Centre for Risk Studies Research Showcase 13 January 2015

Session 3: FinCat

Financial Catastrophe Risk Research

Centre for Risk Studies
UNIVERSITY OF CAMBRIDGE
Judge Business School

Dr. Andrew Coburn

Director of Advisory Board

Centre for Risk Studies

Stress Testing: Recent Controversy

FINANCIAL TIMES

November 3, 2014 10:59 pm

Stress test assumptions were not particularly stressful

The New York Times

European Bank Stress Tests Worked: Sort Of

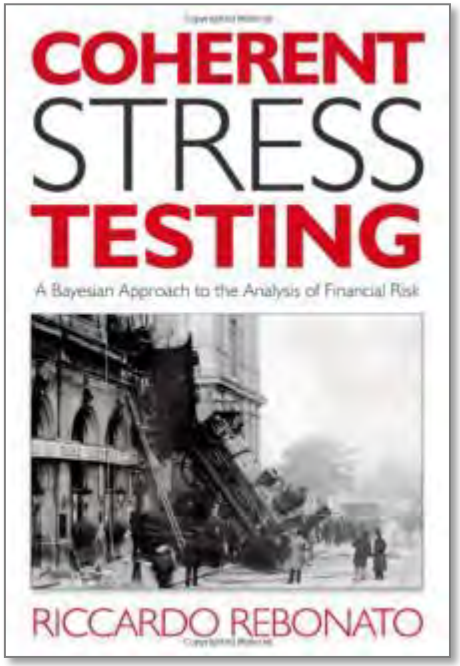
By JACK EWING
Published: July 30, 2010

The New York Times

INVESTMENT BANKING | LEGAL/REGULATORY NYT NOW

Just 13 Banks Fail E.C.B. Stress Test, in Possible Economic Turning Point

By JACK EWING October 26, 2014 7:00 am 28 COMMENTS

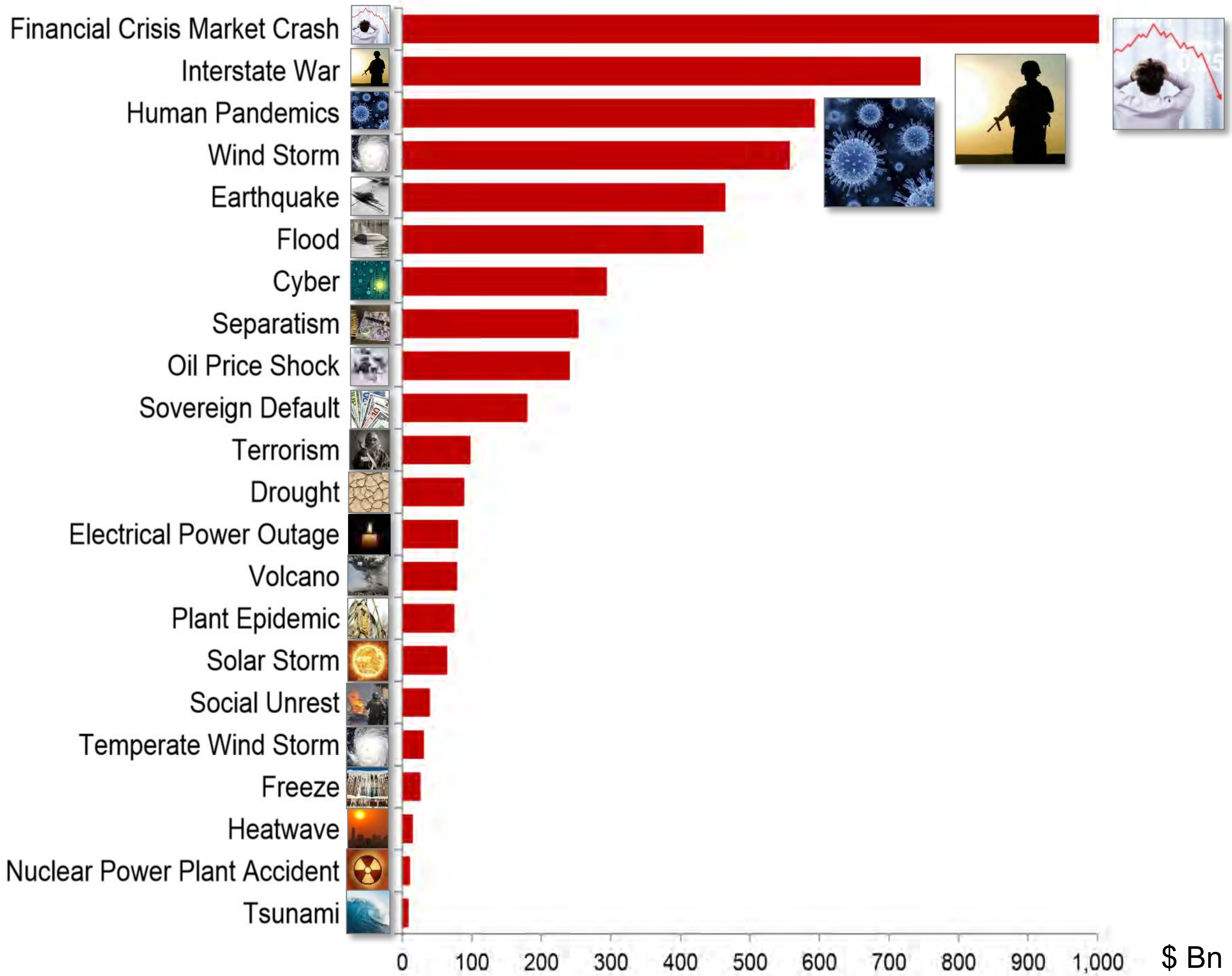


revelations about Europe's biggest banks. But some wondered whether the relatively sanguine results meant that the health exam was not tough enough, despite the central bank's promises that the assessments would be rigorous.

stress tests, widely criticized as too easy

In Britain, the major banks all passed the stress test comfortably.

Risk from 23 Threats to the Global Economy



GDP@Risk from 2015 to 2025

Research Objectives of Cambridge FinCat Project

Causes of Future Crises

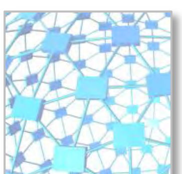
- What might trigger future FinCats? Defining a full taxonomy; Developing an authoritative historical catalogue; How often and how bad?

Developing Stress Test Scenarios

- What toolkit do we need to model the impacts of potential events? Can we ensure ‘coherence’ in their effects?

Developing a Model of Global Financial System

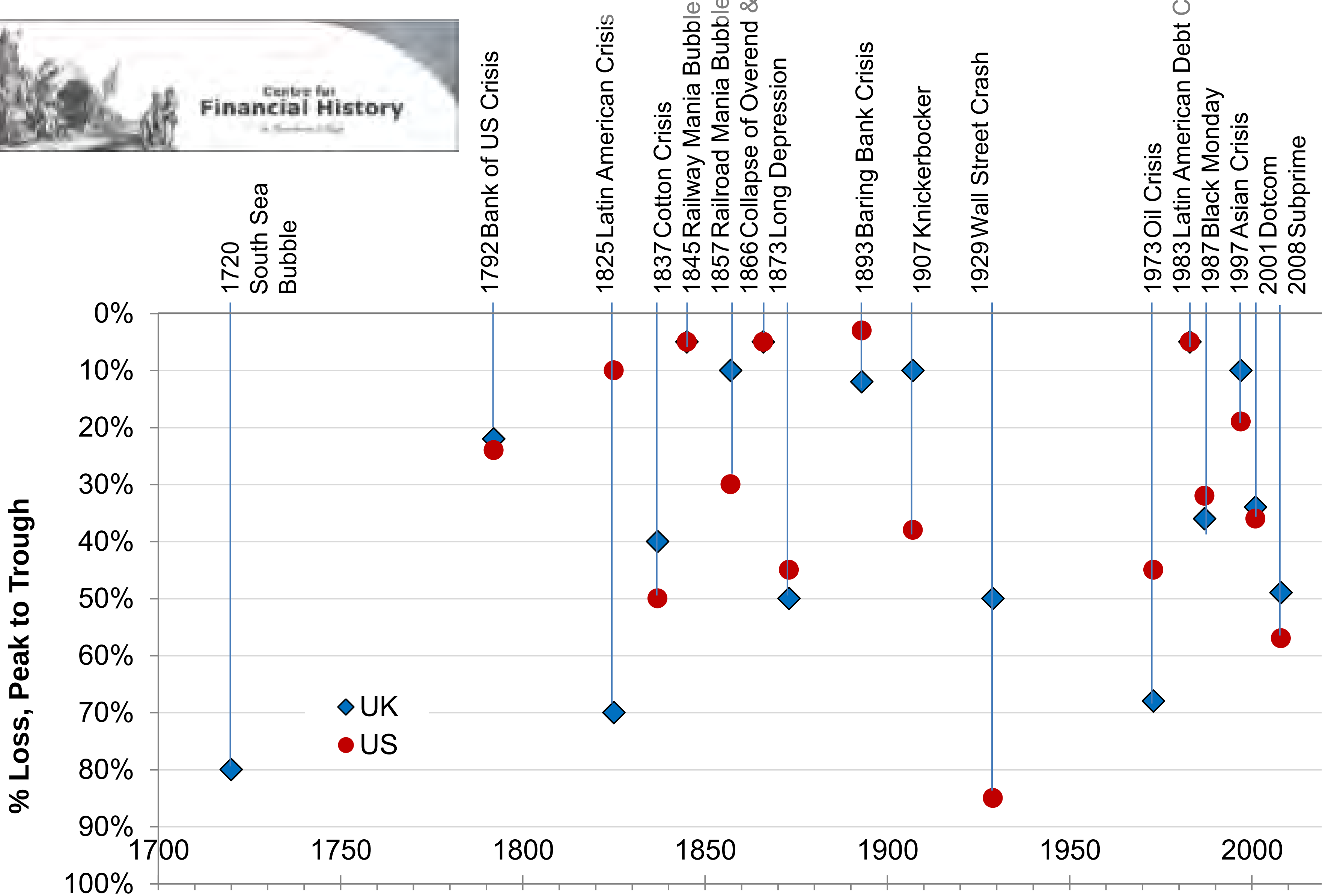
- Understanding the structure of the financial universe and how crises propagate through it



Understanding Financial System Behaviour

- Understanding financial network modelling, interconnectivity, network behaviour, critiquing common modelling approaches, social behaviour

Stock Market Impact of Historical Crises



Financial Crises: Stockmarket Loss

Taxonomy of Financial Catastrophe

- Qualitatively different causes of **endogenous** financial shocks

Financial Shock

Asset Bubble

Sovereign Default

Bank Run

Market Crash

Based on Allen & Gale 2009, **Understanding Financial Crises**

Financial Irregularity

Flash Crash

Financial Stress Test Scenarios

Asset Bubble Shock

Global Property Crash

Sudden collapse of property prices in China followed by many other emerging and developed markets triggers a cascading crisis throughout the global financial system

Sovereign Default Shock

Eurozone Meltdown

Unexpected default of Italy is followed by a number of other European countries, leading to multiple cession from the Union and causing an extensive financial crisis for investors

High-Inflation Trend

Food and Energy Price Spiral

A series of world events puts pressure on energy prices and food prices in a price increasing spiral, which becomes structural and takes many years to unwind

De-Americanization of Financial System

Dollar Deposed

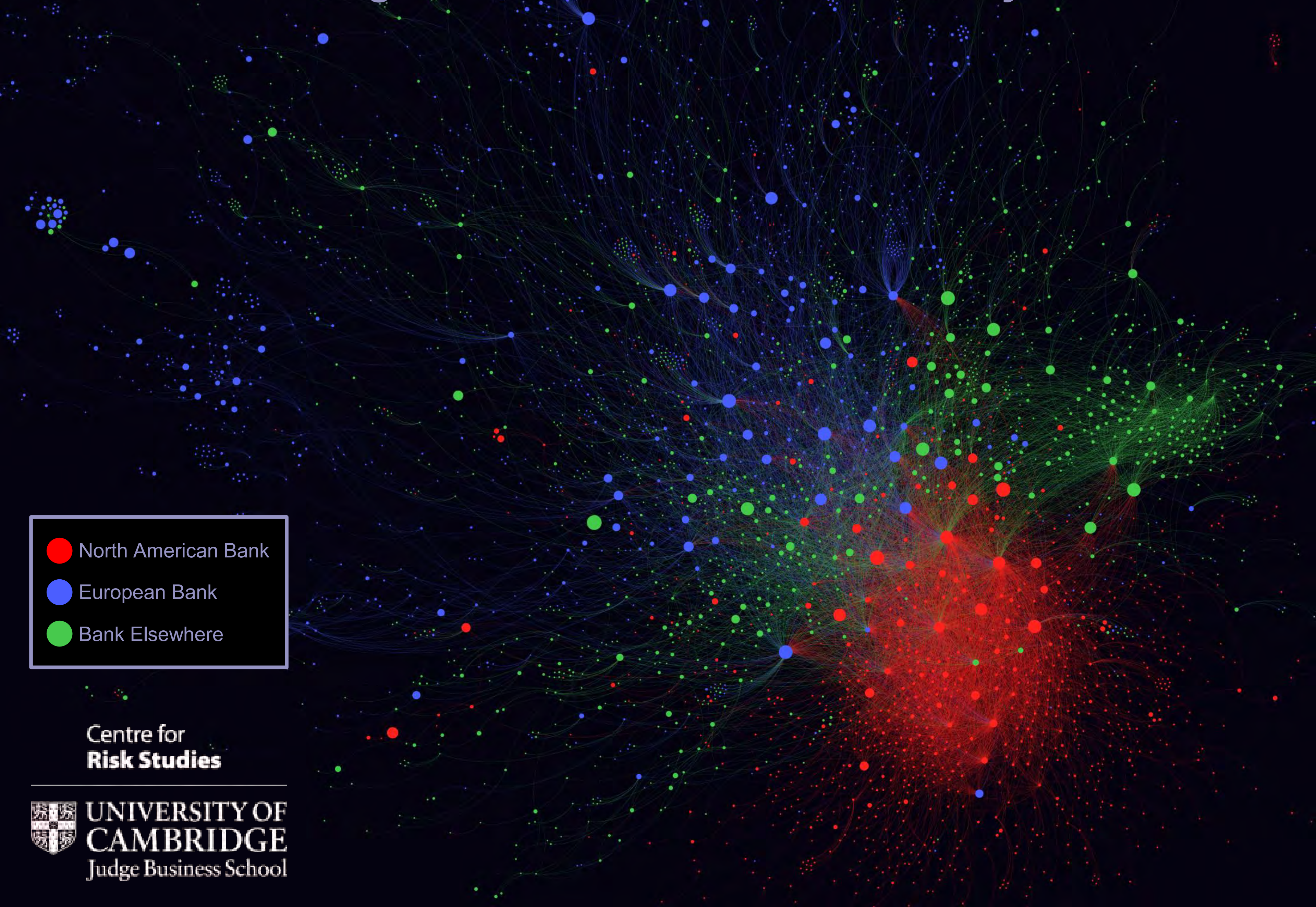
US dollar loses its dominance as the default trading currency as it becomes supplanted by the Chinese Renminbi, with rapid unwinding of US Treasury positions and economic chaos

Developing a Model of Global Financial System

Data Sources include:

- Integrating multiple sources of data on banks, lending patterns, cross-holdings, and assets
- Currently includes 18,516 banks
  - Important to include all jurisdictions and markets as one global financial system
- This example focuses on cross-holdings and mortgage lending
- Future potential to link it to database of corporate enterprises

Cambridge Model of Global Financial System



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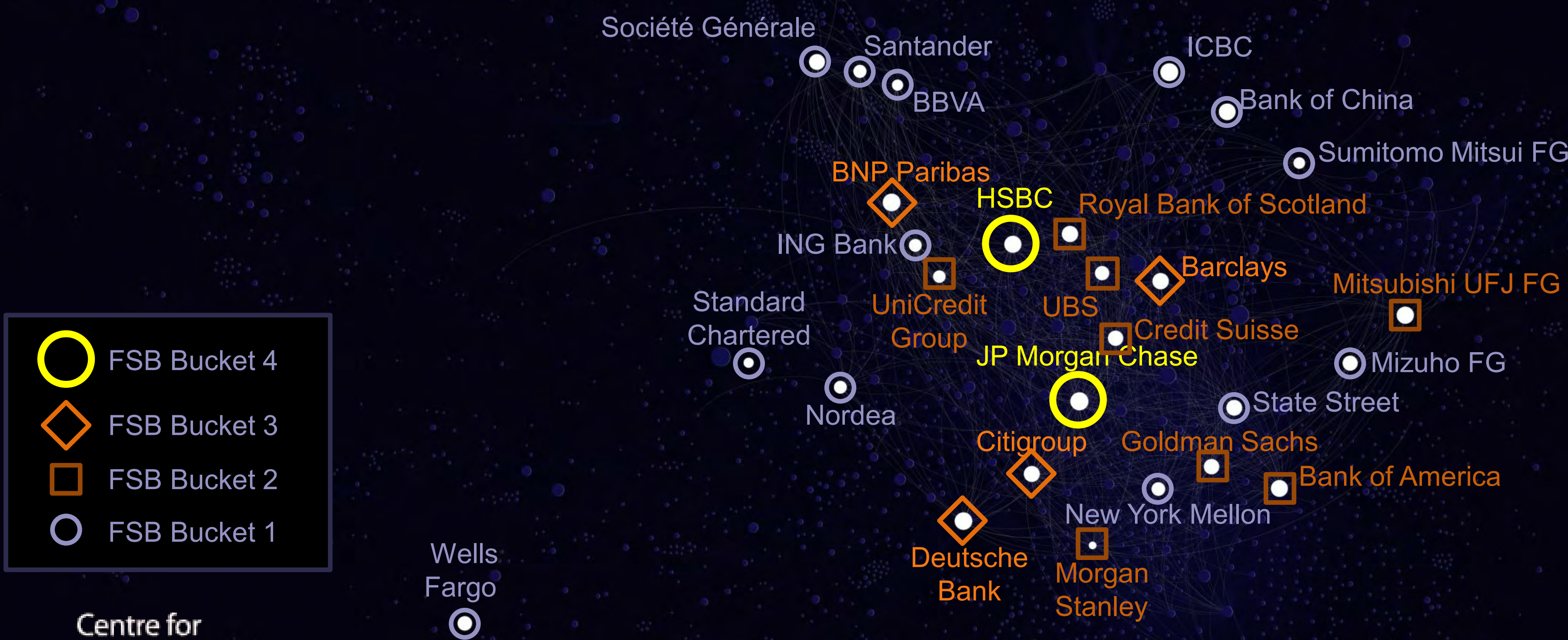
Summary of Financial System Statistics

- 18,447 banks
  - Total market value of **$210 Trillion**
  - Total equity value of **$17.7 Trillion**
- Mortgage assets total **$18.3 Trillion**
  - Mortgage lending exceeds the equity value of banks
- All banks have exposure to assets that would devalue in the event of a property price correction
- Cross-holding network links 4,221 banks
- ‘Low density’ (sparse) interbank lending network
  - Real network of who lends to who is not public
  - Interbank lending network inferred from known total lending and borrowing with a higher probability of
    - Intra-country lending
    - Small borrowing bank ↔ big lending bank
    - Small lending bank ↔ big borrowing bank
- Shadow banking sector under-represented

Global Systemically Important Banks (GSIBS)



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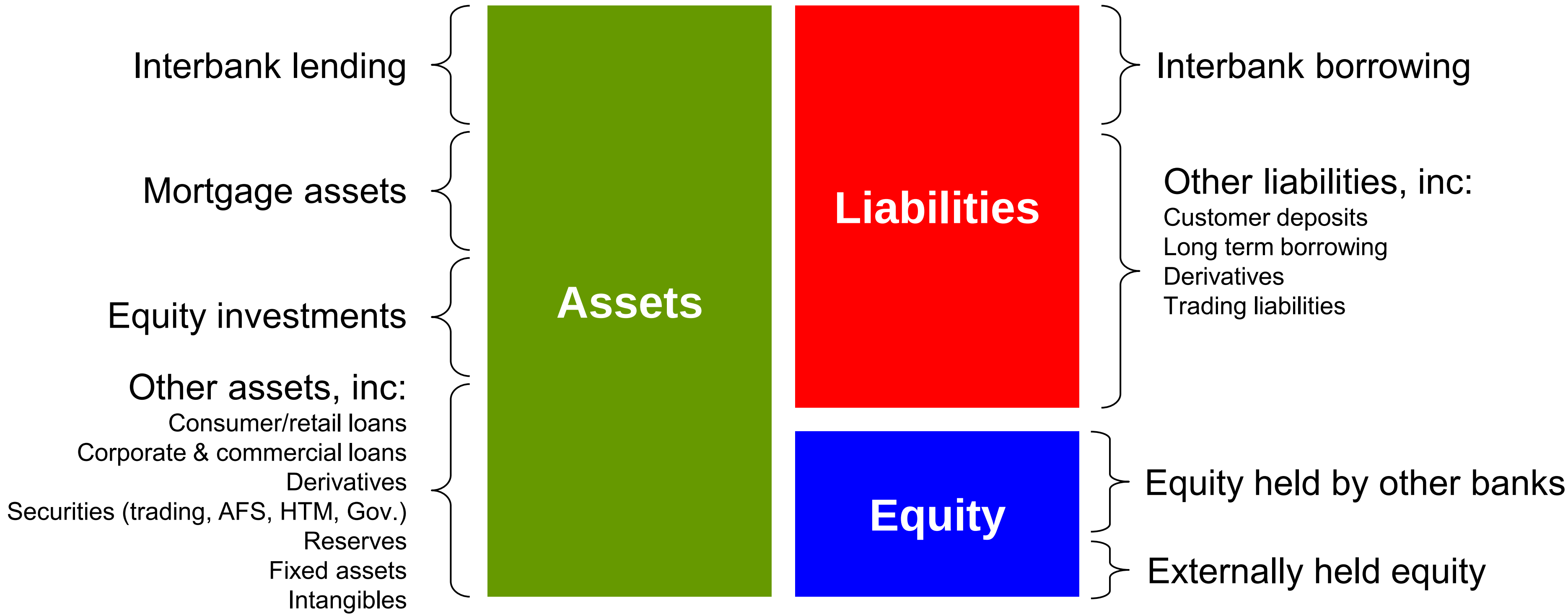
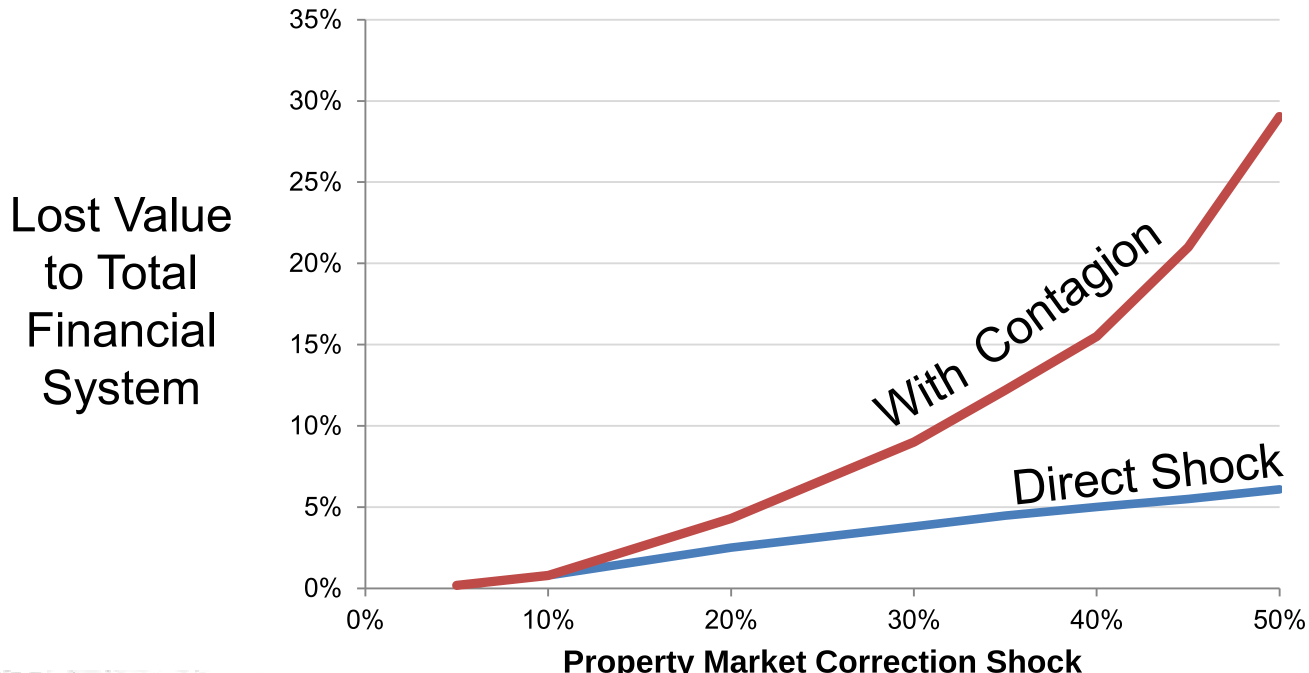
Bank Balance Sheets



Finding the Contagion Point for Property Bubble

Top 6 Tiers of Property Markets

Property Value Reduction Shock:	**5%**	**10%**	**20%**	**30%**	**35%**	**40%**	**50%**
Asset Value Reduction:	0%	1%	5%	7%	7.5%	8%	10%
Lost Value to Total Financial System							
Direct Shock:	0.2%	0.8%	2.9%	4.1%	4.5%	4.9%	6.1%
Total Loss with Contagion (Same markets + International):	0.2%	0.8%	4.3%	9.0%	12.2%	15.5%	29.0%
Contagion amplifier:	0.0	0.0	0.5	1.2	1.7	2.2	3.8
Number of Failed Banks:	0	0	150	243	291	342	1,059
Banks that failed from Mortgage-shock:	0	0	159	239	284	324	1,027
Banks that failed through contagion:	0	0	0	6	7	18	32
Failed GSIBs:	0	0	0	2	4	6	14



Tier 1-6 Countries (Most exposed 24 markets)

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Global Property Bubble Stress Test Scenario

1 Tier 1 Markets – China and emerging markets – suffer property correction

Property Market Bubble Risk

Tier 1: China & Emerging Markets
China, Hong Kong, India, Brazil,
Philippines, Indonesia, Turkey

Global Property Bubble Stress Test Scenario

4 Property price slump affects UK – Tier 4 market

Property Market Bubble Risk

Tier 1: China & Emerging Markets
China, Hong Kong, India, Brazil, Philippines, Indonesia, Turkey

Tier 2: Commonwealth
Canada, Australia, New Zealand

Tier 3: Nordics
Norway, Finland, Sweden

Tier 4: UK
United Kingdom

Global Property Bubble Stress Test Scenario

7 Milder property pricing correction in US

Property Market Bubble Risk

Tier 1: China & Emerging Markets
China, Hong Kong, India, Brazil, Philippines, Indonesia, Turkey

Tier 2: Commonwealth
Canada, Australia, New Zealand

Tier 3: Nordics
Norway, Finland, Sweden

Tier 4: UK
United Kingdom

Tier 5: Europeans
France, Belgium, Netherlands

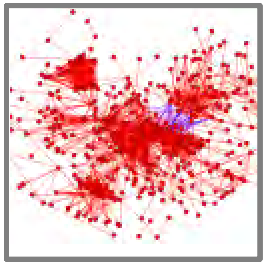
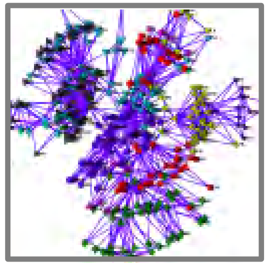
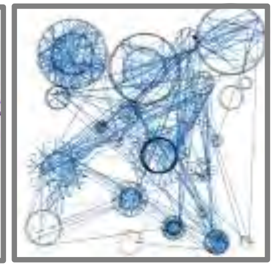
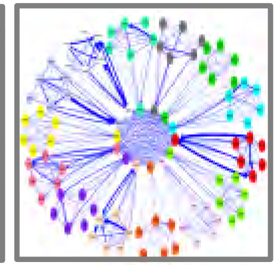
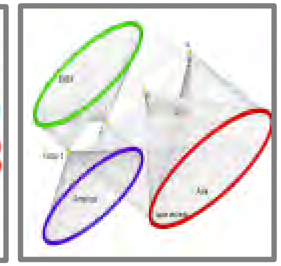
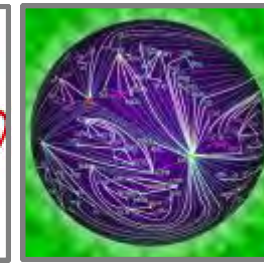
Tier 6: Other Europe
Spain, Portugal, Italy, Greece, Ireland, Austria, Denmark

Tier 7: US
United States

Scenario Results

- Our fictional 'Global Property Crash of 2015' wipes out 10-30% of the value of the financial system
  - It is highly systemic, and has strong contagion characteristics
- Multiple G-SIBs fail
- It is geographically diverse and has implications for all major markets
- This **$20-60 Trillion value loss** would be significantly larger than the value loss to the system suffered in the 2008-9 Great Financial Crisis
  - We estimate the lost Global GDP 2007-12 at $18 Trillion **($20 Trillion** at today's values)
  - The GFC caused a lengthy period of reduced economic activity
- Performance of individual financial institutions is highly heterogeneous
  - Internal risk management processes can dramatically change the outcome for specific financial entities

Financial Risk & Network Theory Seminar 2014

- Inauguration of **Journal of Network Theory in Finance**
- 23 papers from key players in the field presenting cutting-edge research
- 108 attendees including:
  - Regulators
  - Financial practioners
  - Academics
- Variety of techniques, data analysis and models presented
- Keynotes included central banks presenting their techniques for assessing systemic risk and capital requirements in their market
- Highest ever attendee feedback score for a CRS event (4.7 out of 5)



Stress Testing Issues

- Stress tests are criticized for being
  - Not tough enough
  - Unrealistic (univariate, not 'coherent', poor assumptions, anachronistic)
  - Extremely time consuming and resource intensive to perform
  - Out of date by the time they are done
- Analysts talk about the need for new approaches to stress testing
  - Centre for Risk Studies proposes to have this as the theme for the 2015 Risk Summit: 'Risk Testing: Stressing the boundaries'

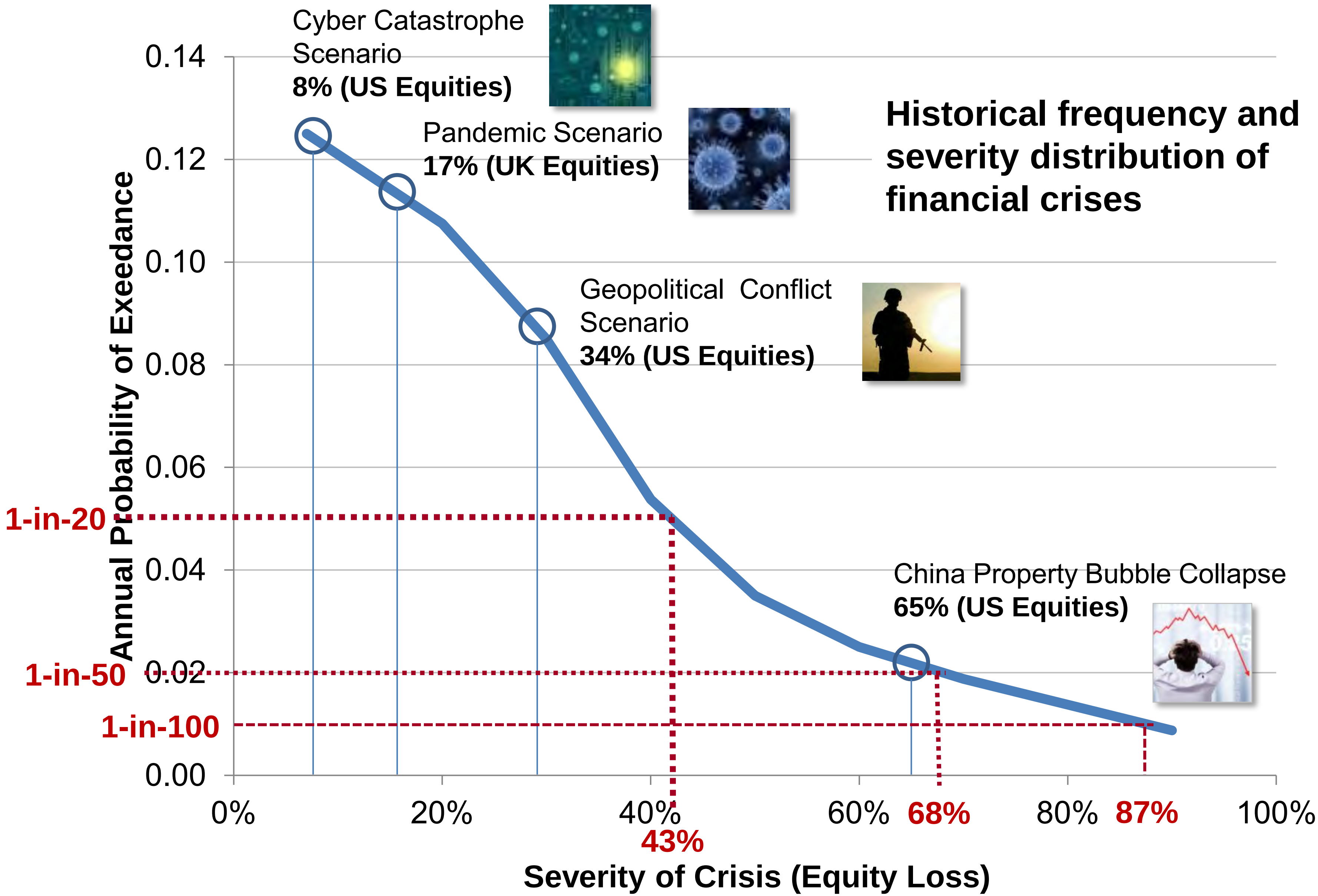
The current debate includes

- How severe should stress tests be?
- What levels of severity reassure the market?
- What levels of security do we want for our financial institutions?
- What can financial institutions learn from other disciplines about their use of stress testing?

Doing Financial Stress Tests Properly

- To do Financial Stress Tests properly we need to define the stress level to be applied based on **probability**
- Probabilistic risk assessment uses an ‘exceedance probability’ (EP) curve
- A model would create a large number of stochastic events, with their likelihood of occurrence
  - The consequences of each event, e.g. change in portfolio return, are computed
  - Ranking losses by probability provides the likelihood of exceeding different levels of loss
  - Provides the full probability distribution of loss
  - The level of protection or risk management requires can be defined from the probability of occurrence (e.g. the 1-in-50 chance of occurrence)
- This EP approach is a proven technique used in catastrophe risk management in the insurance industry
  - It replaced deterministic ‘stress tests’ in 1990s
  - It is now standard practice for regulatory filings and risk transfer transactions
  - It has provided effective protection for insurers for decades
- Our aim is to produce a financial catastrophe probabilistic model that can assess risk resilience based on the full frequency-severity distribution

Illustrative Financial Catastrophe EP Curve



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Financial Catastrophe Research Agenda

- Complete the development of a model of the global financial system
- Analyze causes, contexts and contagion processes for a number of scenarios of economic downturns and financial catastrophes
- Explore implications for practitioners managing tail risk in the financial services and investment industry and contribute to the debate on ‘stress test’ design

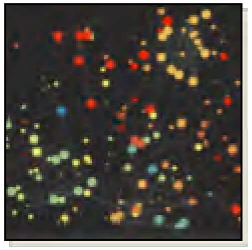
Centre for Risk Studies 2015 Research Agenda

Research Application Areas

A. Multi-Threat Economic Risk

B. Financial Catastrophe Risk

C. Cyber Catastrophe Risk



+ Infrastructure & Methodology

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