



Centre for Risk Studies Research Showcase
23 January 2014

**Overview of Centre for Risk Studies
Research Agenda 2014**

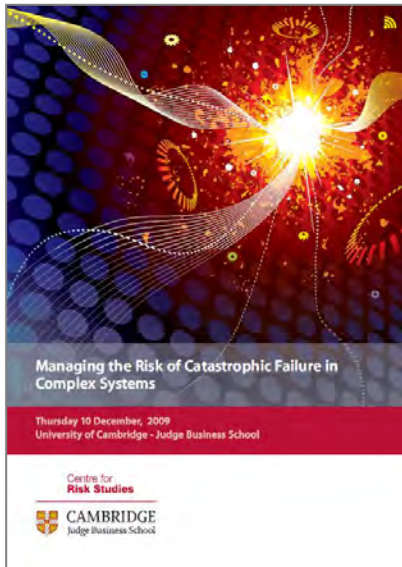
Centre for
Risk Studies



UNIVERSITY OF
CAMBRIDGE
Judge Business School

Dr. Andrew Coburn
Research Associate































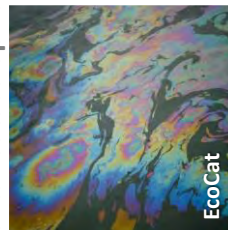


























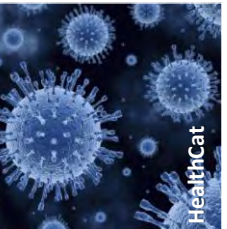
































Understanding Catastrophic Failure in Complex Systems



- Proceedings:
 - <http://www.risk.jbs.cam.ac.uk/news/events/risksummits/risksummit2009.html>
- Focus of the Centre for Risk Studies has been an enabler of projects and interchanges on complexity science and emergent behaviour
- Analysis of tightly-coupled systems, non-linear feedback loops, and failure analysis
- Risk Centre conference: **Managing the Risk of Catastrophic Failure in Complex Systems**
- Triggered a research programme into the effects of shocks on business networks: **‘A Shock to the System’**



2012: Cambridge Risk Framework **Threat Taxonomy**

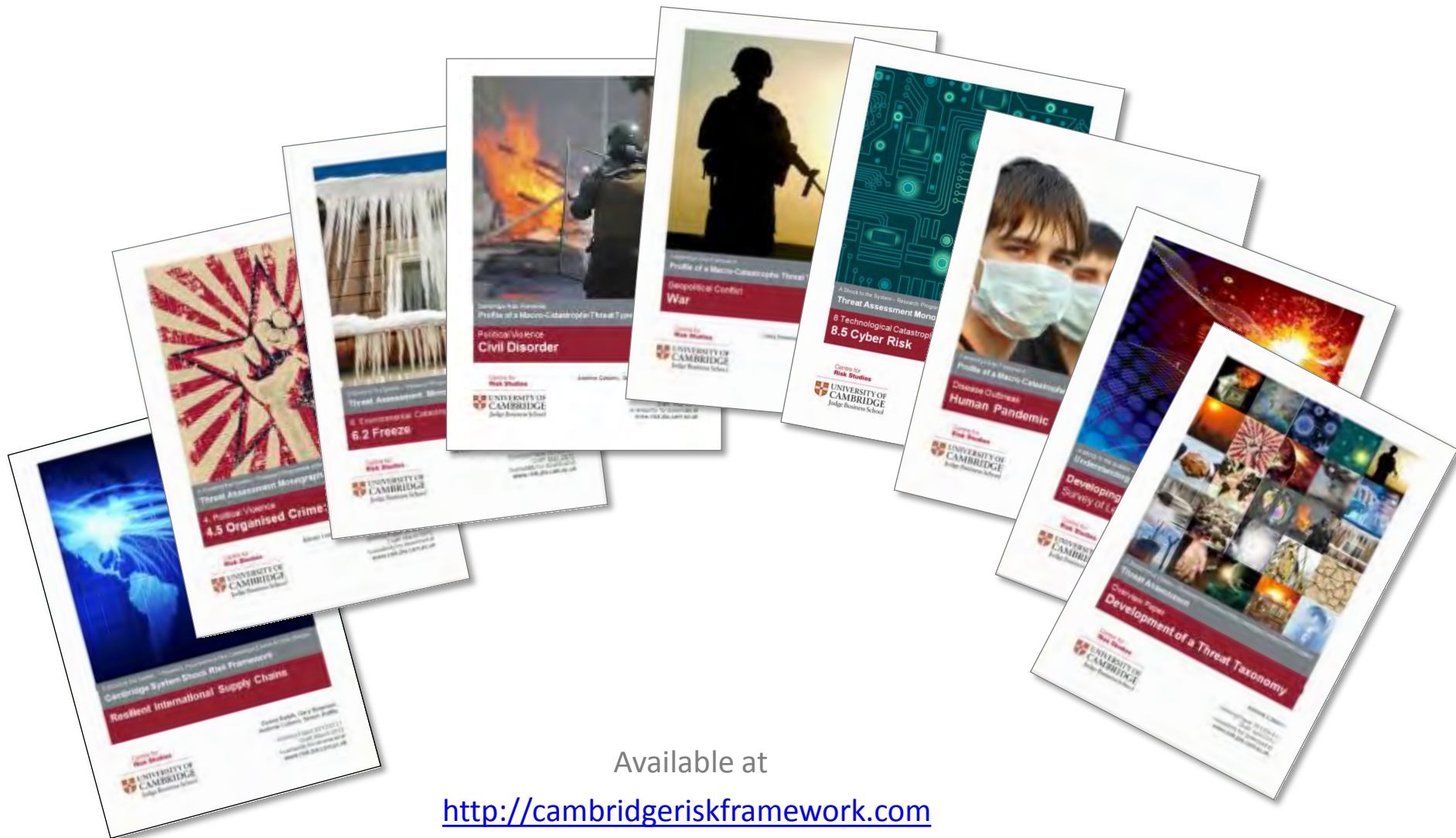
Financial Shock	 FinCat	 Asset Bubble	Trade Dispute	 TradeCat	 Labour Dispute	Geopolitical Conflict	 WarCat	 Conventional War	Political Violence	 HateCat	 Terrorism					
	 Market Crash	 Sovereign Default		 Bank Run	 Trade Sanctions		 Asymmetric War	 Separatism								
	 Volcanic Eruption	 Flood		 Tsunami	 Cartel Pressure		 Nationalization	 Tariff War		 External Force	 Civil War	 Nuclear War	 Organized Crime	 Assassination	 Civil Disorder	
Natural Catastrophe	 NatCat	 Earthquake	Climatic Catastrophe	 WeatherCat	 Drought	Environmental Catastrophe	 EcoCat	 Sea Level Rise	Technological Catastrophe	 TechCat	 Nuclear Meltdown					
	 Volcanic Eruption	 Flood		 Tsunami	 Tornado & Hail		 Electric Storm	 Heatwave		 Wildfire	 Pollution Event	 Atmospheric System Change	 Cyber Catastrophe	 Technological Accident	 Infrastructure Failure	
	 Earthquake	 Windstorm		 Tornado & Hail	 Electric Storm		 Heatwave	 Wildfire		 Pollution Event	 Atmospheric System Change	 Sea Level Rise	 Ocean System Change	 Industrial Accident		
Disease Outbreak	 HealthCat	 Human Epidemic	Humanitarian Crisis	 AidCat	 Famine	Externality	 SpaceCat	 Meteorite	Other	 NextCat	 Question Mark					
	 Animal Epidemic	 Waterborne Epidemic		 Zoonosis	 Plant Epidemic		 Child Poverty	 Welfare System Failure		 Refugee Crisis	 Space Threat	 Ozone Layer Collapse	 Satellite System Failure	 Question Mark	 Question Mark	 Question Mark
	 Waterborne Epidemic	 Zoonosis		 Plant Epidemic	 Child Poverty		 Welfare System Failure	 Refugee Crisis		 Space Threat	 Ozone Layer Collapse	 Satellite System Failure	 Question Mark	 Question Mark	 Question Mark	

Progress During 2013

- Began to populate the threat taxonomy
- Developed a selection of threats into illustrative stress test scenarios
- Developed a methodology to assess the consequences of a scenario on multi-line business, macroeconomy, and investment portfolios
- Collated a large set of databases on the global networks that underpin our economy
- Developed early-stage models of disruption to networks and financial and economic contagion

Risk Centre 2013 Outputs

Cambridge Working Paper Series



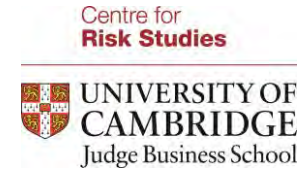
Available at

<http://cambridgeriskframework.com>

Global Landscape of Risk

Insurance Industry Standardization Initiative

- Workshop co-hosted by Munich Re and Cambridge Risk Centre, 10 September 2013
- Attended by a group of major insurers interested in the topic of managing emerging risks
- Included British Standards Institute
 - Testing insurers' interest in developing a Publicly Available Specification (PAS)
- Workshop concluded that there is need for standardisation of:
 - terminology and concepts
 - scenario data schemas
 - exposure structures



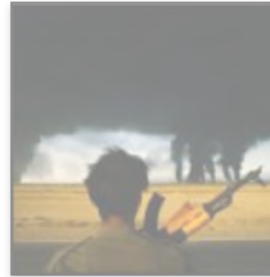
2013: Scenarios Development



Geopolitical Conflict

Sino-Japanese Conflict in the East China Sea

Regional conflict in South China Sea
embroiling multiple military powers
SME: Richard Hartley, Josh Wallace, Cytora;



Oil Price Shock

Regime Change in Saudi Arabia

Arab Spring event leads to western military
intervention triggering major oil price spike
*SME: Ivan Ureta, Geneva School of Diplomacy &
Richard Hartley, Josh Wallace, Cytora;*



Cyber Catastrophe

Sybil Logic Bomb Cyber Attack

Major compromise of commercial IT systems
by cyber attack

*SME: Rob Watson, Richard Clayton, Frank Stajano,
Cambridge Computer Labs; Éireann Leverett, I/O Active*



Banking Crisis

Bank run in Southern European

Run on banks in Greece and Cyprus causing
contagion through European financial system



Human Pandemic

Sao Paulo Flu Pandemic

Virulent influenza pandemic causes months
of absenteeism and economic disruption

SME: Mary Chang, Molly Sullivan, RMS



Climatic Freeze Event

8 week freeze in Northern Hemisphere

Severe and extended winter in Northern Europe
and East Coast USA



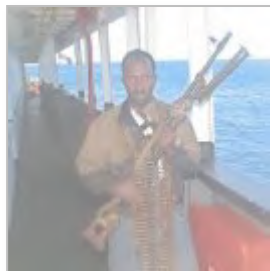
Social Unrest Risk

'Sack the Bankers'

Worldwide Protest Movement

Austerity-driven riots and strikes across
multiple cities in several Eurozone countries

SME: Ivan Ureta, Geneva Schl of Diplomacy



Piracy Crisis

Severe Piracy Activity in Horn of Africa

Intensity of piracy incidents increases to the point
that shipping patterns are impacted

Can We Understand ...

Various types of emerging risks:



Pandemics



Social Unrest



Geopolitical Conflicts



Cyber

And assess their potential to cause:

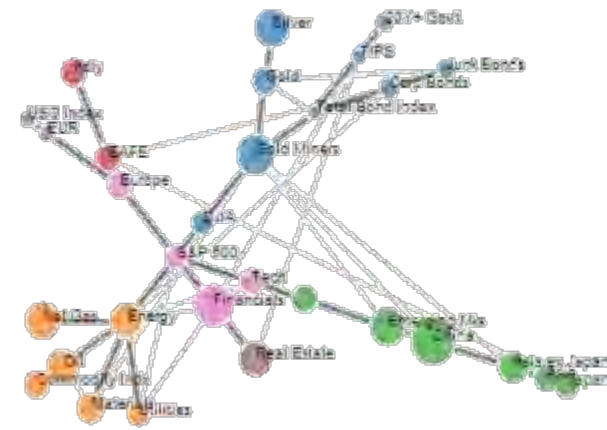
**Underwriting
Losses**



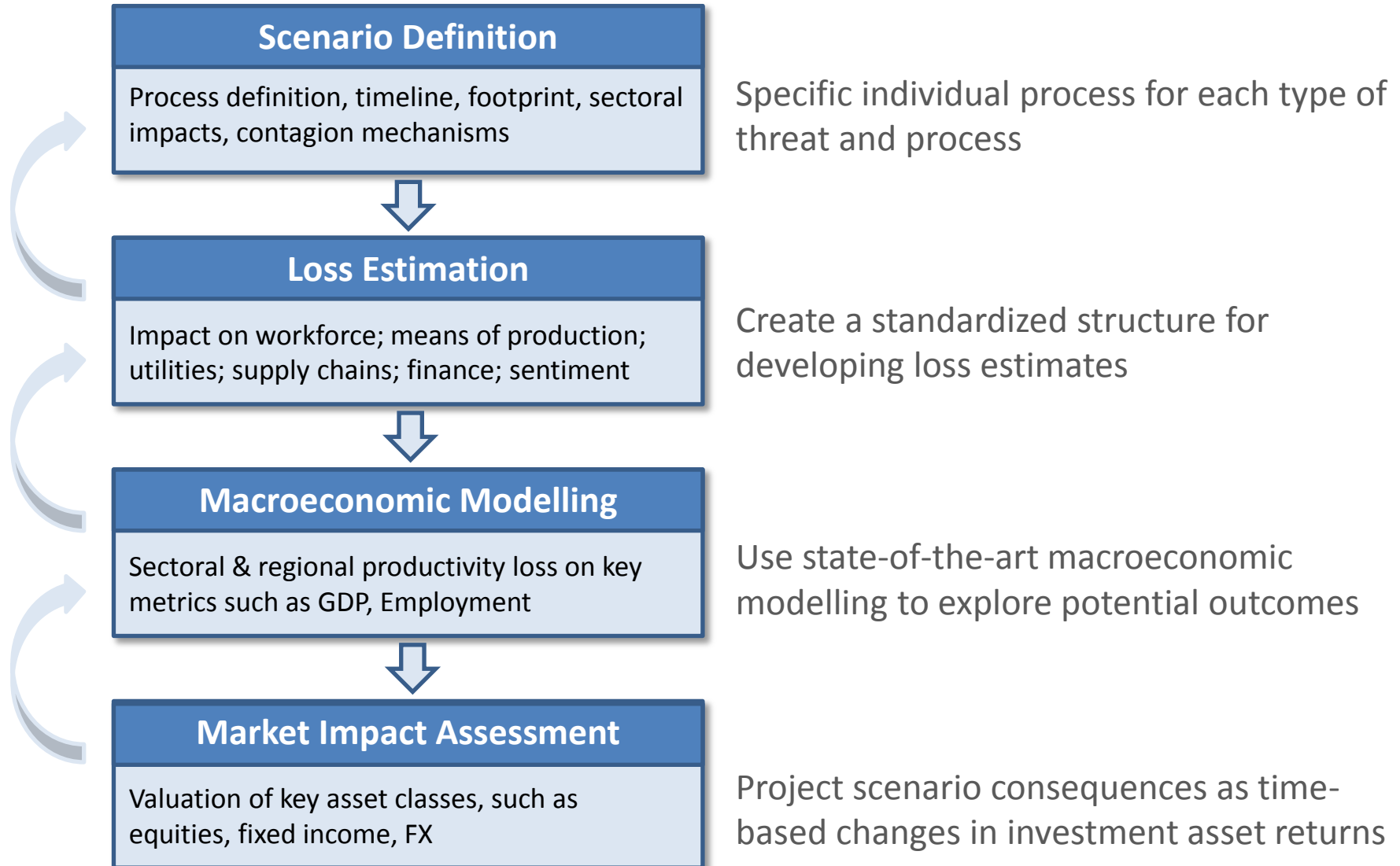
**Non-Underwriting
Operational Impact**



**Investment Portfolio
Impact**



CRS Scenario Development Process

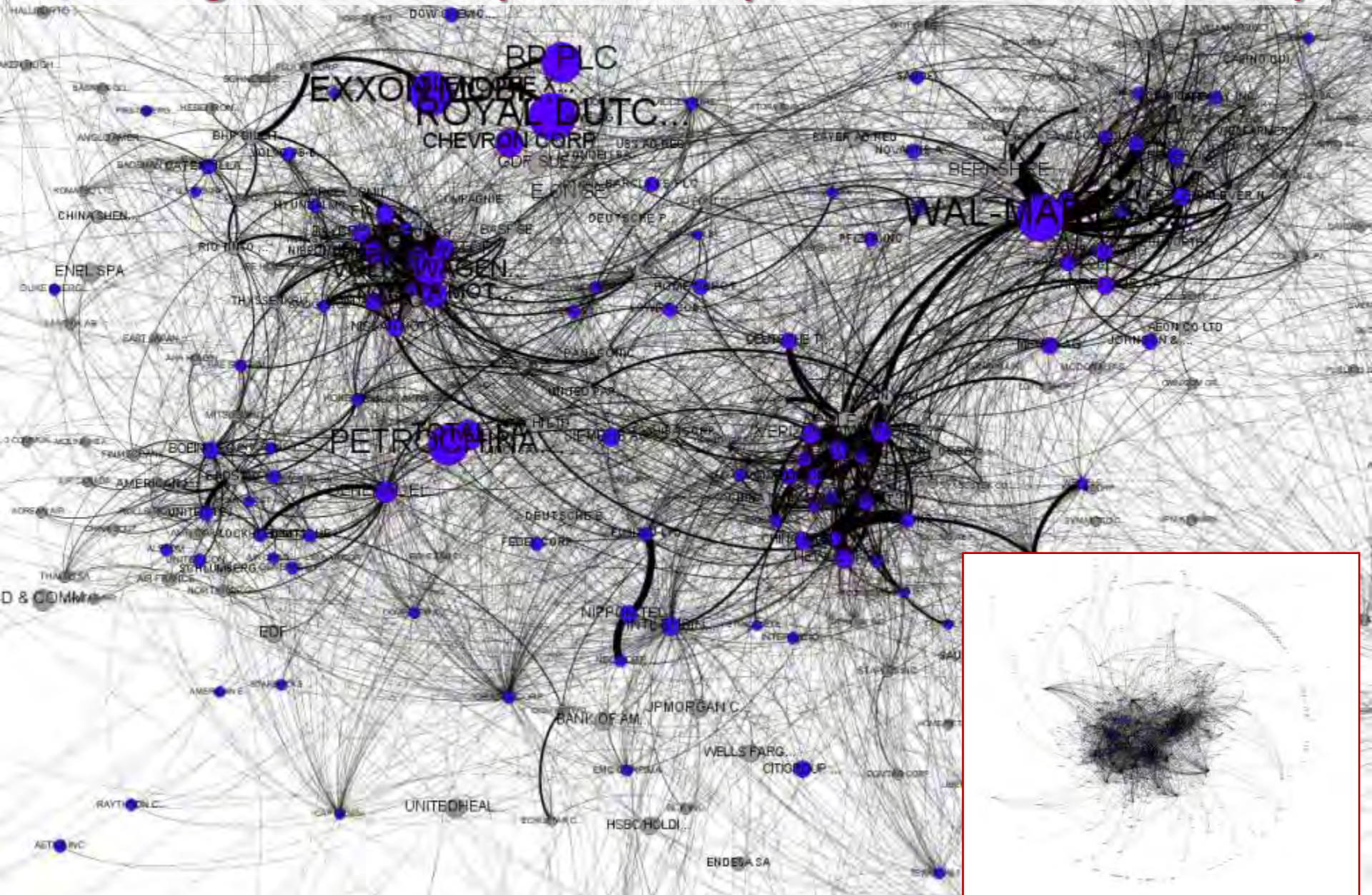


Key Methodological Challenges

- Can we construct an extreme fictional scenario that is plausible through using evidence-based precedents?
 - Can these scenarios meet the challenge of being useable by businesses and ultimately adopted for use in risk management?
- Can we estimate the losses that would result from extreme events that haven't occurred in today's world?
 - Can we create a robust and transparent estimation process?
- Can we push macroeconomic models outside their comfort zone to model extreme events usefully?
 - How far beyond range of the model's parameterization?
- Can we model the impact of hypotheticals on investment asset classes and portfolios?
 - How useful are asset value 'fundamentals', and how much market sentiment and crisis behaviour do we need to incorporate?

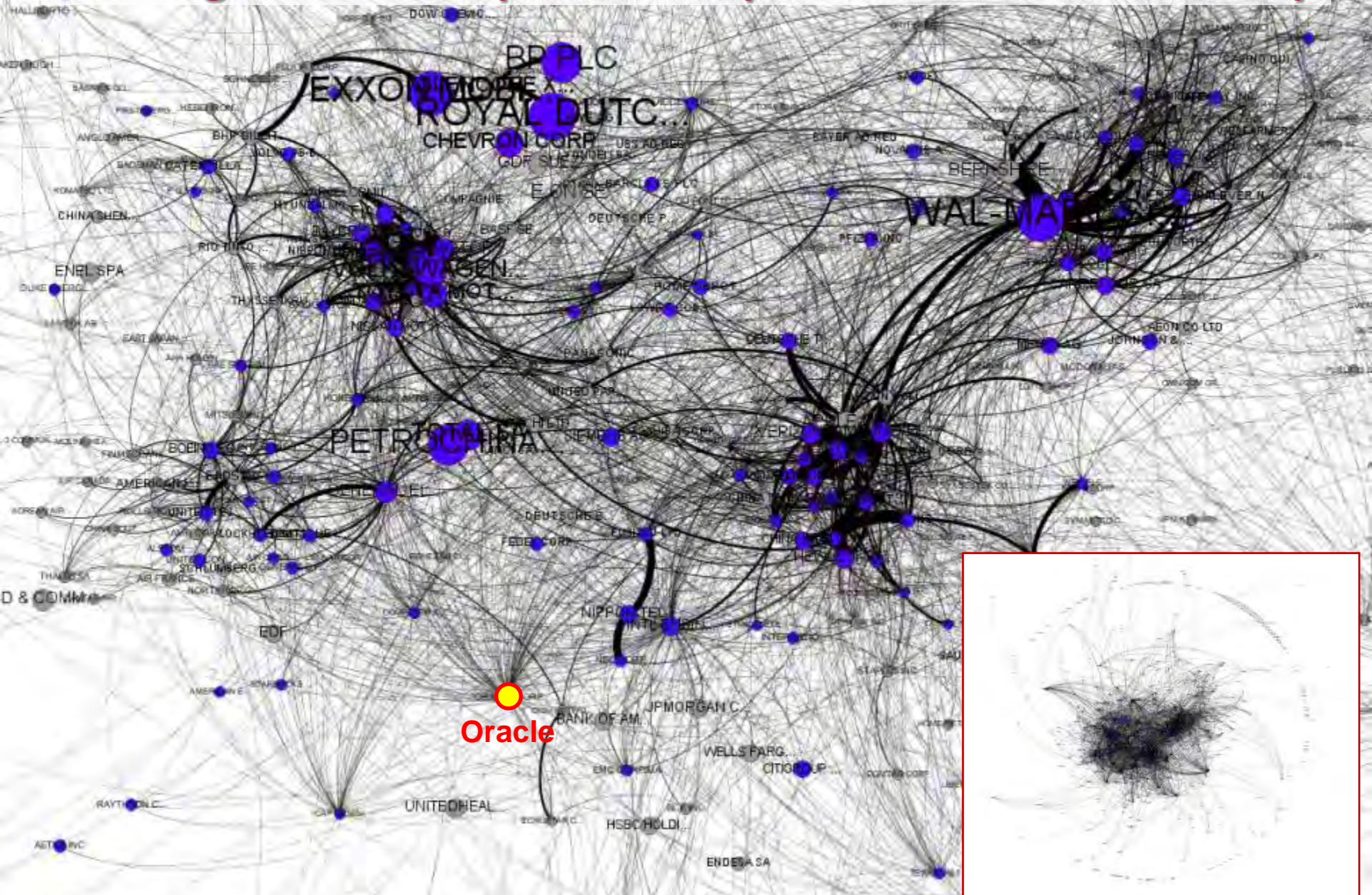
CHINA PETR...

Trading Relationships of Enterprises in Global Economy



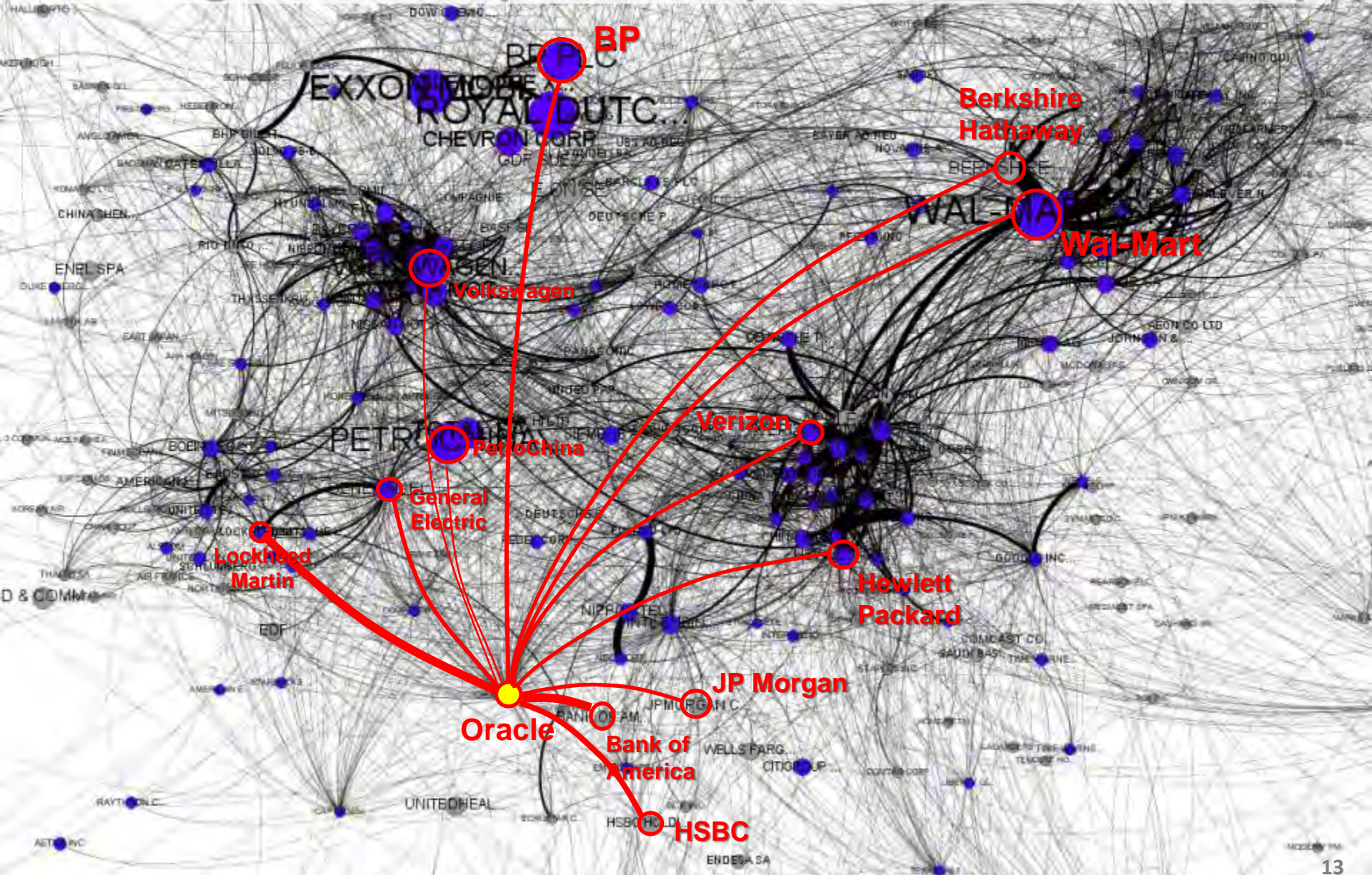
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Trading Relationships of Enterprises in Global Economy

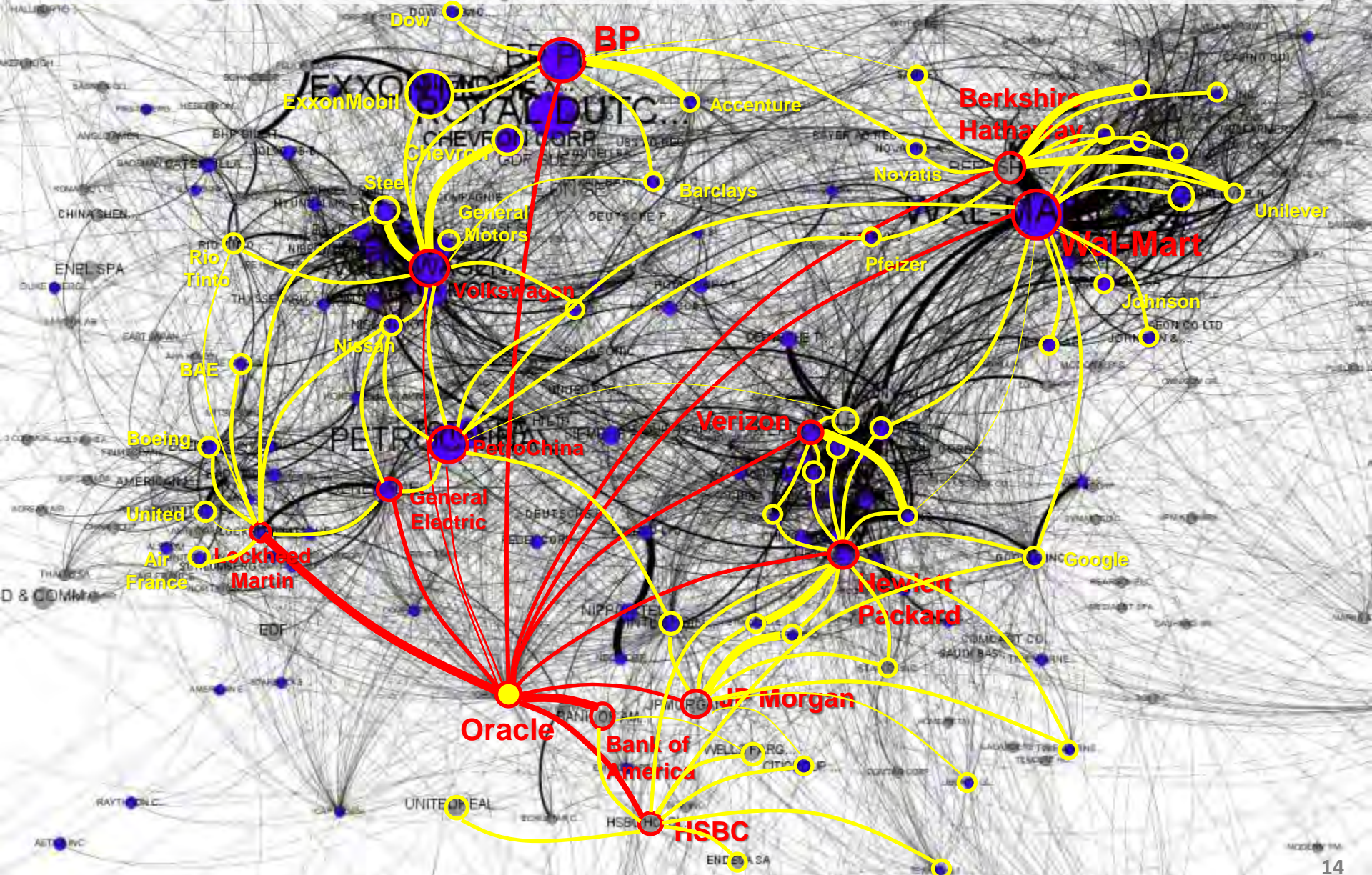


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Trading Relationships of Enterprises in Global Economy

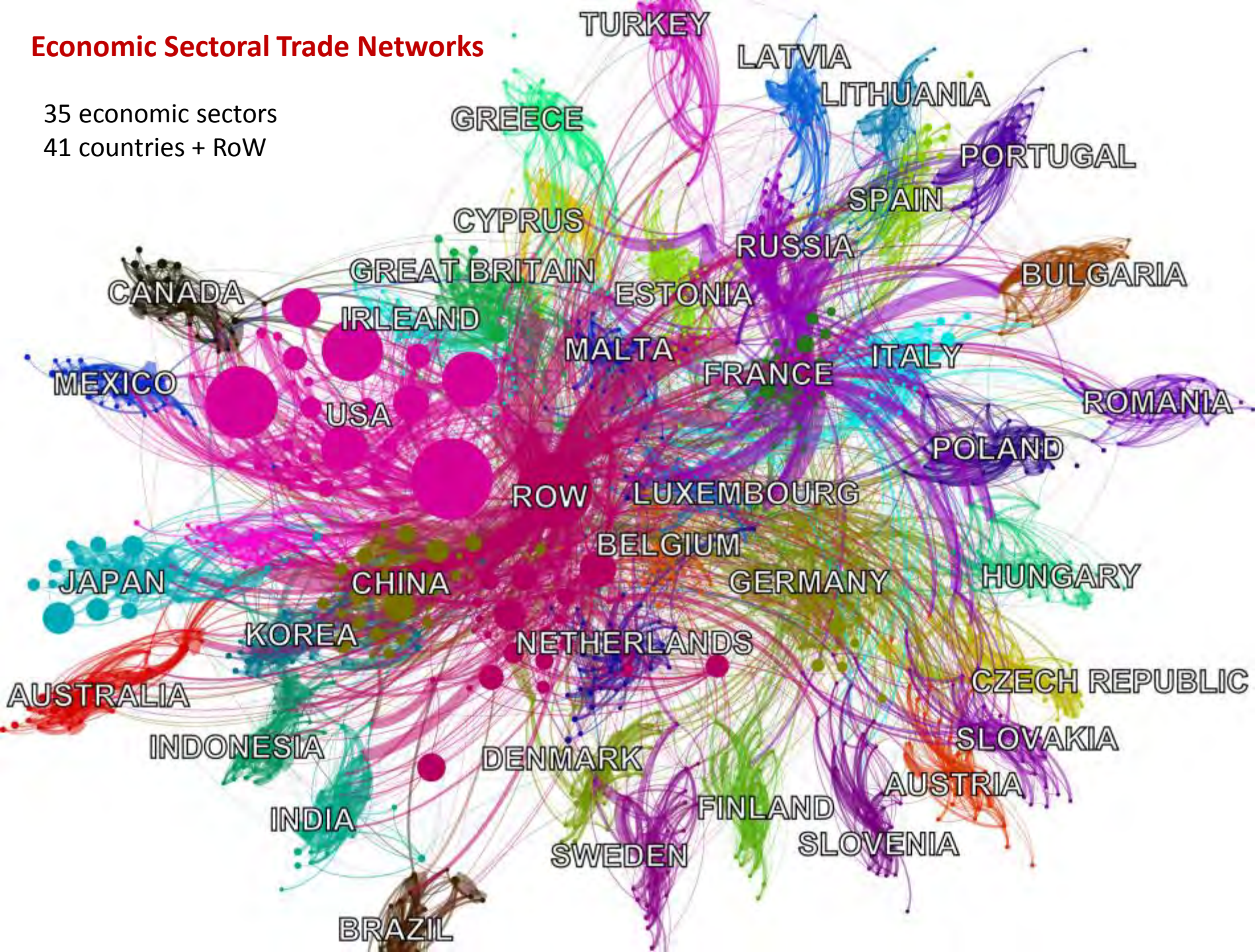


Trading Relationships of Enterprises in Global Economy



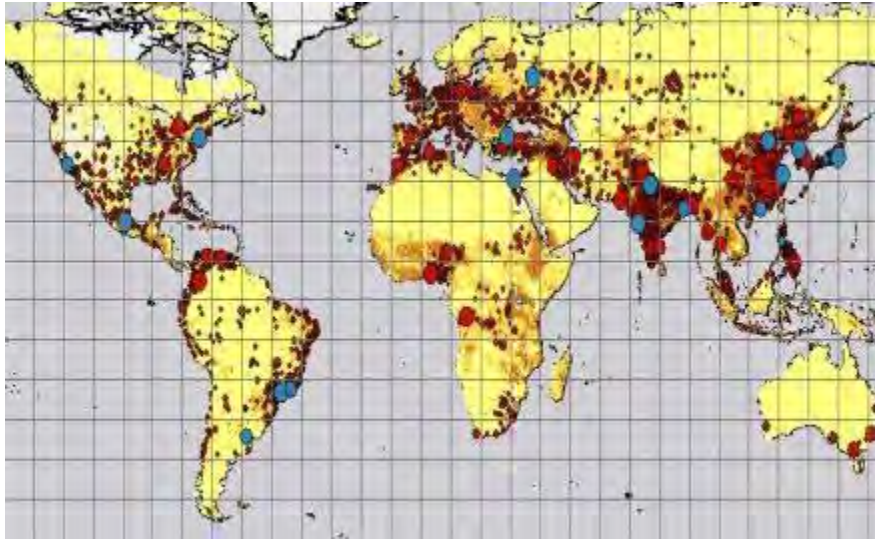
Economic Sectoral Trade Networks

35 economic sectors
41 countries + RoW



Substrate Databases Compiled in 2013

World City Database



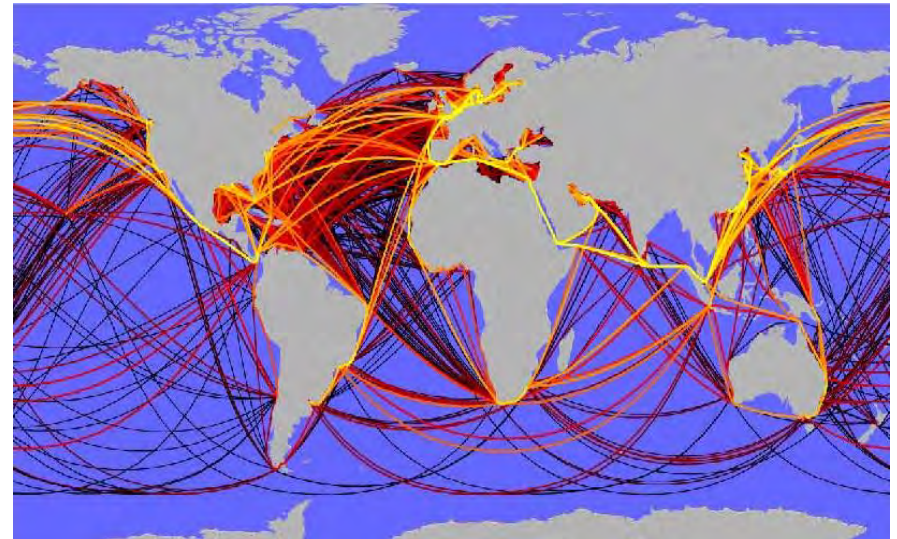
Air Travel Network



Communications Networks



Cargo Shipping Networks



A Banking Network Liquidity Contagion Model

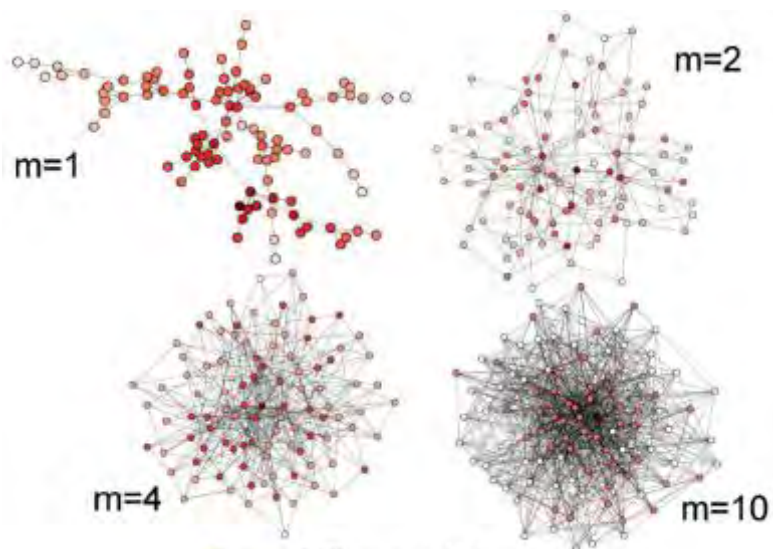


Figure: Different scale free networks

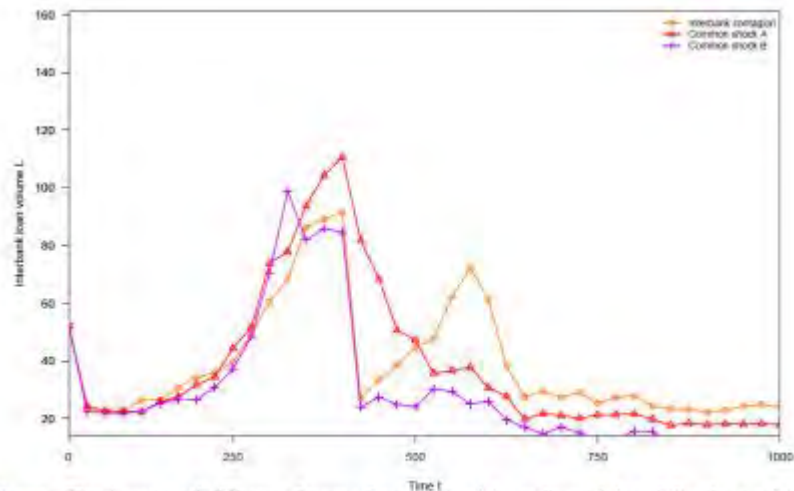
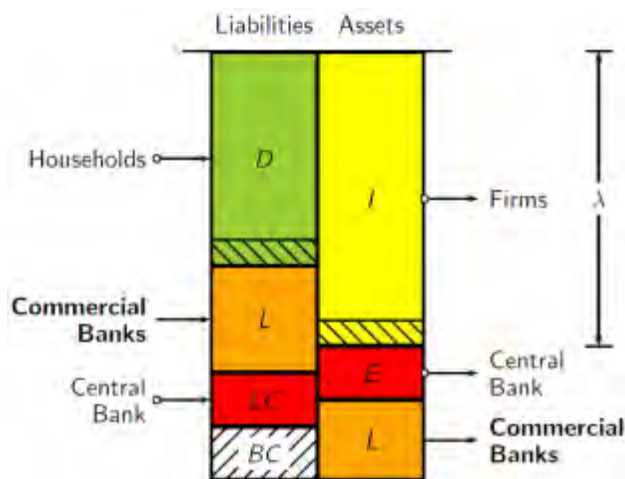


Figure: The impact of different forms of systemic risk on financial stability in a crisis scenario ($\rho_I^+ = 0.09, \rho_I^- = -0.08$) in a random network (connLevel=0.8)

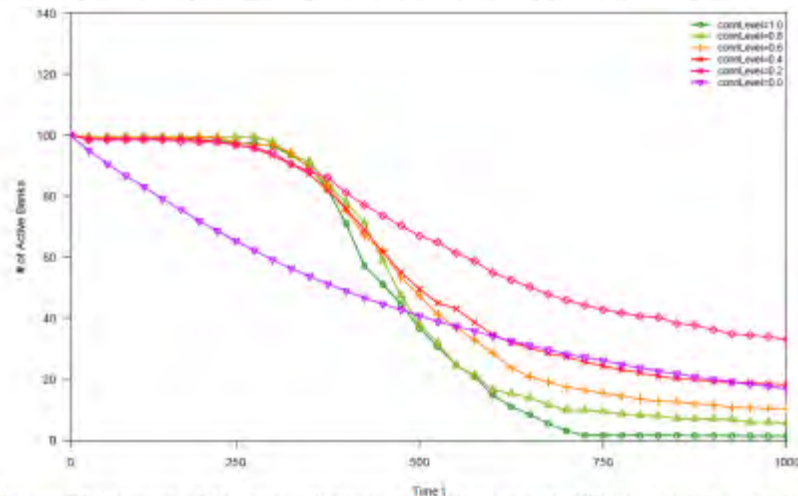
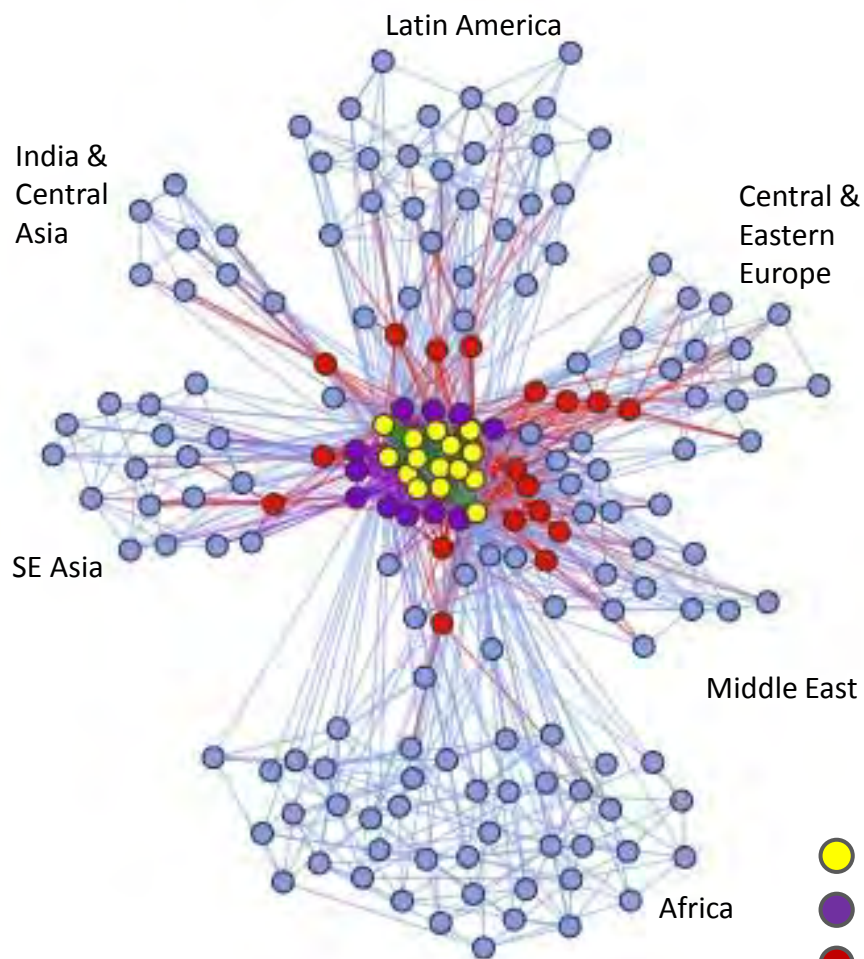


Figure: The impact of the network topology on financial stability in a crisis scenario ($\rho_I^+ = 0.09, \rho_I^- = -0.08$) in a random network.



Co-Pierre Georg, 2012
 'Black Rhino' model of shocks on a banking network

Cambridge FinCat International Banking Network Model



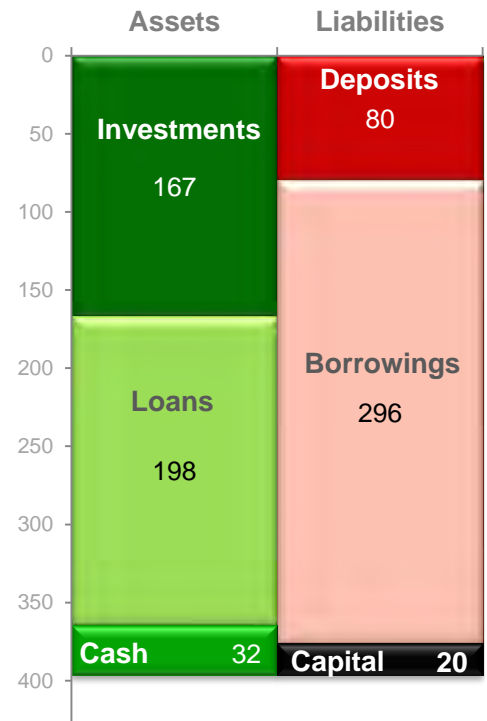
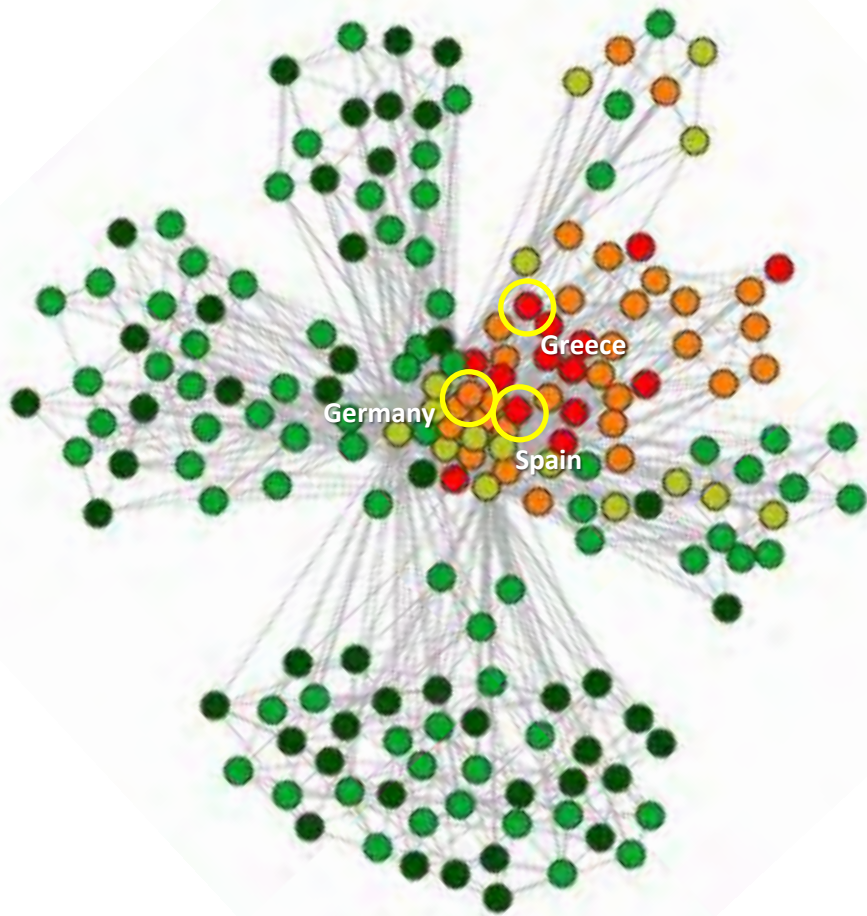
Topology



Geography

- Inner Core (Tier 0)
- Outer Core (Tier 1)
- Inner Periphery (Tier 2)
- Outer Periphery (Tier 3)

Contagion in International Banking Network from Greek Bank Run

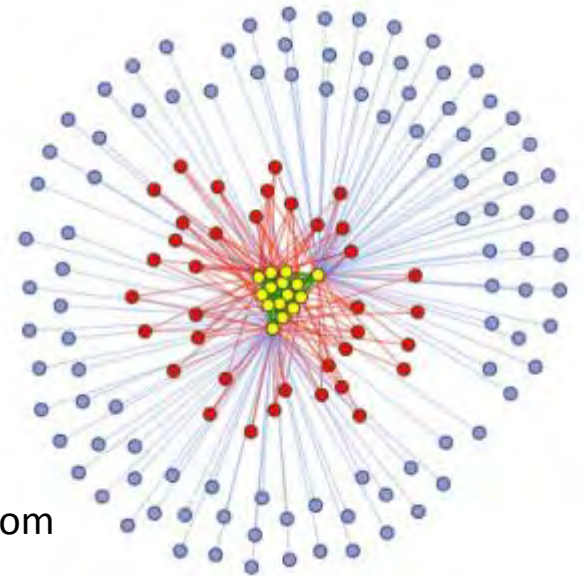


- Default (Capital Ratio < 0)
- Near Default (CR < 2%)
- Impacted (CR < 4%)
- Compromised (CR reduced)
- Unaffected (CR maintained)



State of the Art of Financial Network Models

- Hasn't yet achieved realistic behaviour in network performance
 - Agent rules, confidence, and psychological behaviour is not well encoded
 - May not behave like a mechanistic system
- Not all the actors (central banks, companies, creditors) are well represented in these models
- Financial actors are a single agent
- Very simplified representation of real-world data



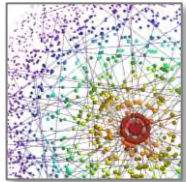
Topology of international banking network as a force-directed graph, from Cambridge FinCat Risk Model

2014 CRS Research Programme Themes



1. Global Complex Risk Landscape

- Establishing a comprehensive taxonomy of future large scale threats, tracking ‘Emerging Risks’, and developing stress-test scenarios.



2. Understanding Complex Business Exposure

- Compiling data on the interconnectivity of the business world, and exploring their propensity for and vulnerability to cascading failure



3. Financial Catastrophe Risk

- Using the Cambridge Risk Framework to explore stability, contagion, and crises in financial networks



4. Insurability of International Supply Chains

- Developing metrics of loss, ‘efficient resiliency’, and benefits of improvements to global supply chains and business networks.



5. Understanding the Threat of Cyber Catastrophe

- Developing a more rigorous framework for the evaluation of extreme cyber risk, as one of the most significant threats in the taxonomy.