

# Measuring Counterparty Networks

Mark D. Flood

*Office of Financial Research*

---

**Consortium for Systemic Risk Analytics (CSRA) Conference**

Cambridge, Mass., 11 June 2014

**Views and opinions expressed are those of the speaker and do not necessarily represent official OFR positions or policy.**

## Office of Financial Research (OFR)

*Office within the U.S. Treasury*

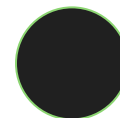
*Established by the Dodd-Frank Act of 2010*

*Serves the Financial Stability Oversight Council (FSOC), its members, and the public*

- improving data and information for financial stability monitoring and analysis
  - quality
  - transparency
  - accessibility
- conducting and sponsoring research related to financial stability
- promoting best practices in risk management.

*Two main divisions (“Centers”)*

- Data Center
- Research and Analysis Center



## Network Measurement

Mila Getmansky Sherman

U. Massachusetts

Ayeh Bandeh-Ahmadi

Office of Financial Research

## Market Sizing

Louiqa Raschid

U. Maryland

Joe Langsam

U. Maryland

Bryan Ball

New York U.

H.V. Jagadish

U. Michigan

P. Wiriathamabhum

U. Maryland

## Operational Networks

Bill Nichols

Office of Financial Research

Suzanne Stahl-Marmo

Office of Financial Research

Ayeh Bandeh-Ahmadi

Office of Financial Research



## Fallacy of composition

The whole is not the sum of the parts

## Complex economic systems

Relationships: economics is a social science

Systems: emergent phenomena

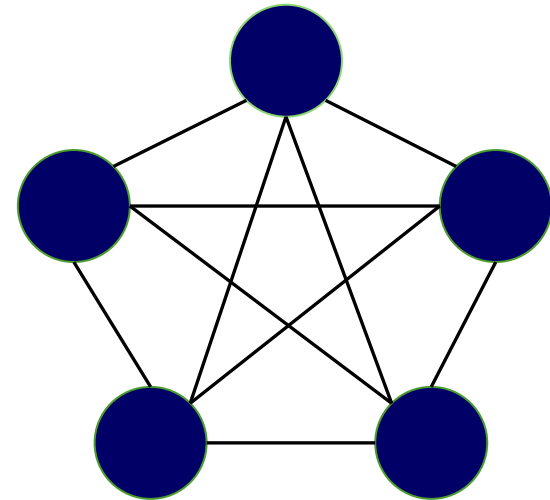
The whole is not the sum of the parts

## Systems engineering

Sub-systems and components

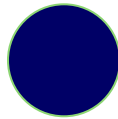
Interfaces and functional allocation

Multiscale phenomena

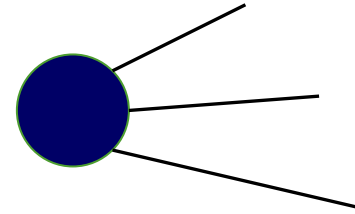


“4-L” Club – Billio, Getmansky, Lo and Pellizon (2012):

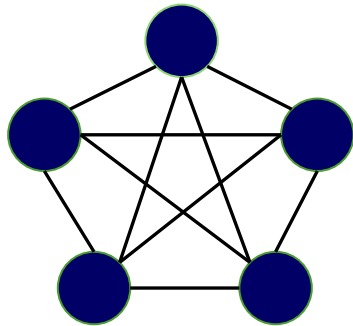
Leverage



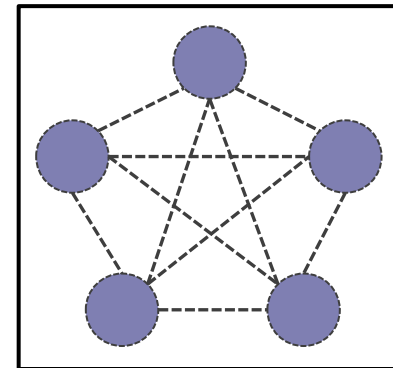
Losses



Linkages



Liquidity



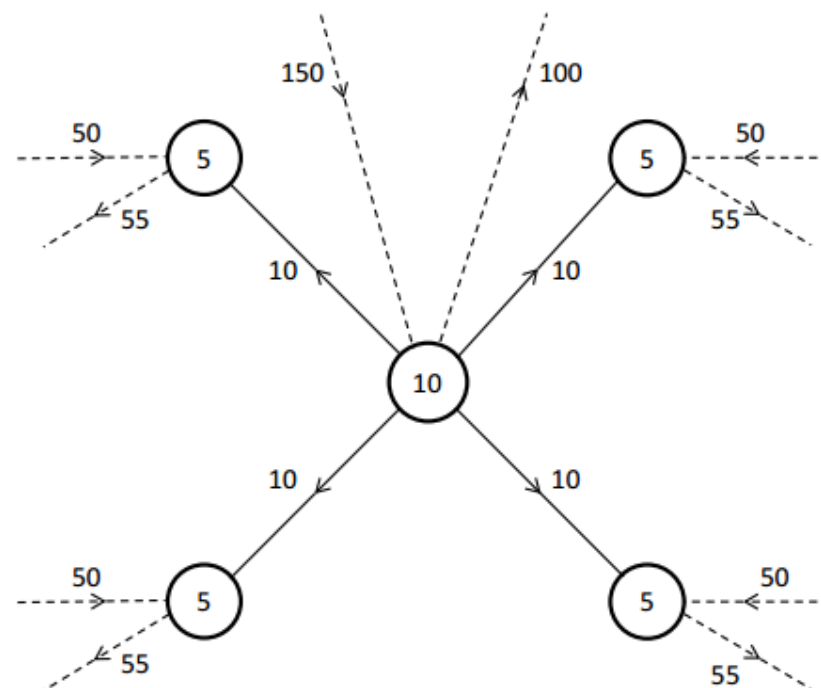
## How Likely Is Contagion in Financial Networks? – Glasserman and Young (2013)

### Key results:

- Pure “domino” default contagion is improbable
- Does not depend on the topology of the network
- Capital has a damping effect

### But amplification is possible if:

- Failing institution is very large
- Financial firms are highly leveraged
- Interconnections (exposures) within the financial system are large
- Costs of bankruptcy are large
- Feedback (e.g., fire sales) is present



### A network subject to default propagation:

- Each node is a firm; net worth (\$) indicated in the circle
- Inbound edges indicate assets owed to the firm
- Outbound edges indicate liabilities owed by the firm
- Solid edges are obligations within the financial network
- Dashed edges are exposures outside the financial network

Image source: Glasserman and Young (2013)

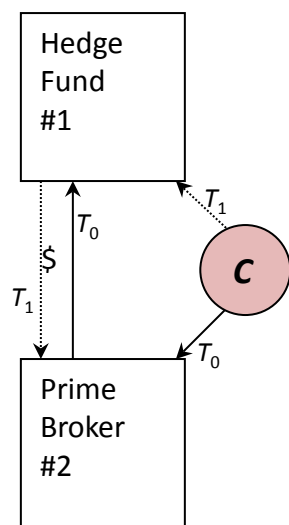
## Hypothecation vs Rehypothecation

- Pledging collateral for a loan, versus
- Reusing the same securities as collateral for a second (or third, etc.) loan

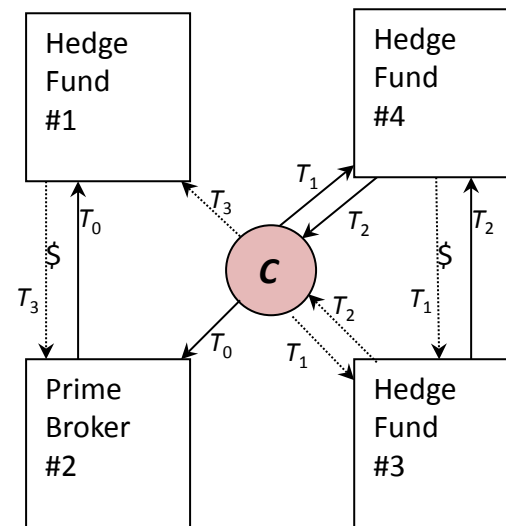
From the U.K. bankruptcy court in the Lehman Brothers (LBIE) failure:

*"[I]t would be necessary to investigate particular records held by LBIE and to obtain data and records from relevant third party custodians, depositaries and other parties. ... [T]he difficulties that this process faces, not least the refusal of a number of custodians and others to comply with demands for information and that, in the meantime, the administrators are only able to call upon limited LBIE resources."*

Source: Deryugina (2009, pp. 274-75, note 111)

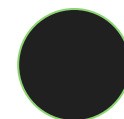


Simple repo



Repo with rehypothecation for a short sale

Image source: Flood, Mendelowitz, and Nichols (2012)





## Firm-level financial statements

### Highly standardized

- FASB
- GAAP
- Basel capital rules

### Backward looking

- Historical/fair value
- Monovalent

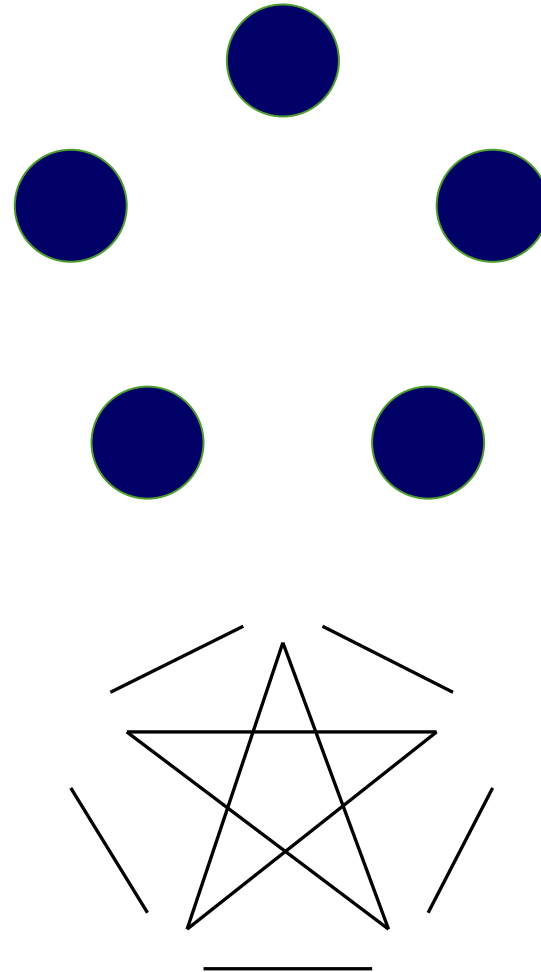
## Market transaction information

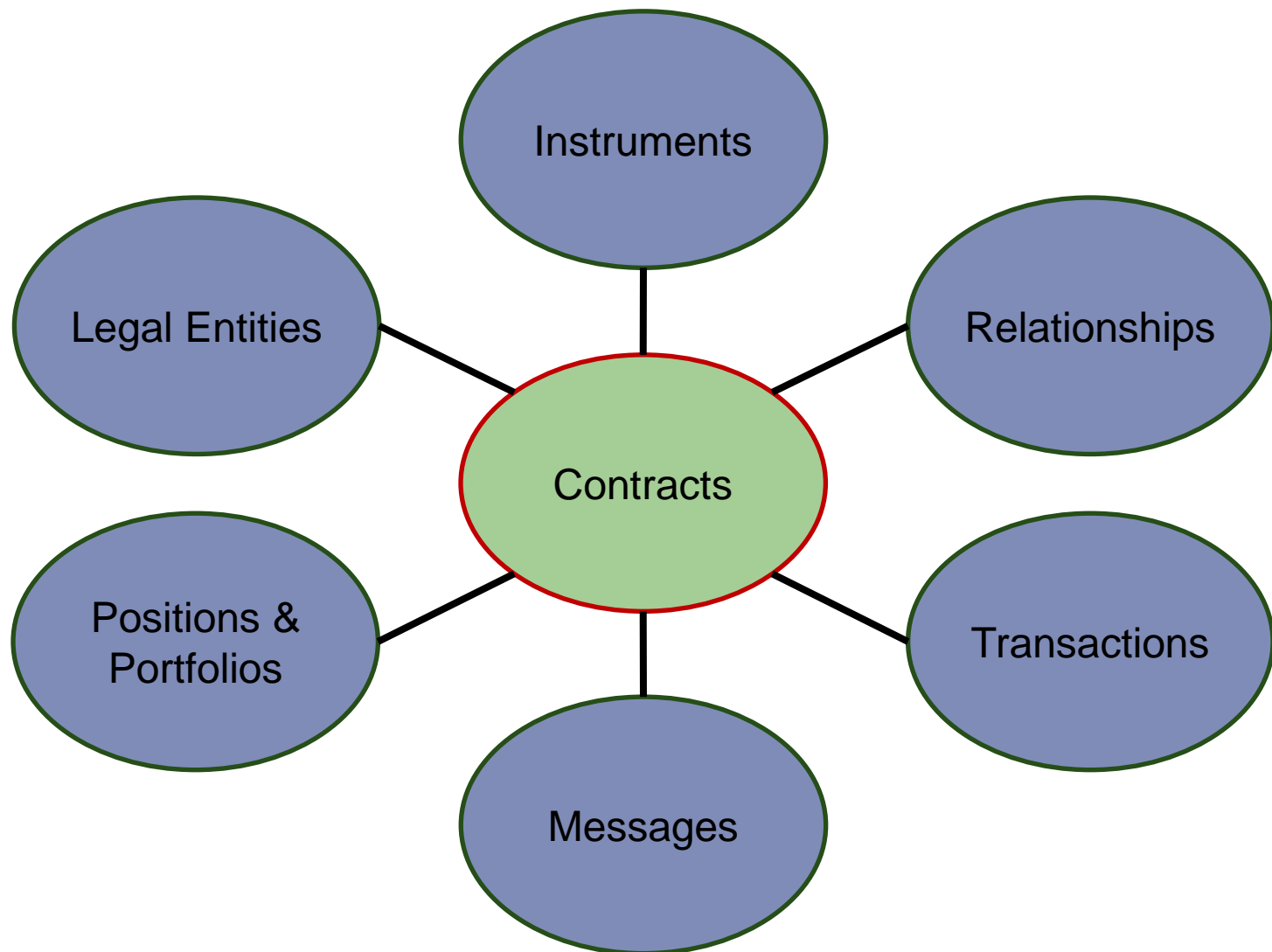
### Pre-trade transparency

- Quotes and spreads
- Limit orders

### Post-trade transparency

- Transaction prices
- Volumes





## What question do you want to answer?

Risk concentration

Rapid growth – what is size?

Network complexity

## What data do you want to collect?

Identifiers (LEIs) – what should we reify w/GUIDs?

Size – what does this mean?

- Banking book – book value
- Trading book – fair value
- Risk reporting – VaR, DV01, etc.

Timing (temporal resolution, synchronization, etc.)

## It depends on the research/policy task

Data exploration, “sensemaking”

Decision support, early warning

Transparency

Forensics

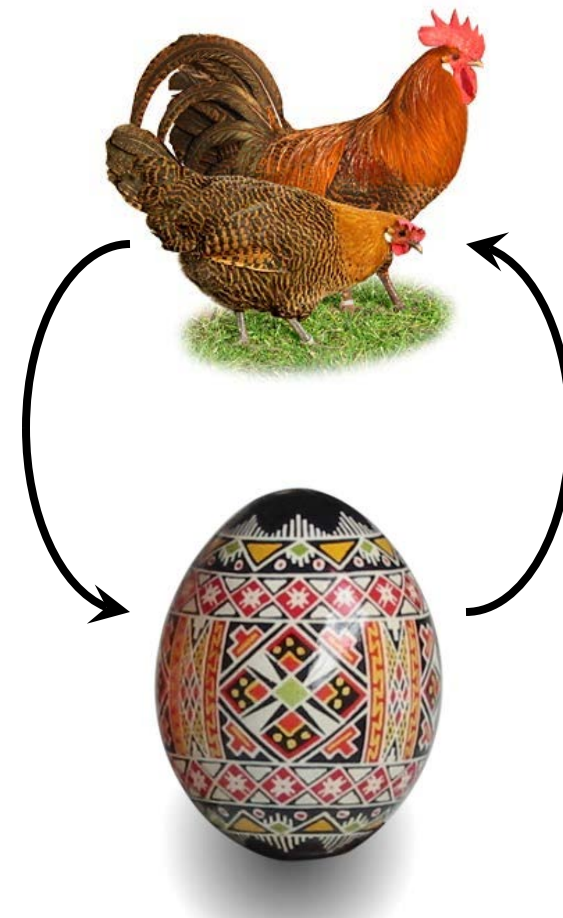


Image source : Stijn Ghesquiere (2004), [www.wikipedia.org](http://www.wikipedia.org)

## Should we track specific relationships?

The Physiocrats

Input-Output Analysis

Flow of Funds & Social Accounting Matrix

## ... Or are anonymous signals adequate?

The Invisible Hand

Laissez Faire

- Prices as signals
- Delegated management

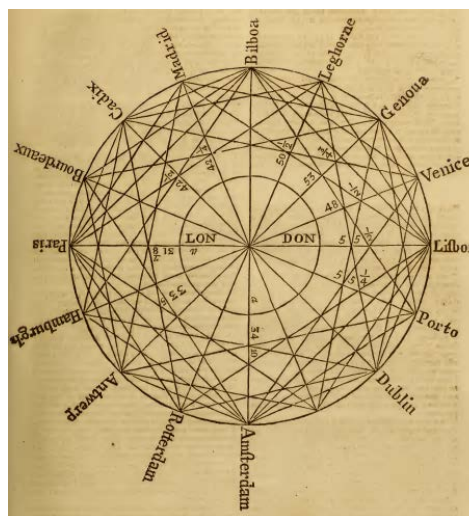
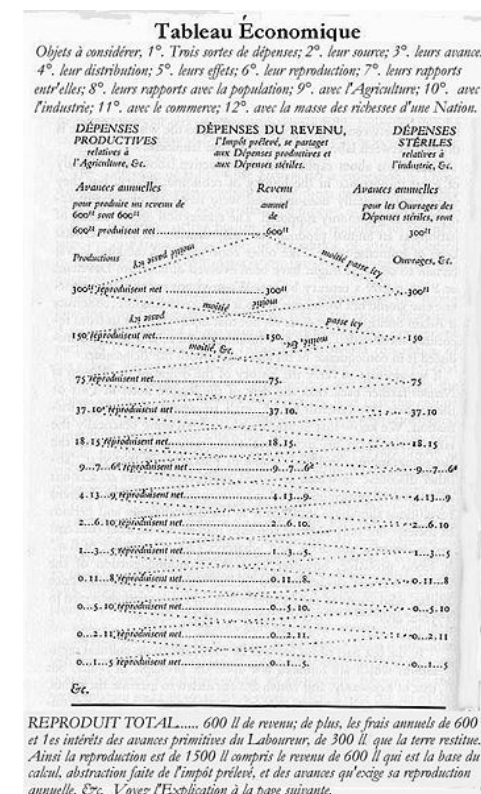


Image source : Wikipedia, Postlethwayt (1774): archive.org



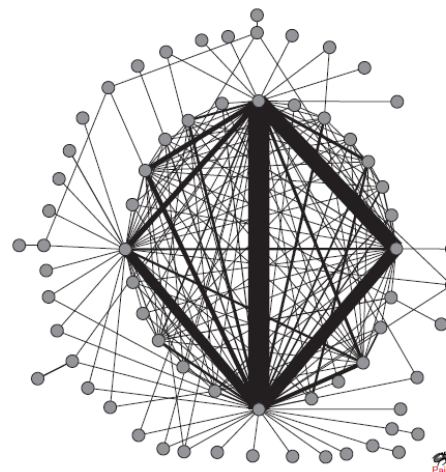
## Strategic network formation

Counterparty graphs are non-random

- Avoid Erdős-Rényi

Conflict-of-interest rules

E.g., core-periphery topology



## Legal and regulatory constraints

Chartering – permissible activities

Volcker Rule

E.g., SEC Rule 2a-7 for money funds

## Endogenous constraints

Investment mandates and “objectives”

- Leverage limits, use of derivatives, etc.

Risk reduction procedures

- Netting and novation

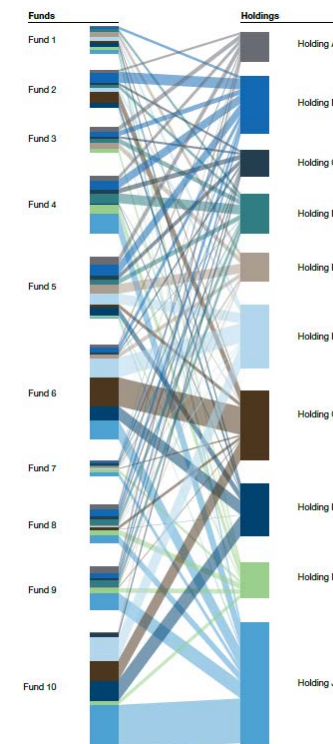


Image source : Soramäki, Bech, Arnold, Glass, and Beyeler (2007), OFR (2012)

## Diagnostic summaries – some examples:

### Size

- “Financialization”
- Growth rates and operational risks

### Complexity

- Lehman collateral mess
- Securitization
- Investment tiering

### Concentration

- Herfindahl indexes
- Network diameter

### Fragility

- Systemically important nodes
- Critical infrastructure
- Correlated exposures

Figure 3: Mortgage Recording with MERS

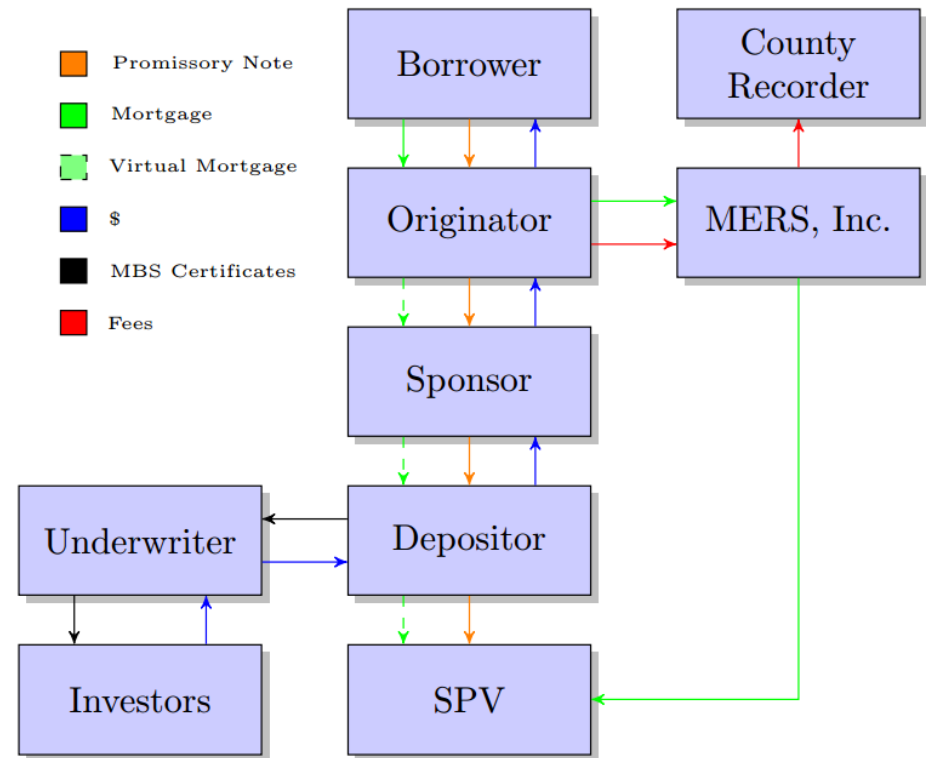


Image source : Hunt, Stanton and Wallace (2014)

## New Data Sources – some examples:

FINRA TRACE	2002 - Corporate/agency bond transactions
DTCC CDS	2008 - Credit default swap transactions
SEC N-MFP	2010 - Monthly money fund holdings
BIS DataHub	2010 - Cross-border exposures
FRB-NY repo	2010 - Tri-party repo transactions
SEC MIDAS	2013 - U.S. equities order flow

## Motivation

Technological advances

- Internet investment
- Storage (e.g., graph databases)

Disintermediation, shadow banking

Financial stability

- 2007-09 crisis
- Flash crash

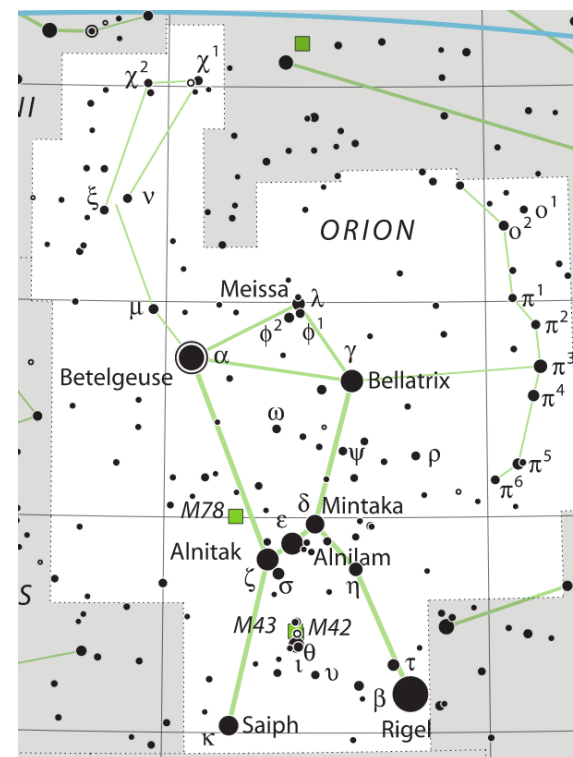


Image source : IAU/Sky & Telescope (2011), [www.wikipedia.org](http://www.wikipedia.org)

## Endogenous Myopia

Firms will not disclose their positions

Myopia: firms' visibility distance  $\leq 1$

→ Role for public supervision

## State-dependent Data Requirements

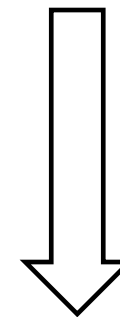
Supervisory needs increase under:

- Crisis monitoring
- Failure resolution
- Forensic investigation

Shneiderman's Visualization Mantra

- Overview first
- Zoom and filter
- Details on demand

System-wide  
Data Collection



*Requires*

**Data Standards**



## Fundamental tension – fallacy of composition

Measuring specific relationships vs. emergent signals

Flexibility vs. maintenance burden

## New tools are appearing

Transaction- and order-level feeds

Networking and storage

Macroprudential models

## Contract is king

Focus on the relationships

Settled contracts are high-quality data

Central to many network phenomena

## Data collection

Myopic participants and “disinterested” monitors

State-contingent data-collection

Standardization is critical

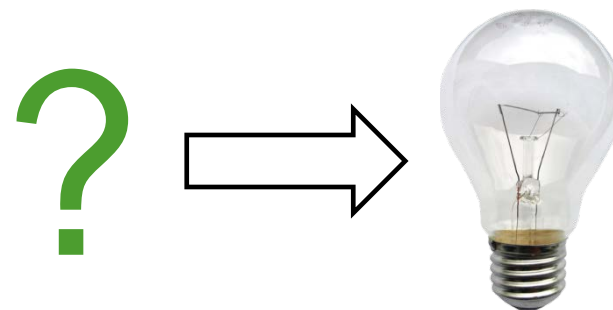


Image source : [www.wikipedia.org](http://www.wikipedia.org)



**Thanks!**