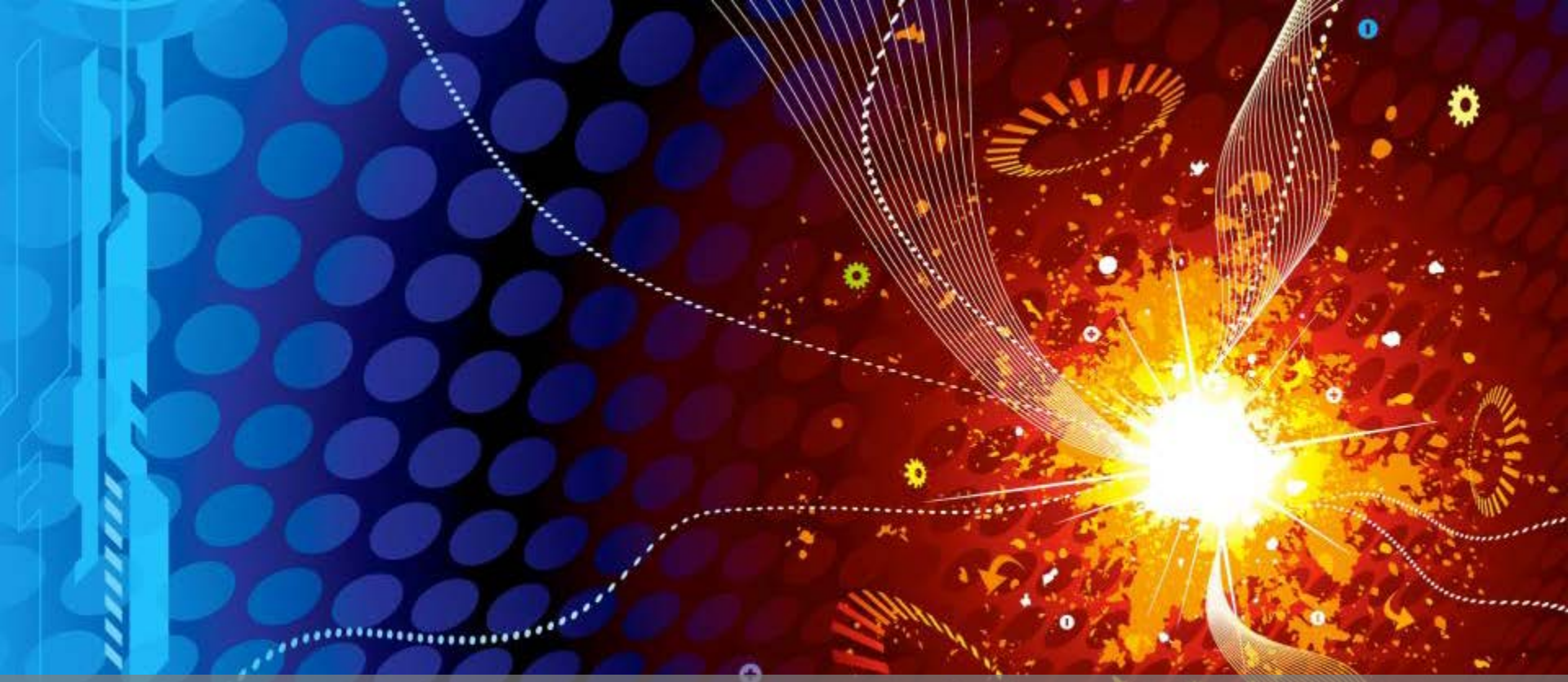


CRS Advisory Board Meeting - 13 Jan 2016

Financial Risk and Network Analysis

Centre for Risk Studies

UNIVERSITY OF CAMBRIDGE
Judge Business School

Ali Rais Shaghaghi

Agenda

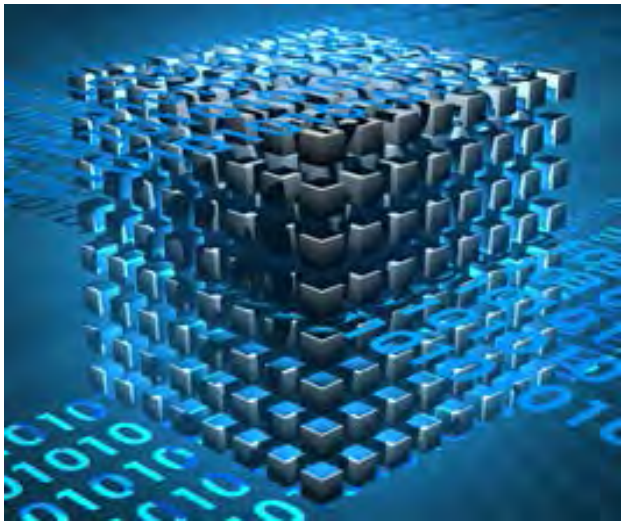
- Contagion and systemic risk
  - Network models to analyse financial stability
  - CRS work on Cambridge Banking Model
- Future Work

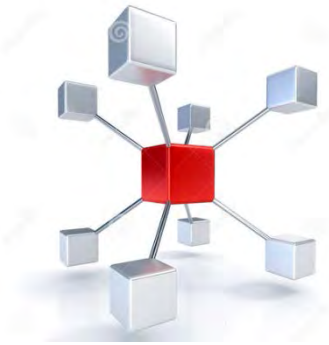
We Need a Better Understanding of Contagion

- The 2007 financial crisis has shown that economists have been behind the curve in regard to **mapping**, **modelling** and **monitoring** the highly **interconnected** and global financial system
- The failure of financial institutions has led to fears of system failure from **domino effects** of one failed entity bringing down others. This has given rise to concepts such as financial contagion and ***"too interconnected to fail".***

The Financial System

- Holistic Visualization to overcome fallacy of composition type errors
- ICT database driven multi-agent financial networks
- Integration and automation of financial databases in a framework to transform the data from a document or record view of the world to an object-centric view
- In these frameworks multiple facts about the same real-world financial entity are accessed to give a composite visualization of their interactions with other such entities in a scalable way.



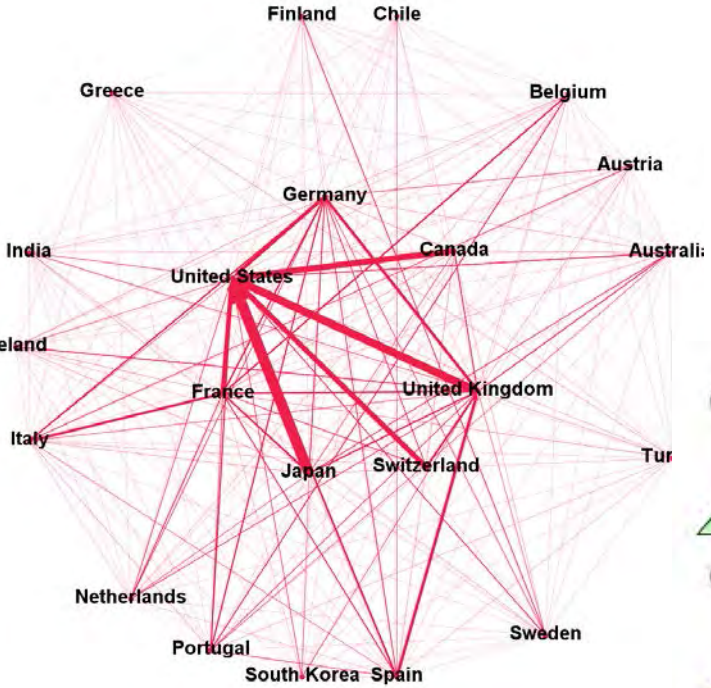


Systemic Risk and Interconnectedness

- **Systemic Risk :** Risk associated with the failure of the entire financial system
- **Channels of Contagion**
  - Interbank lending, Security settlement, FX settlement, Derivative exposures, Equity cross-holdings, Asset prices
  - Interaction between these contagion mechanisms is more important than a single mechanism on its own

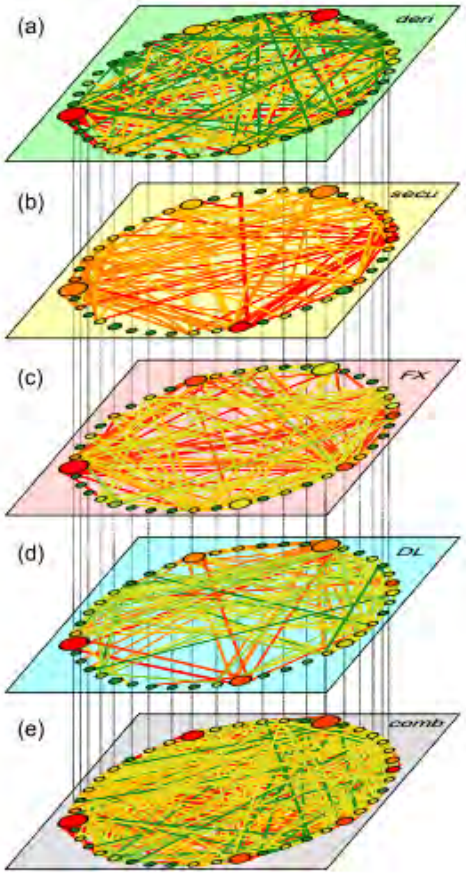
- **Why does interconnectedness matter for financial stability?**
  - Structure of links between nodes matters
- Two methodological problems of financial contagion and systemic risk:
  - **Paradox of Volatility** and the pitfalls of market price data based systemic risk measures hence structural bilateral data based networks modeling needed
  - non-trivial **Negative Externalities problem**→ the need for holistic visualization

Network Topology



Cross Border Exposure

2014, BIS data, CRS Research



Multi-layer Structure of Mexican Banking Network

Sep 2013 Poledna et.al 2015

Austrian Interbank Market

Boss et.al 2003

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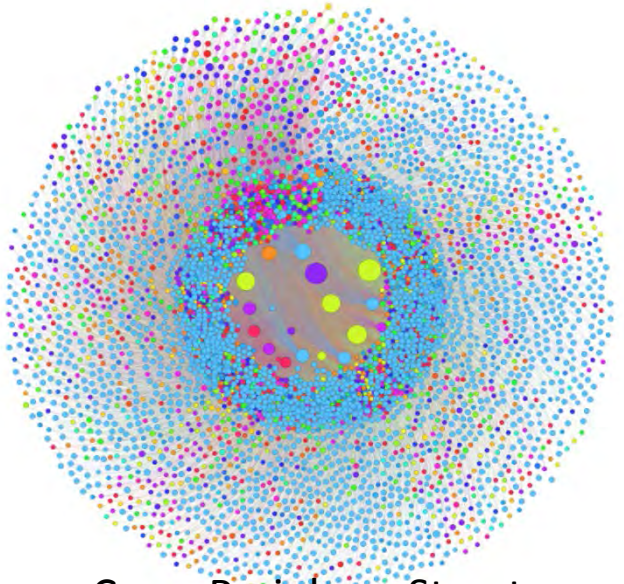
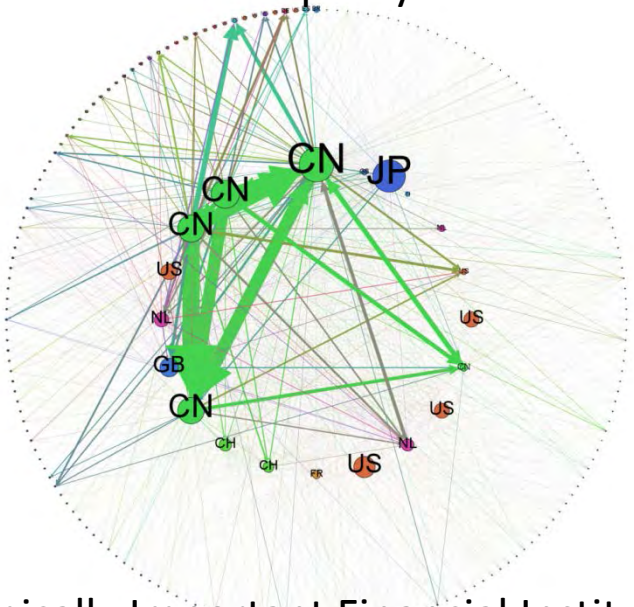
Cambridge Global Interbank Network Model

- Balance sheet data on Financial Institutions
  - Iteration 1: 18,516 Banks Total market value of $214 Trillion Total equity value of $17.4 Trillion
  - Iteration 2: 5134 Banks



Core- Periphery Structure

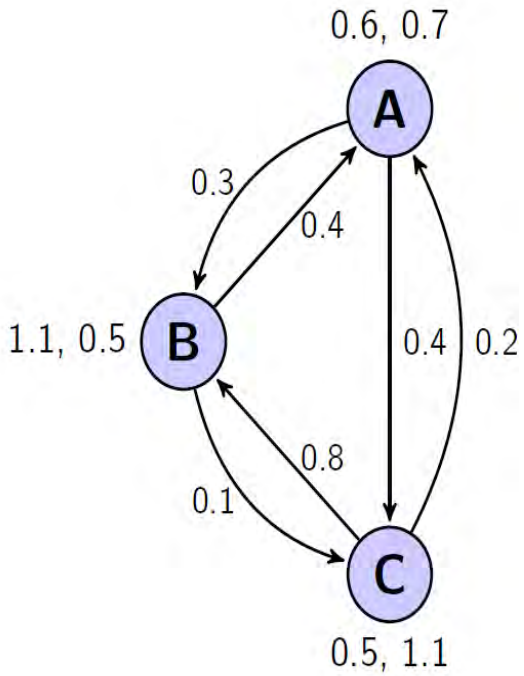
- Network reconstruction→ bilateral exposures; interbank lending



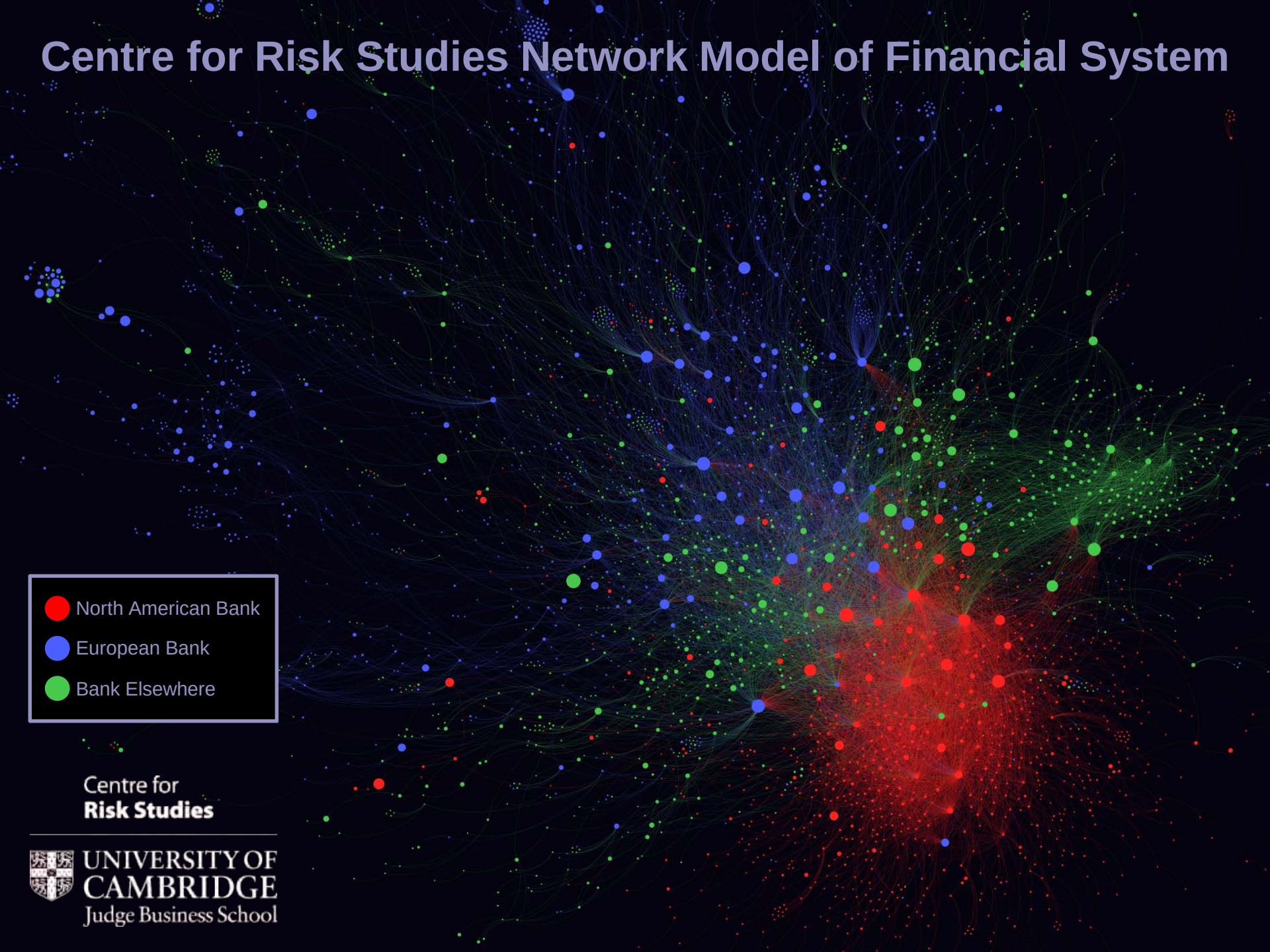
Systemically Important Financial Institutions

Network Reconstruction

- The related bilateral exposure information is not always collected or disclosed.
- Need of a method to reconstruct (estimate) the bilateral exposure network via the incomplete information from Financial Institutions balance sheet data on liabilities and assets
- Using computational algorithms to satisfy balance sheet constraints.



Centre for Risk Studies Network Model of Financial System



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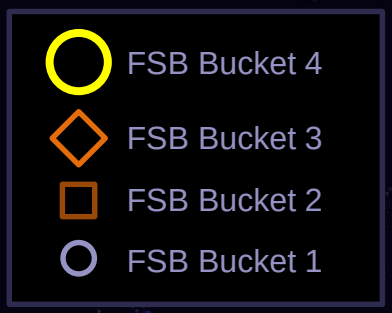
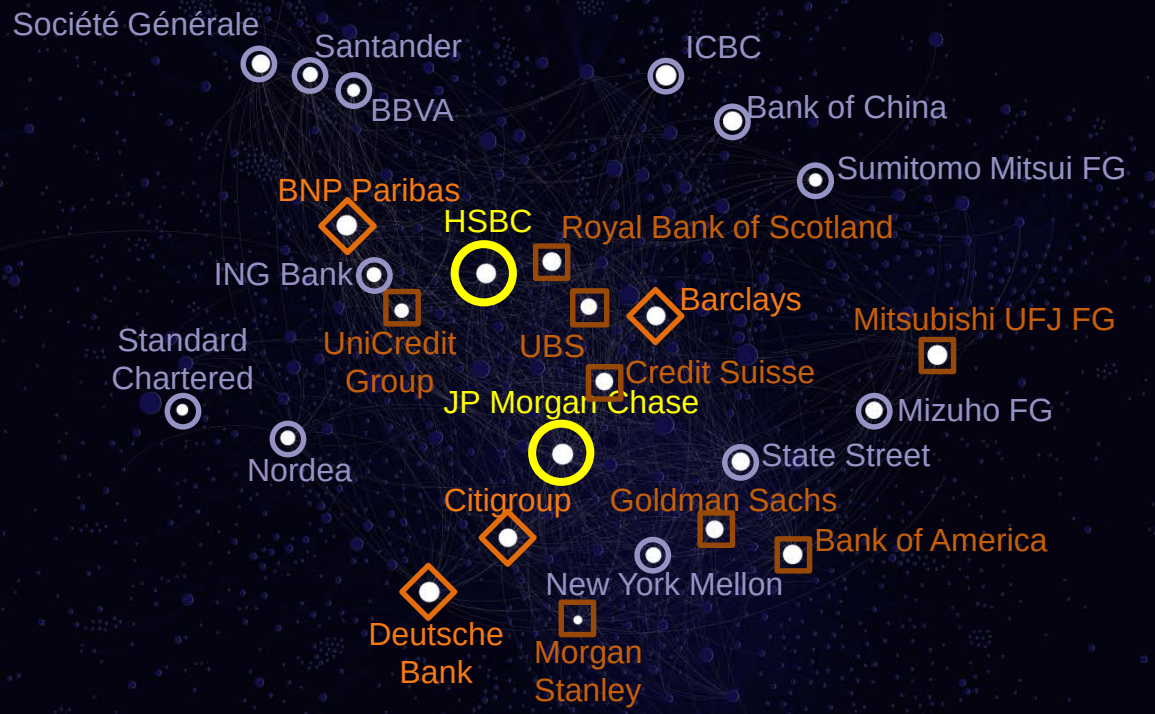
Global Systemically Important Banks (GSIBS)

Star-finder guide





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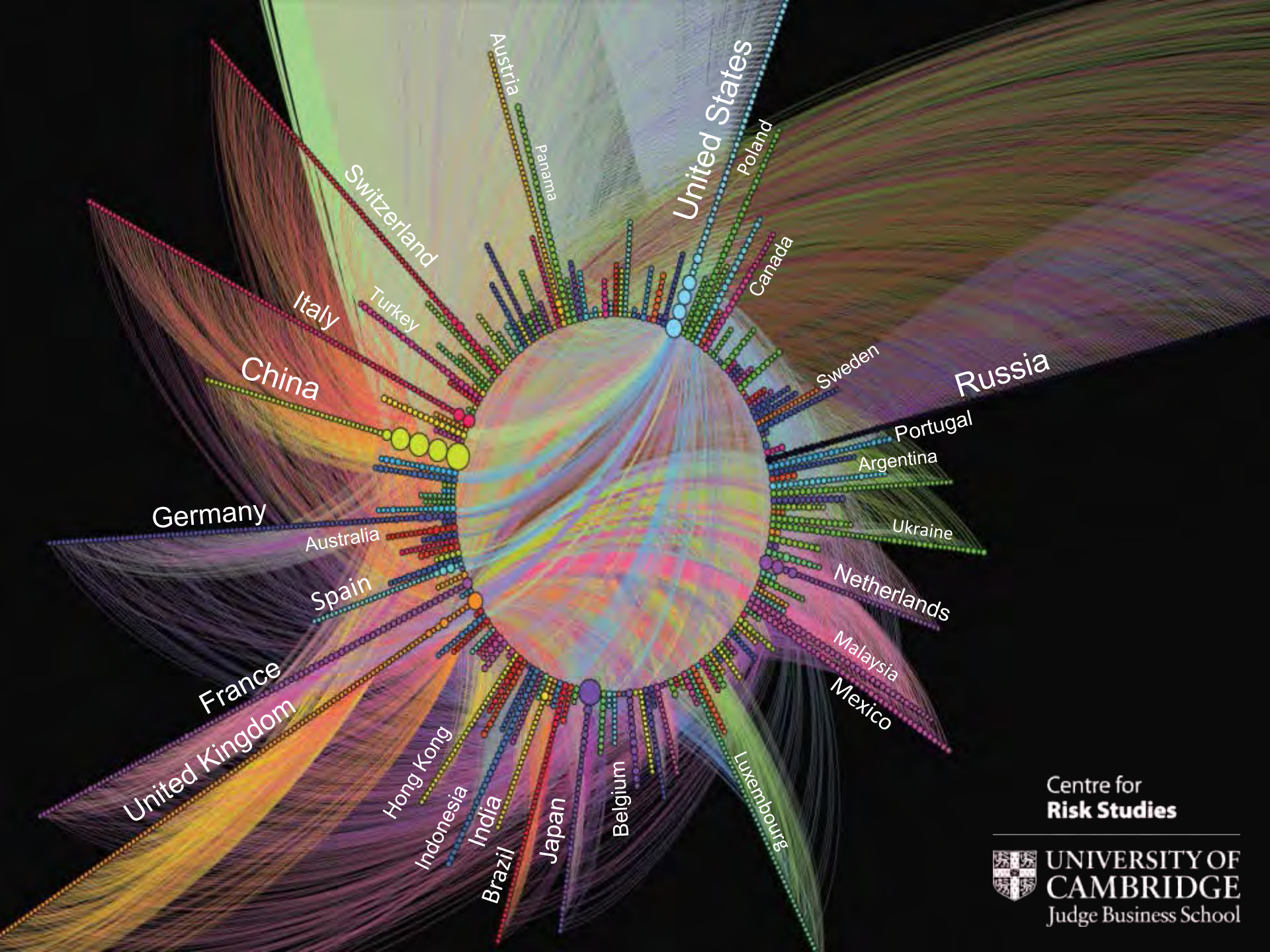

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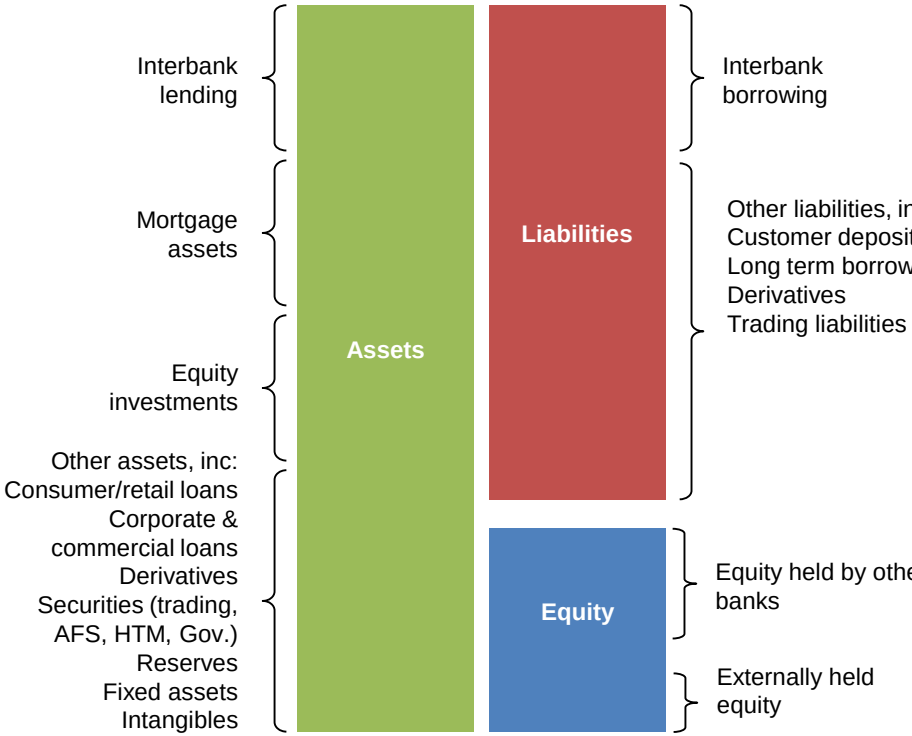
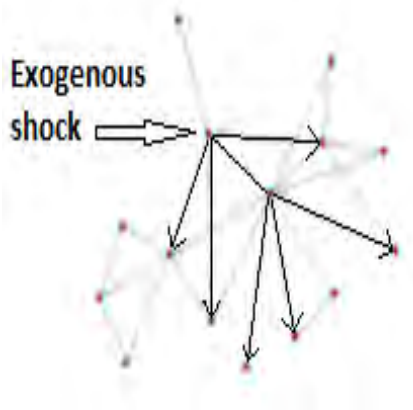
Contagion Model Description

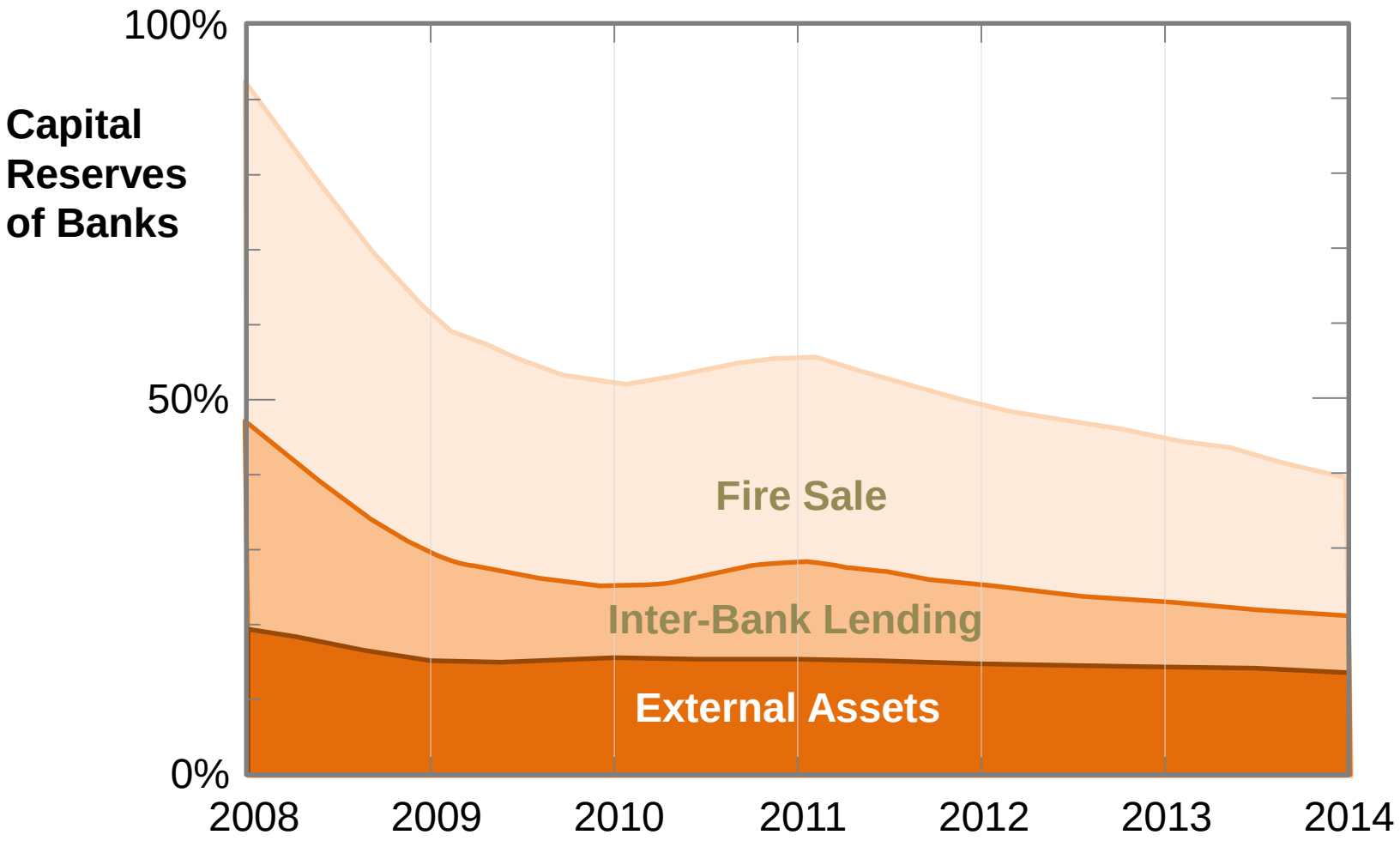
- Interbank system as a directed network whose nodes are banks
- Every node is characterised by an internal structure given by its balance sheet
- Contagion Dynamics: the effect of a bank being under distress is almost immediately incorporated into the value of the interbank assets held by a directly connected creditor bank





Stressing the Financial System

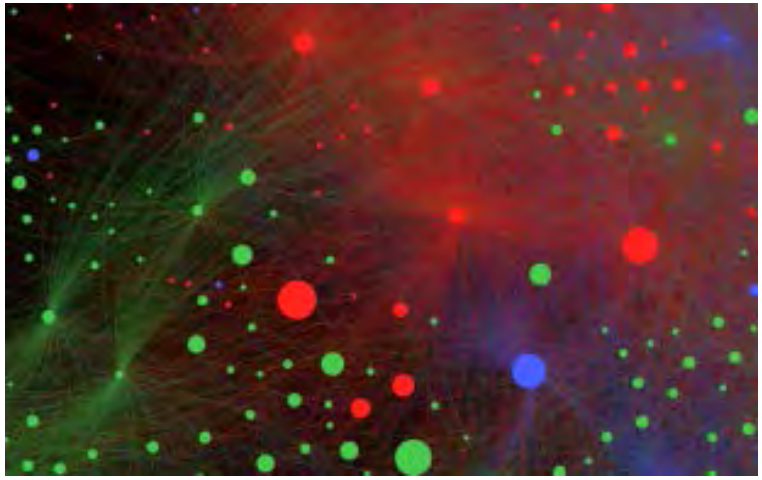
For a shock of 0.5% asset devaluation

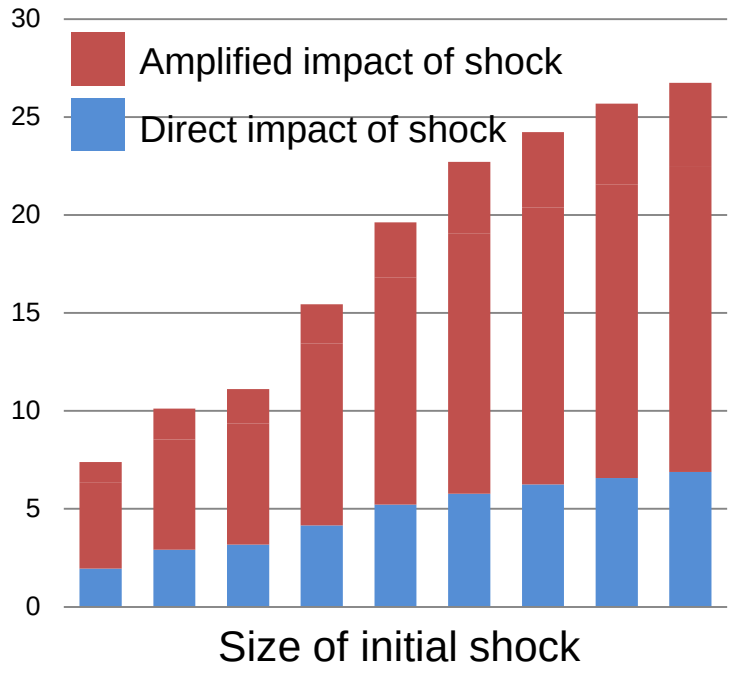


Olaf Bochmann: Cambridge Banking Model

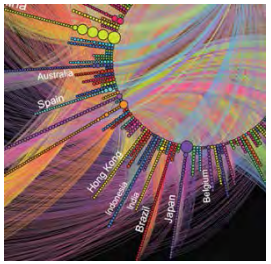
Understanding Contagion and Systemic Shock

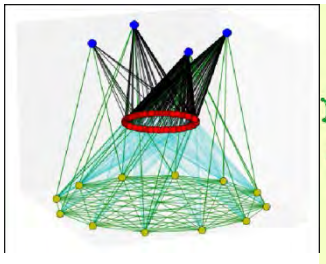
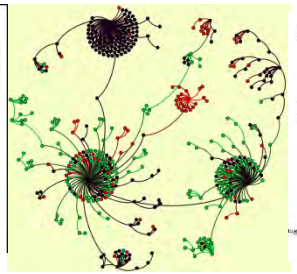
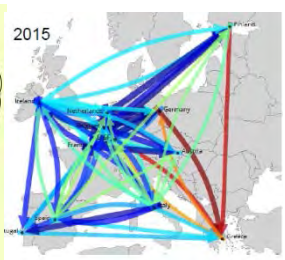
- The financial system is increasingly interconnected and integral to the economic system
  - Understanding the structure of the financial system and all its connections is vital
  - ‘Financial Cartography’
- Financial instability spreads through a variety of mechanisms
- Contagion amplifies:
  - severity of the shock impact
  - extent of who is affected
- It is behavioural
  - issues of trust, perception, and self-interest drive the collapse
  - Can we model ‘confidence’?
- This is a key research field
  - Working with the community of researchers on networks in finance
- Cambridge is seeking to build a practitioner model of global financial system

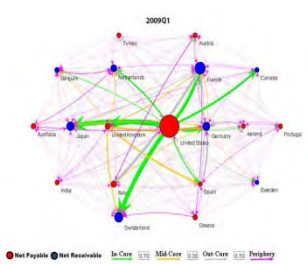




The CRS Financial Risk and Network Seminar





- 2015 seminar In collaboration with **Journal of Network Theory in Finance**
- Many papers from key players in the field presenting cutting-edge research
- Attendees included
  - Regulators
  - Financial practitioners
  - Academics
- Network Visualisation Competition
- Keynotes included central banks presenting their techniques for assessing systemic risk and capital requirements in their market
- Next Seminar
- **14th of September**, 2016
- Venue: University of Cambridge, UK



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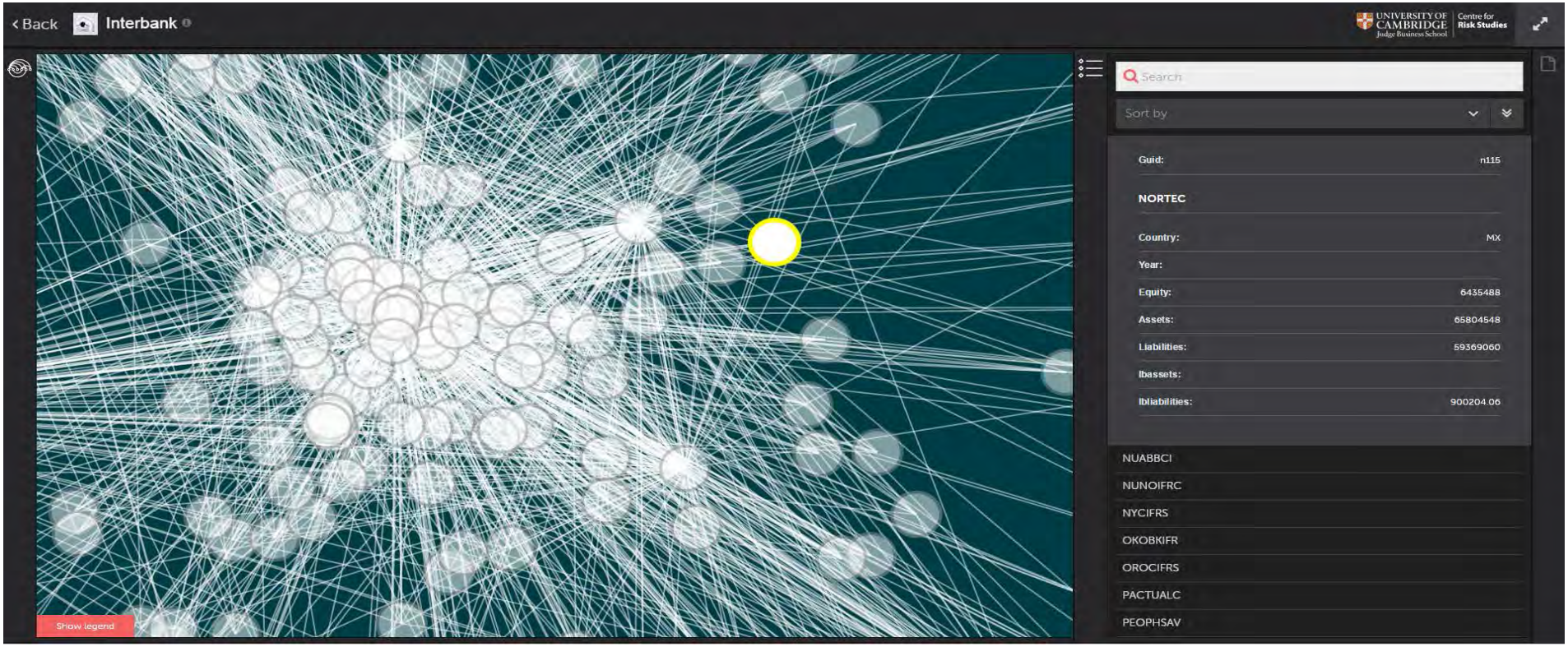
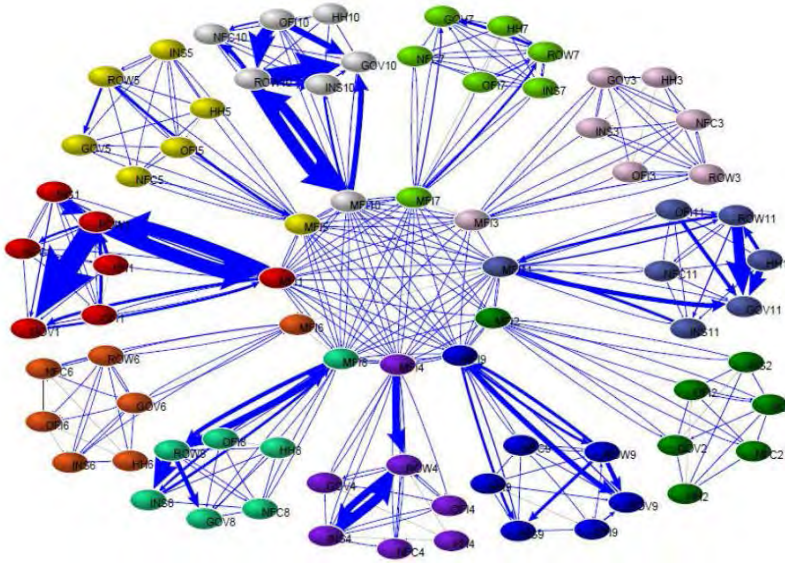
Cambridge Risk Framework

- Web-based user-interface
- Stress test scenario results
- Network visualisation (various layouts, filter)

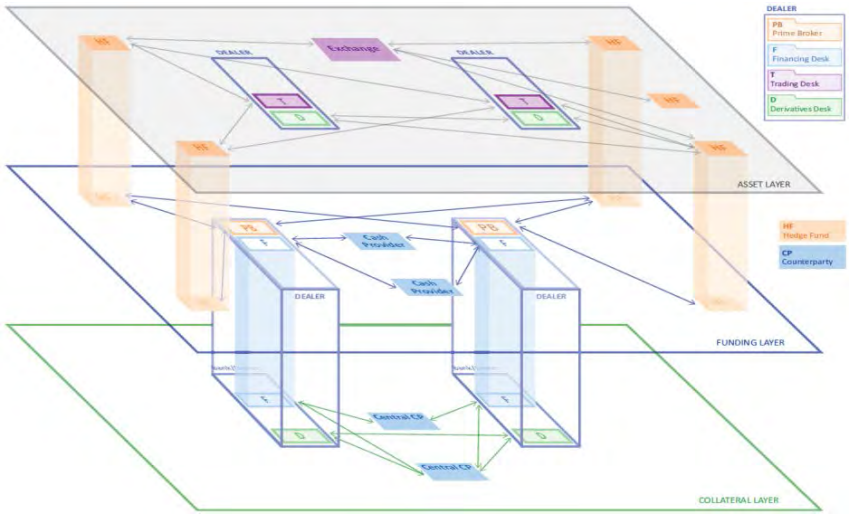


Future Work

- The complex nature of the financial system requires further methodological research
  - Extend the current banking model to include other dynamics of the financial system**; regulation and policy implications**, **central banks Macroprudential policy**
- Characterizing the financial system as a **multilayer** interdependent network can provide new insights into the underlying structure of the financial system, its vulnerabilities, and its resilience.
  - Eg. Corporate Bond Market, CDS Market, Interbank lending
- Collaboration with **OFR** (Office of Financial Research)
  - The Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 established the OFR
  - Modelling counterparty credit risk



Macro network of eleven euro area countries. Olli Castrén and Michela Rancan 2013



Multi-layer characteristics of financial systems, OFR Research

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