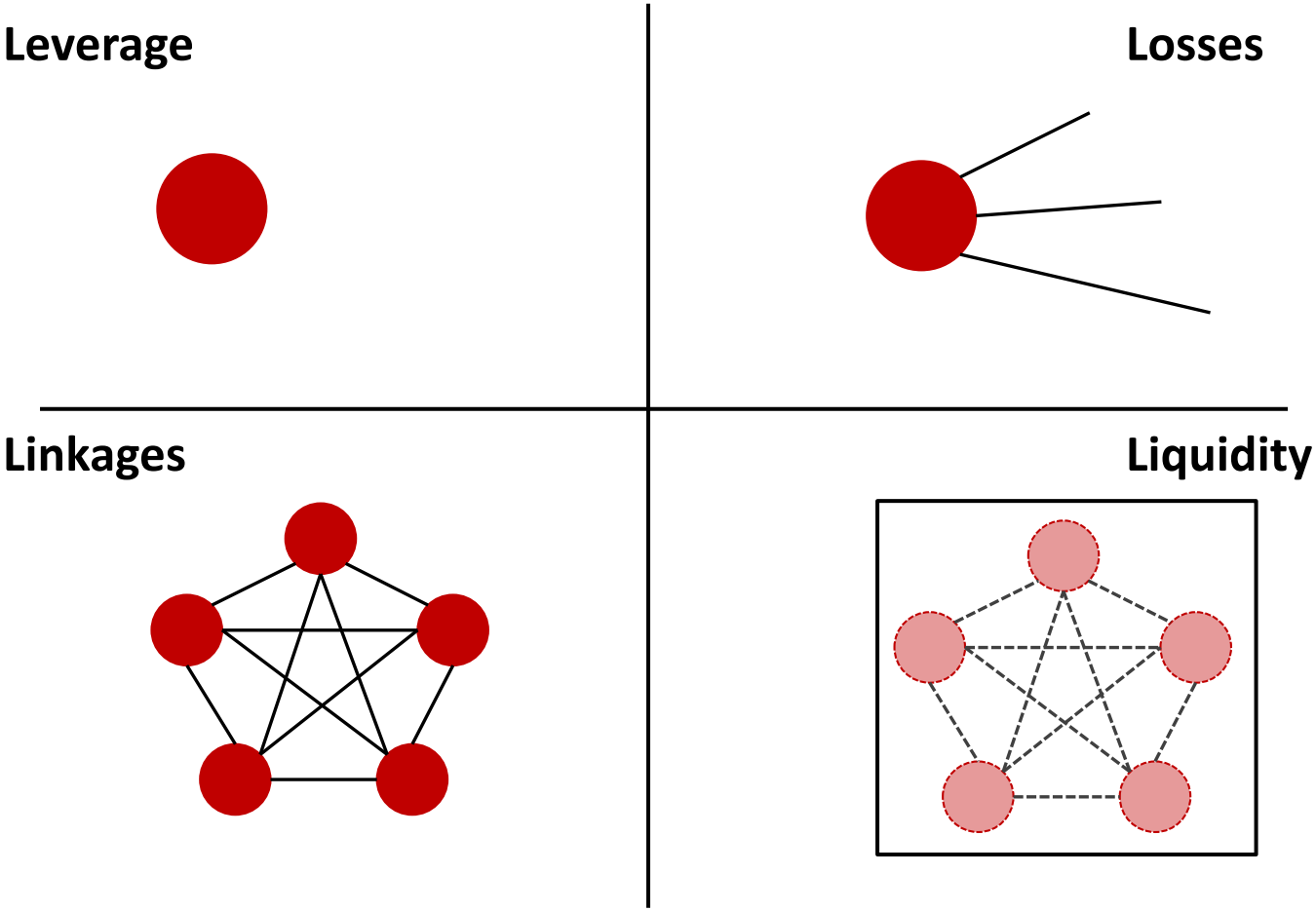
Post-trade transparency

- Transaction prices
- Volumes



Taxonomy of key information structures

The *Four Ls* of systemic risk – Billio, et al. (2012)



Leverage Cycle

Minsky (1977) moments

- Marginal buyer is the most optimistic buyer
- Speculators' access to leverage drives price cycles

Housing Leverage Cycle
Margins Offered (Down Payment Required) and Housing Prices

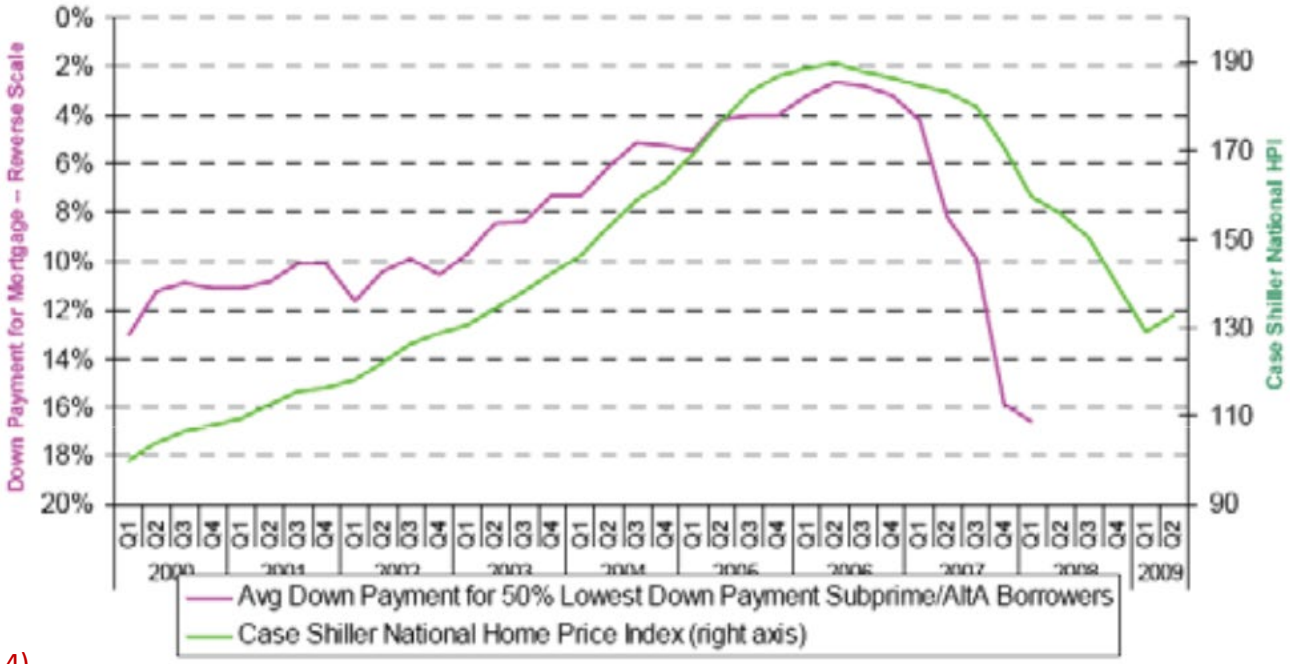
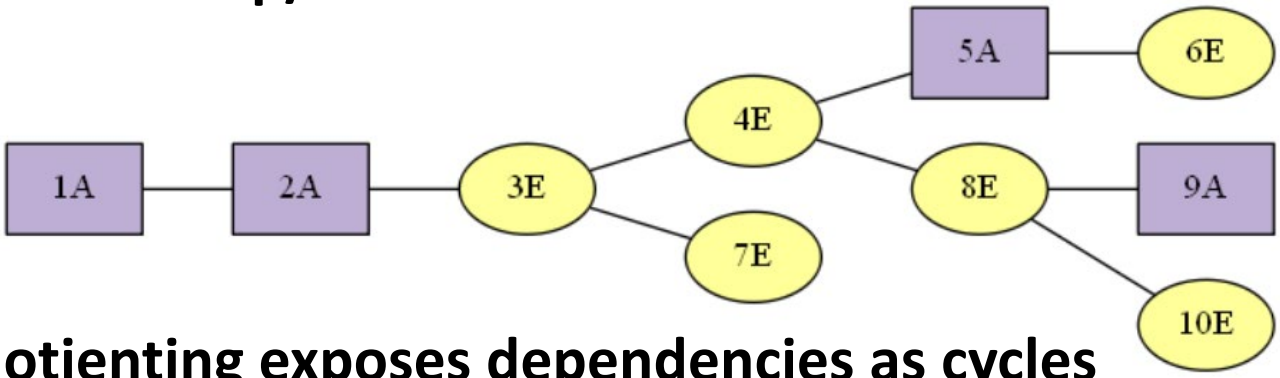


Image: Fostel and Geanakoplos (2014)

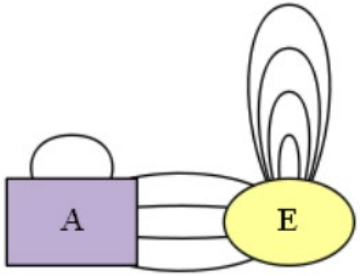
Linkage complexity in bank holding companies (BHCs)

BHCs have complex internal structure

- **Focus on ownership/control hierarchies**



- **Graph quotienting exposes dependencies as cycles**

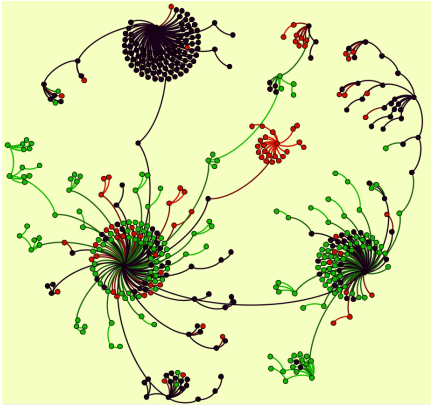


Images: Flood, et al. (2017)

We have the data

- **FR Y-10 reports**
- **FFIEC / NIC**

Wells Fargo, 2006 & 2010



Fundamental Rule of Data Collection

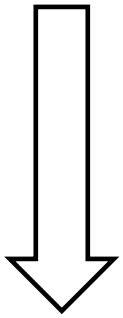
Endogenous Myopia

- **Firms' visibility into their networks**
  - **Distance ≤ 1 contractual link**
  - **Position information is closely held**
- **Implies a role for public supervision**

State-dependent data requirements

- **Supervisory needs increase under**
  - **Crisis monitoring**
  - **Failure resolution**
  - **Forensic investigation**

System-wide Data Collection



Requires

Data Standards

Reading Suggestions

- D. Acemoglu, A. Ozdaglar, and A. Tahbaz-Salehi (2015), "Systemic Risk and Stability in Financial Networks," *American Economic Review*, 105(2), 564–608.
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Thanks!