



Global Landscape of Risks Workshop

London, 10 September 2013

Trying to Define the Risk Landscape

Centre for
Risk Studies



UNIVERSITY OF
CAMBRIDGE
Judge Business School

Munich RE 

University of Cambridge Centre for Risk Studies



Current research tracks include:

- Emerging risks and systemic risk in insurance management
- Resiliency in International Supply Chains (RSIC)
- Financial crises and systemic risk in banking (FinCat)
- Risk governance and corporate risk strategy

Research Supporters



Academic Collaborators



Thematic links between projects are complex systems and shocks

Cambridge Risk Framework is an approach and toolkit for researching systemic shocks

Some Recent Events Disrupting International Business



Hurricane Sandy 2012

impacted a region that generates 40% of US economy. Flights from many airports disrupted. Eastern sea port closures disrupted international shipping for weeks



Arab Spring 2011-12

Impacts on many international businesses. Increased fuel prices. 22% of businesses globally reported that the unrest has a negative impact on their business



Credit Crunch 2008

US housing price crash in 2007 caused liquidity crisis impacting all major economies and triggering lengthy recession , impacting global businesses



Japan Tōhoku Tsunami 2011

Killed 26,000, destroyed factories and infrastructure, triggered Fukushima nuclear meltdown. Disrupted supply chains for electronics and other high-tech components



Swine Flu Pandemic 2009

caused international panic with initial reports of a high virulence virus, leading to travel and business disruption for many weeks



Thailand Floods 2011

Manufacturing regions in Chao Phraya flood plains inundated disrupting supply chains for international businesses . Large contingent business interruption claims

Catastrophe Modelling Meets Complex Systems

- The Centre for Risk Studies arises from shared interests by the participants in exploring areas of intersection between
 - Catastrophe modelling and extreme risk analytics
 - Complex systems and networks failures
- Advance the scientific understanding of how systems can be made more resilient to the threat of catastrophic failures

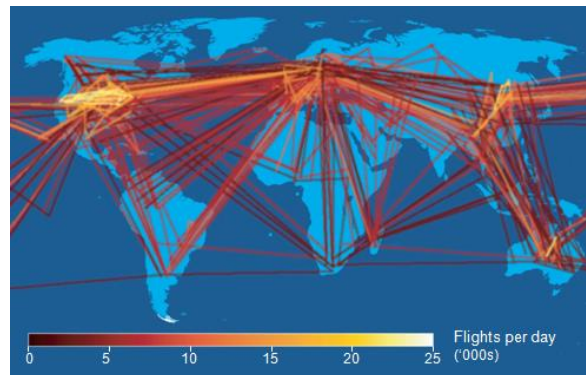
To answer questions such as:

'What would be the impact of a [War in Taiwan] on the [Air Travel Network] and how would this impact the [Global Economy]?'

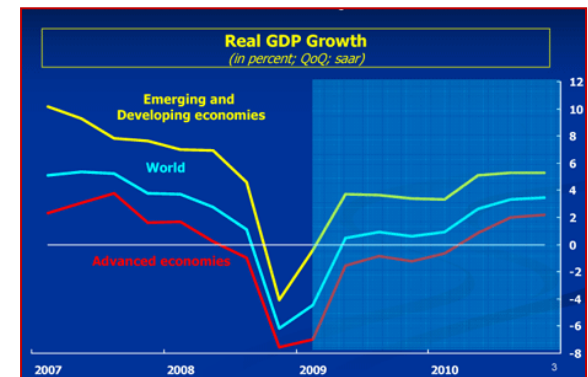
Regional Conflict



Air Travel Network

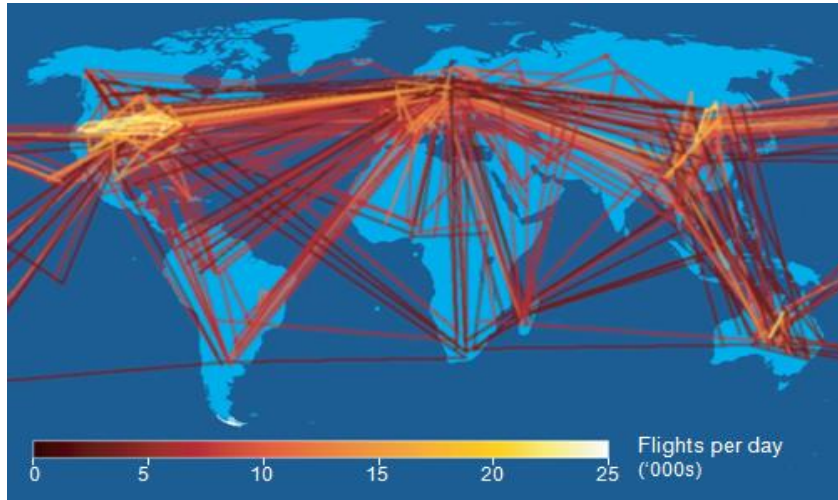


Global Economy

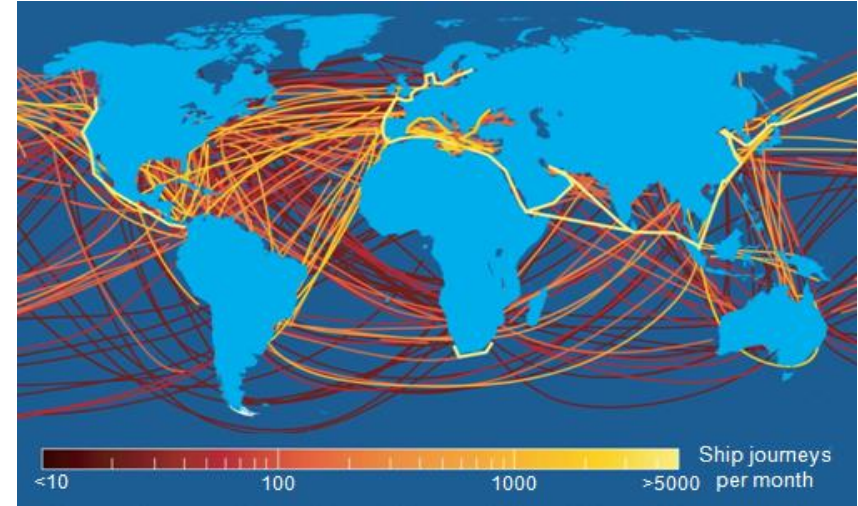


Business Activity as a System of Systems

Air Travel Network



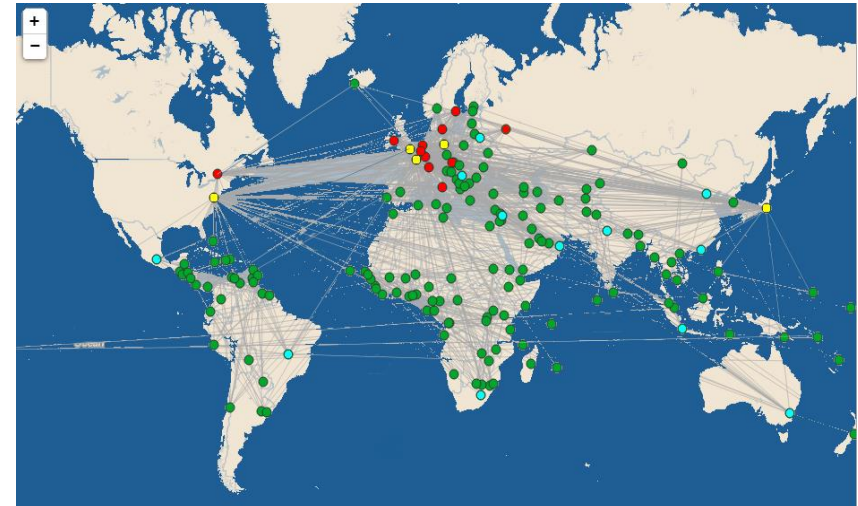
Cargo Shipping Networks



International Trade Patterns



Global Financial System



Can We Understand ...

Various types of emerging risks:



Pandemics



Social Unrest



Geopolitical Conflicts



Cyber

And assess their potential to cause:

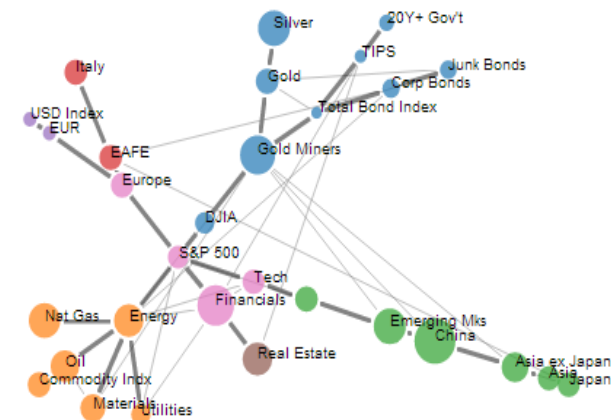
**Underwriting
Losses**



**Non-Underwriting
Operational Impact**



**Investment Portfolio
Impact**



Terminology and Definitions

■ Emerging Risks

- A cause of potential extreme loss that is becoming apparent or more significant than previously understood
- *e.g. cyber catastrophe risk*

■ Correlated Risks / Cascading Risks / Consequential Risks

- One type of peril triggers an event of another type
- *e.g. a large earthquake causes a tsunami that triggers a nuclear meltdown*

■ Clash Risks / Contingent Risks / Network Risks

- An event that causes losses across several lines of insurance business or that causes loss in unexpected locations or across multiple geographical markets
- *e.g. Thailand floods causing contingent BI losses to US business supply chains*

■ Systemic Risks / Financial Contagion / Exogenous and Endogenous Risks

- Economically-impactful threats that ripple through business and financial systems
- *e.g. Housing price bubble*

■ 'Black Swans' / 'Known Unknown' Risks

- A new and unexpected cause of extreme impact
- *e.g. Collapse of the Soviet Union*

■ 'Dragon King' events

- An event of a class of threat that occurs with a greater magnitude than was expected
- *e.g. 9/11 attack as a far larger terrorist attack than had been previously experienced*

Plus many other terms, such as unmodelled risks, unmodellable risks, pear-shaped phenomena, macro-catastrophes etc.

Objectives

- Can we define the universe of potential risks?
 - A taxonomy of threats
- Can we assess what these threats would do to an insurance business?
 - Develop stress test scenarios of hypothetical occurrences
 - Use them to explore the types and magnitudes of impacts
- Can we improve the management of these risks?
 - Develop a best-practice approach to improving resilience:
 - Exclusion language and product structuring
 - Portfolio management and accumulation controls
 - Risk transfer and diversification metrics
- Are there business opportunities in these new risks?
 - New product offerings
 - Expansion of markets and improved diversification
 - Address demand from corporate businesses for balance sheet resilience

Identifying Threats

Different Approaches

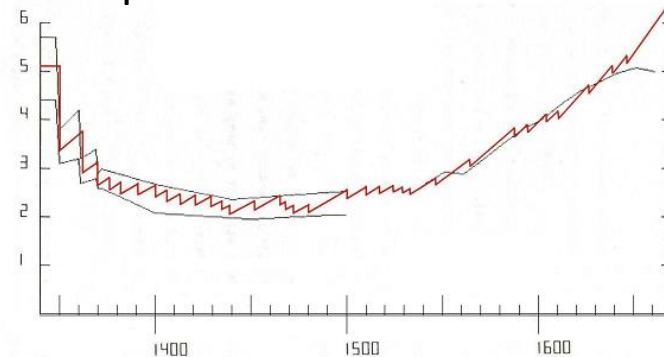
- 'Top Down' Precedent Studies
 - Review historical catalogue and other sources to try to produce an exhaustive list of precedents and potential threats
- 'Bottom Up' Possibility Generation
 - Develop exhaustive permutations of potential causes and systemic interactions to identify worst candidates
- Expert Committees
 - Use creative thinking to imagine potential scenarios and monitor a wide range of indicators of unfolding threats

What Kind of Threats Can We Expect?

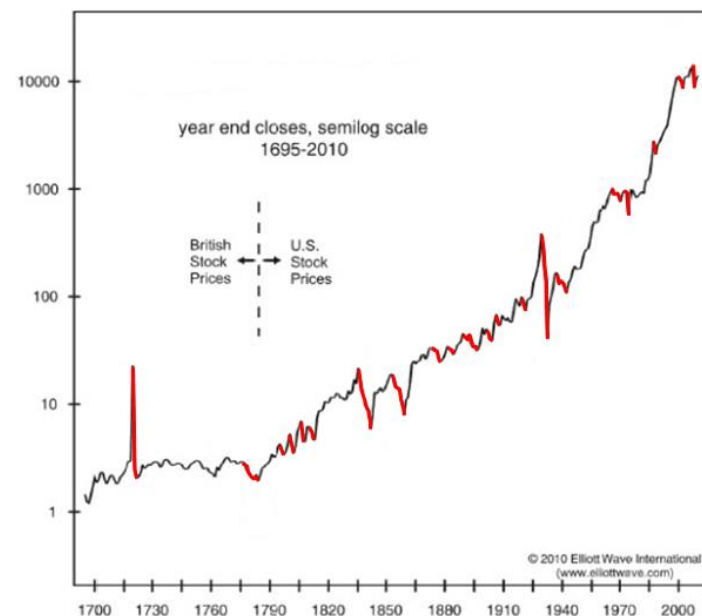
A Systematic Review of Socio-Economic Catastrophes

- Reviewed **a thousand years of data** for historical events causing disruption to social life and economic well-being
- Categorization of causes
 - Primary effort is to ensure that all categories are captured
 - Identify drivers of risk
- Counter-Factual History
 - Near-miss events that could have caused catastrophe with plausible minor deviations from actual events
- Scientific publications proposing mechanisms for major disruptions that do not appear in the historical records
 - Climate change; new technology hazards; changes in frequency and severity of threats

UK Population 1300-1700



300 years of Stock Market records



Source: Jay (2010)

<http://fintrend.com/tag/bear-market/>

Cambridge Risk Framework

Threat Taxonomy

Financial Shock



FinCat



Asset Bubble



Financial Irregularity



Market Crash



Sovereign Default



Bank Run

Natural Catastrophe



NatCat



Earthquake



Windstorm



Volcanic Eruption

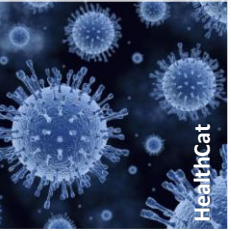


Flood



Tsunami

Disease Outbreak



HealthCat



Human Epidemic



Animal Epidemic



Waterborne Epidemic



Zoonosis



Plant Epidemic

Trade Dispute



TradeCat



Labour Dispute



Trade Sanctions



Cartel Pressure



Nationalization



Tariff War

Climatic Catastrophe



WeatherCat



Drought



Freeze



Tornado & Hail



Electric Storm



Heatwave

Geopolitical Conflict



WarCat



External Force



Civil War



Conventional War



Asymmetric War



Nuclear War

Political Violence



HateCat



Organized Crime



Assassination



Terrorism



Separatism



Civil Disorder

Environmental Catastrophe



EcoCat



Wildfire



Pollution Event



Sea Level Rise



Ocean System Change



Atmospheric System Change

Technological Catastrophe



TechCat



Cyber Catastrophe



Technological Accident



Nuclear Meltdown



Industrial Accident



Infrastructure Failure

Humanitarian Crisis



AidCat



Famine



Water Supply Failure



Child Poverty



Welfare System Failure



Refugee Crisis

Externality



SpaceCat



Space Threat



Ozone Layer Collapse



Meteorite



Solar Storm



Satellite System Failure

Other



























NextCat



Causal and Consequential Correlation of Threats

Primary Trigger

Consequential Threat

		1	2	3	4	5	6	7	8	9	10	11	12
		Financial Shock	Trade Dispute	Geopolitical Conflict	Political Violence	Natural Catastrophe	Climatic Catastrophe	Environmental Cat	Technological Cat	Disease Outbreak	Humanitarian Crisis	Externality	Other
													
1	Financial Shock		4	3	2	2	1	1	1	1	2	1	1
2	Trade Dispute		3	4	2	3	1	1	1	1	1	1	1
3	Geopolitical Conflict		3	2	4	3	1	1	1	1	2	1	1
4	Political Violence		2	2	3	4	0	0	0	3	3	2	1
5	Natural Catastrophe		2	2	2	1	4	2	3	3	2	2	1
6	Climatic Catastrophe		3	2	3	2	3	4	3	2	2	3	1
7	Environmental Catastrophe		3	2	2	2	3	3	4	2	2	2	1
8	Technological Catastrophe		2	2	2	2	2	2	0	4	1	1	1
9	Disease Outbreak		3	2	1	1	1	1	1	2	4	2	1
10	Humanitarian Crisis		2	2	3	3	1	1	1	1	2	4	1
11	Externality		3	2	2	1	3	3	3	3	2	2	1
12	Other												

0	No causal linkage No ability to exacerbate
1	No causal linkage, but would exacerbate consequences if they occur
2	Weak potential to trigger threat occurrence
3	Strong potential to trigger threat occurrence
4	Ability to trigger Other threats within same type class

Developing the Cambridge Threat Taxonomy

■ Taxonomy version 1.0

- 2009-2010
- Initial 160 years

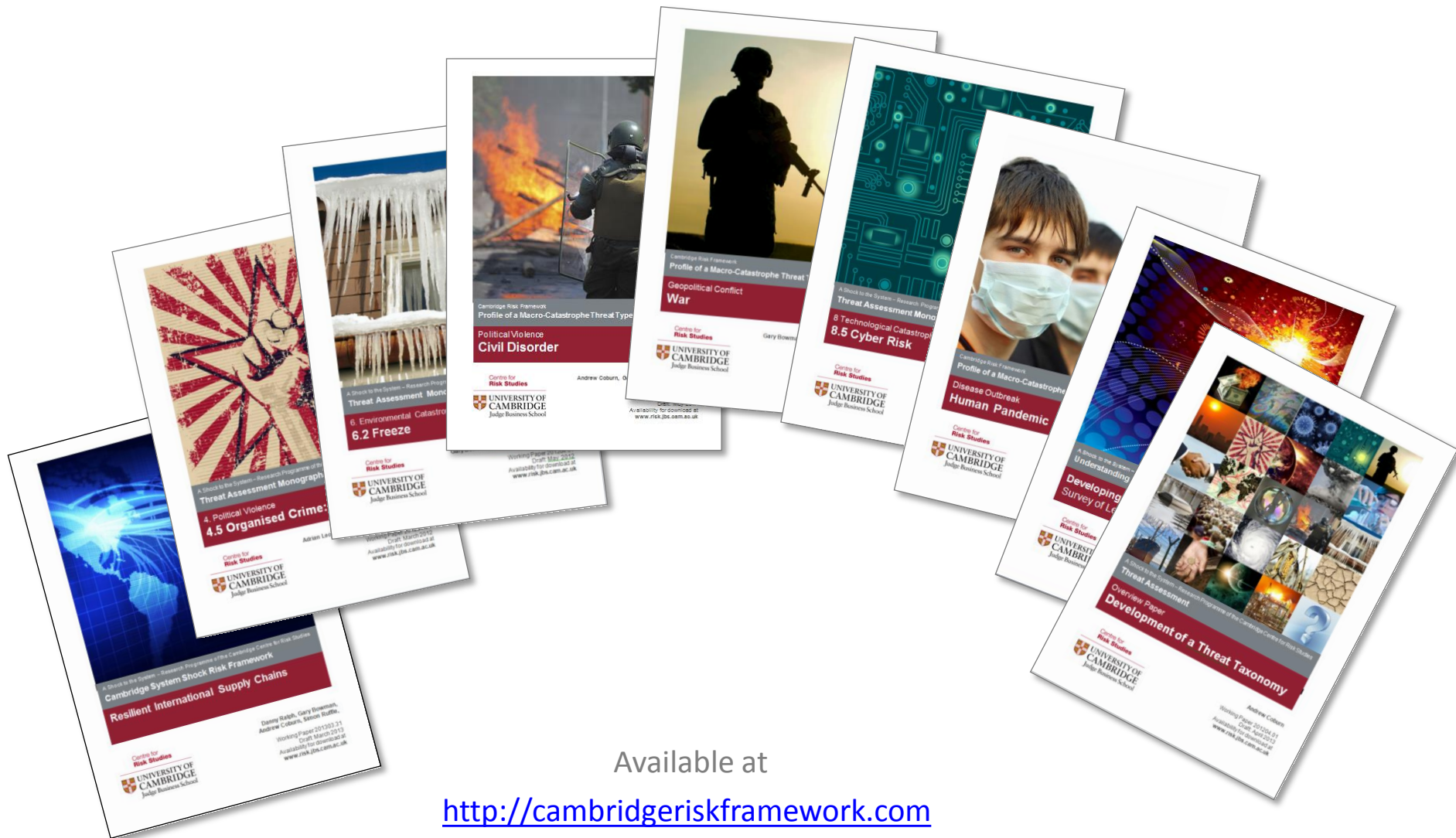
■ Taxonomy version 2.0

- 2011-2102
- Definition of thresholds & qualifying events
- 1000 years historical retrospective
- Included counter-factuals and conjectured categories
- Peer review process

■ Taxonomy version 3.0

- Currently ongoing – we welcome contributions and suggestions
- Focus more on insurance application
- Collapse 12 categories down to 7 ('dashboard' of risk)
- Add regulatory shocks
- Improve categorisation of liability risks

Risk Centre Working Paper Series



Available at

<http://cambridgeriskframework.com>

Developing Methodology Using Example Scenarios



Human Pandemic

Sao Paulo Flu Pandemic

Virulent influenza pandemic causes months of workforce absenteeism and economic disruption

SME: Mary Chang, Molly Sullivan, RMS

CRS Lead: Andrew

Sponsor: Catlin



Civil Disorder Risk

'Sack the Bankers' Worldwide Protest Movement

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

SME: Richard Hartley, Josh Wallace, Cytora; Ivan Ureta, Geneva School of Diplomacy

CRS Lead: Andrew

Sponsor: Munich Re



Cyber Catastrophe

Sybil Logic Bomb Cyber Attack

Major compromise of commercial and national infrastructure IT systems by cyber attack

CRS Lead: Simon

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

Sponsor: Catlin & Lockheed Martin



Geopolitical Conflict

Sino-Japanese Conflict in the East China Sea

Regional conflict in South China Sea embroiling Western military powers and SE Asian nations

CRS Lead: Gary

SME: Richard Hartley, Josh Wallace, Cytora;

Sponsor: Catlin

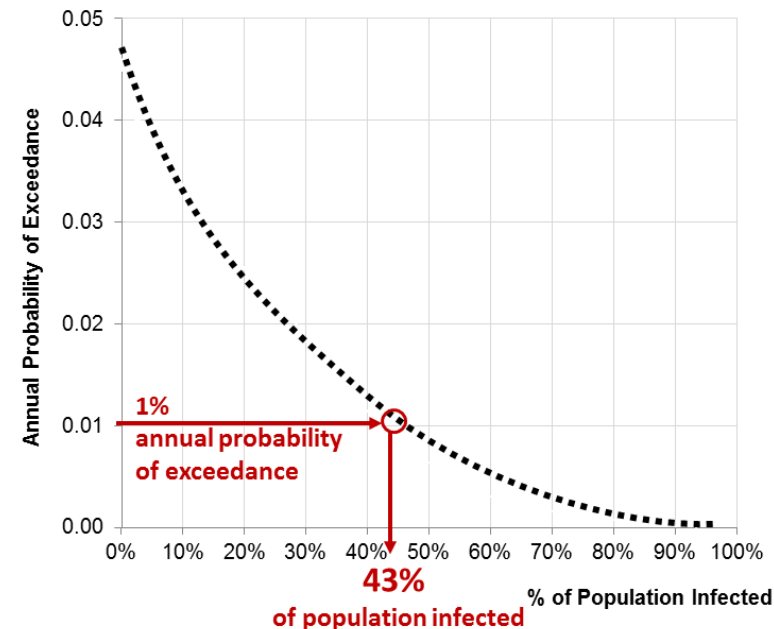


Stress Test Scenario

Sao Paulo Virus Pandemic

Exploring the issues of insurance risk from a human disease threat

- 'New variant' influenza antigenic shift
- Pandemic lasts 6 months and infects 43% of population
- Originates in Latin America and spreads across the globe
- Disease-related absenteeism, business disruption, liability consequences
- Insurance claims on many different types of policy coverages
- Economic impacts from supply shock and demand reduction
- Investment portfolio devaluation with market reactions and stock movements



Underwriting Loss: Clash Assessment

Insurance Claims Across Multiple Lines of Business

Pandemic-related claims on US insurance exposure

Class	Line of Business	
Property		
	Personal Lines/Homeowner	-1
	Personal Contents	0
	Commercial Combined	1
	Construction & Engineering	2
	Commercial Facultative	1
	Binding Authorities	0
Casualty		
	Workers Compensation	4
	Directors & Officers	3
	Financial Lines	4
	General Liability	3
	Healthcare Liability	5
	Professional Lines	1
	Professional Liability	2
Auto		
	Personal Lines	-1
	Commercial & Fleet	-2

Class	Line of Business	
Marine & Specie		
	Cargo	0
	Marine Hull	0
	Marine Liability	1
	Specie	2
Aerospace		
	Airline	3
	Airport	4
	Aviation Products	3
	General Aviation	2
	Space	0
Energy		
	Downstream	1
	Energy Liability	2
	Onshore Energy & Power	2
	Upstream	0
Specialty		
	Accident & Health	4
	Aquaculture insurance	1
	Contingency - film & event	5
	Equine insurance	1
	Excess & Surplus	3
	Life Insurance	3
	Livestock	1

Class	Line of Business	
Life & Health		
	Life Insurance	3
	Health Insurance	5
	Income Protection	4
	Death & Disability	5
	Hospital Cover	5
Pension and Annuities		
	Standard Annuities	-2
	Variable Annuities	-2
	Enhanced Annuities	-3
	Life Settlements	-3
War & Political Risk		
	Kidnap & Ransom	0
	Political Risk	3
	Political Violence & Terrorism	0
	Product Recall	3
	Trade Credit	5
Agriculture		
	Multi-peril crop	1
	Crop hail	0
	Livestock	1
	Forestry	2
	Agriculture	1

Impact on Insurance Claims

Decrease

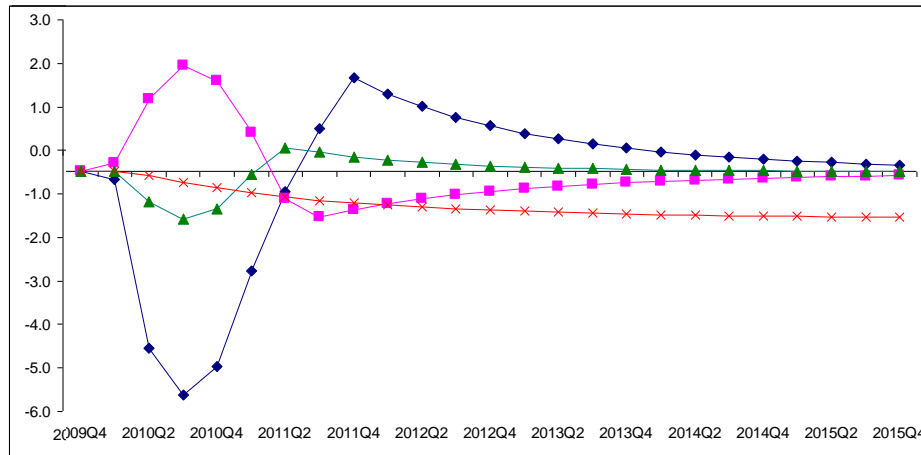
Increase



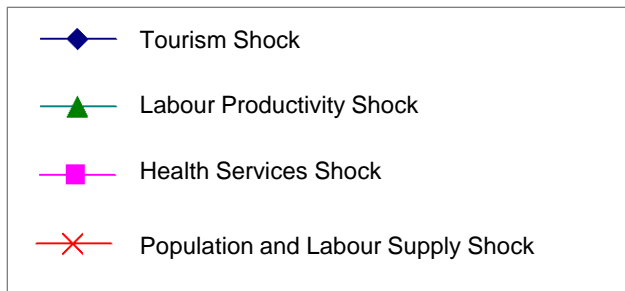
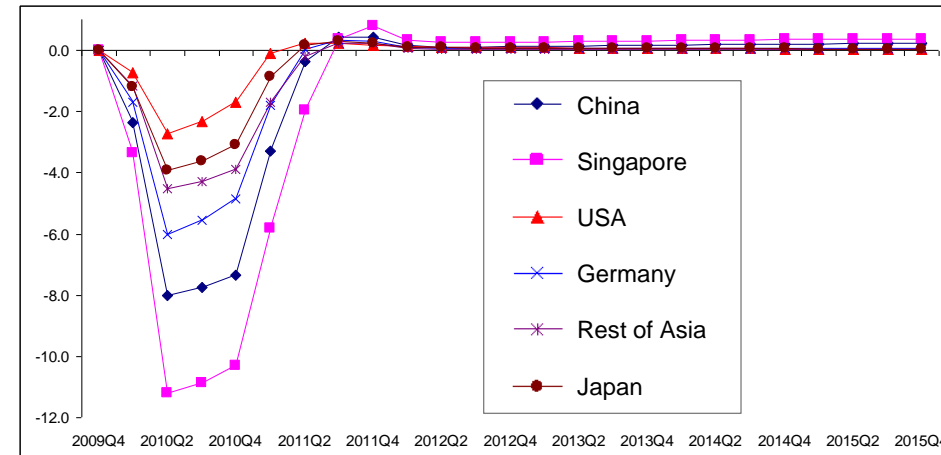


Pandemic Scenario Macro-Economic Impacts

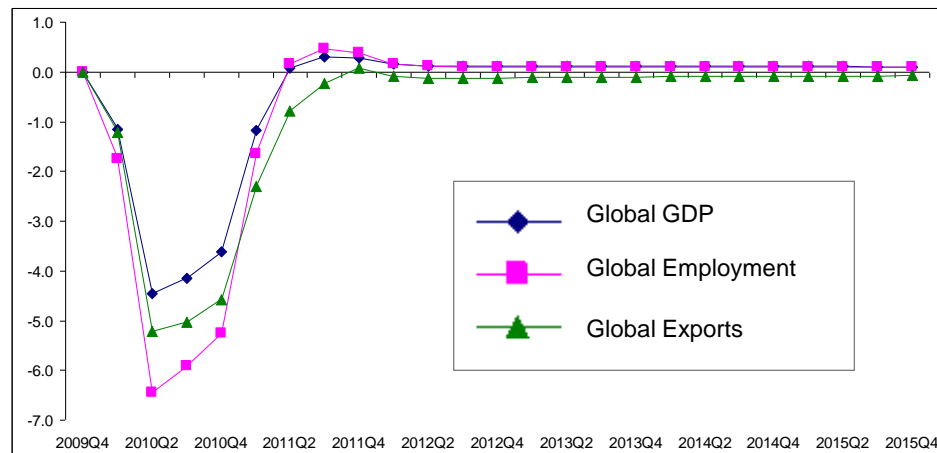
Effects of individual shocks of scenario on global employment (percentage deviations from baseline)



Effects of Scenario on GDP for selected regions assuming asymmetric real wage response (percentage deviation from baseline)

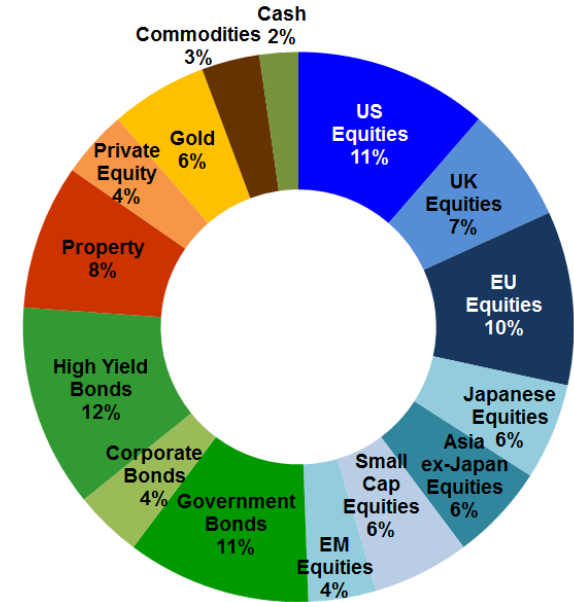
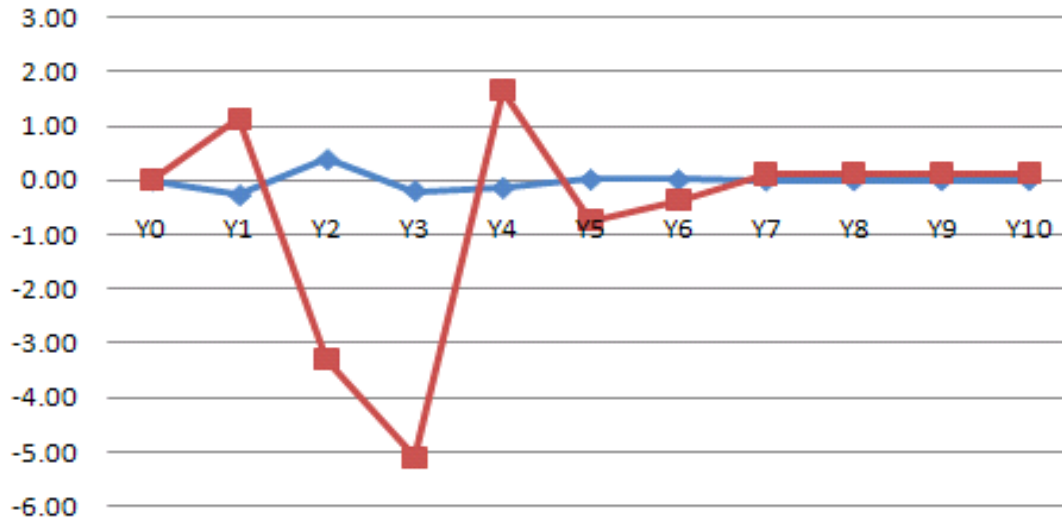


Effects of Scenario on global employment, GDP and exports assuming asymmetric real wage response (percentage deviation from baseline)

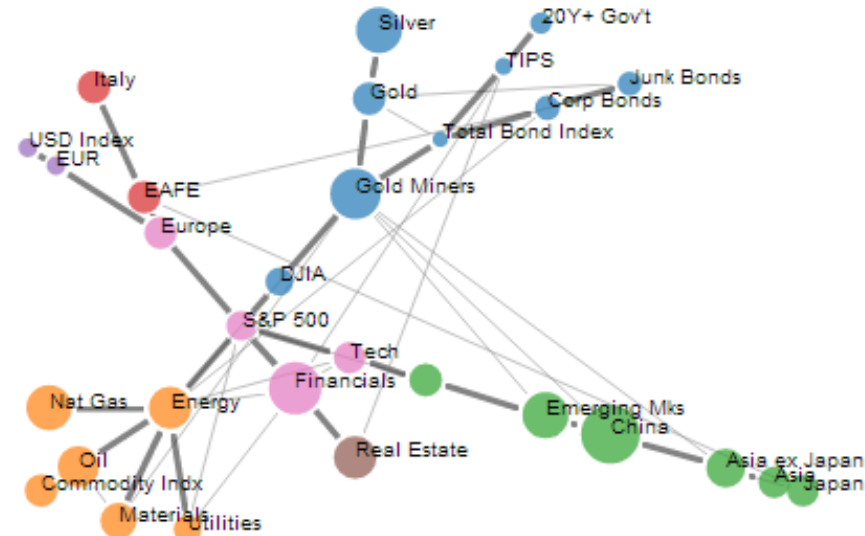


Pandemic Impact on Investment Portfolios

**Portfolio YoY Returns Deviation from Baseline Portfolio
(60:40 , both without Rebalancing)**



- Simplified portfolio of listed equities and bonds
- Variable mix of equities and bonds. e.g.:
 - 50% equities, 40% bonds
- Equities – variable mix of:
 - Developed Markets (DM)
 - Emerging Asia (EMA)
 - Emerging Non-Asia (EMNA)
- Bonds:
 - US, UK, European and Japanese govtmnt generics
 - Combined interest rate duration of 7 years

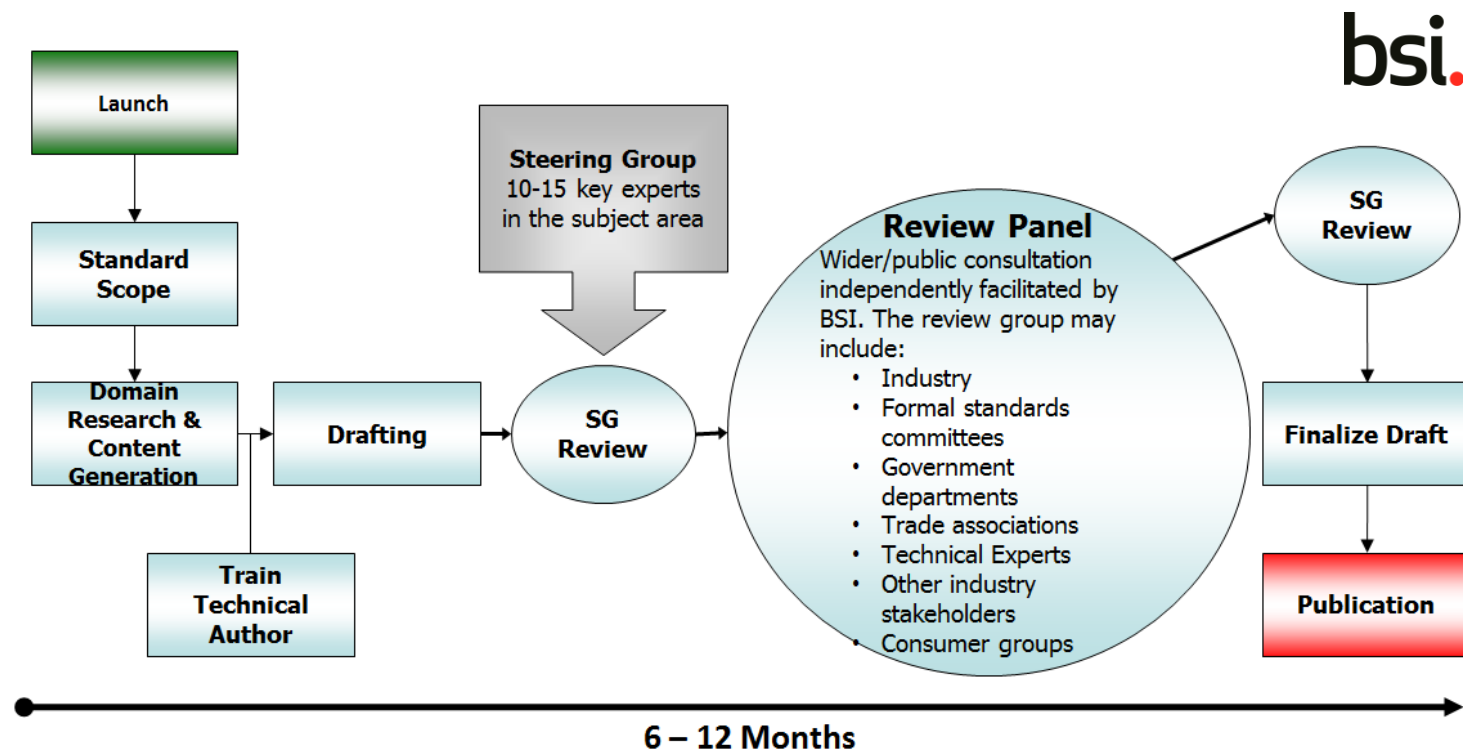


Scenario Development Project

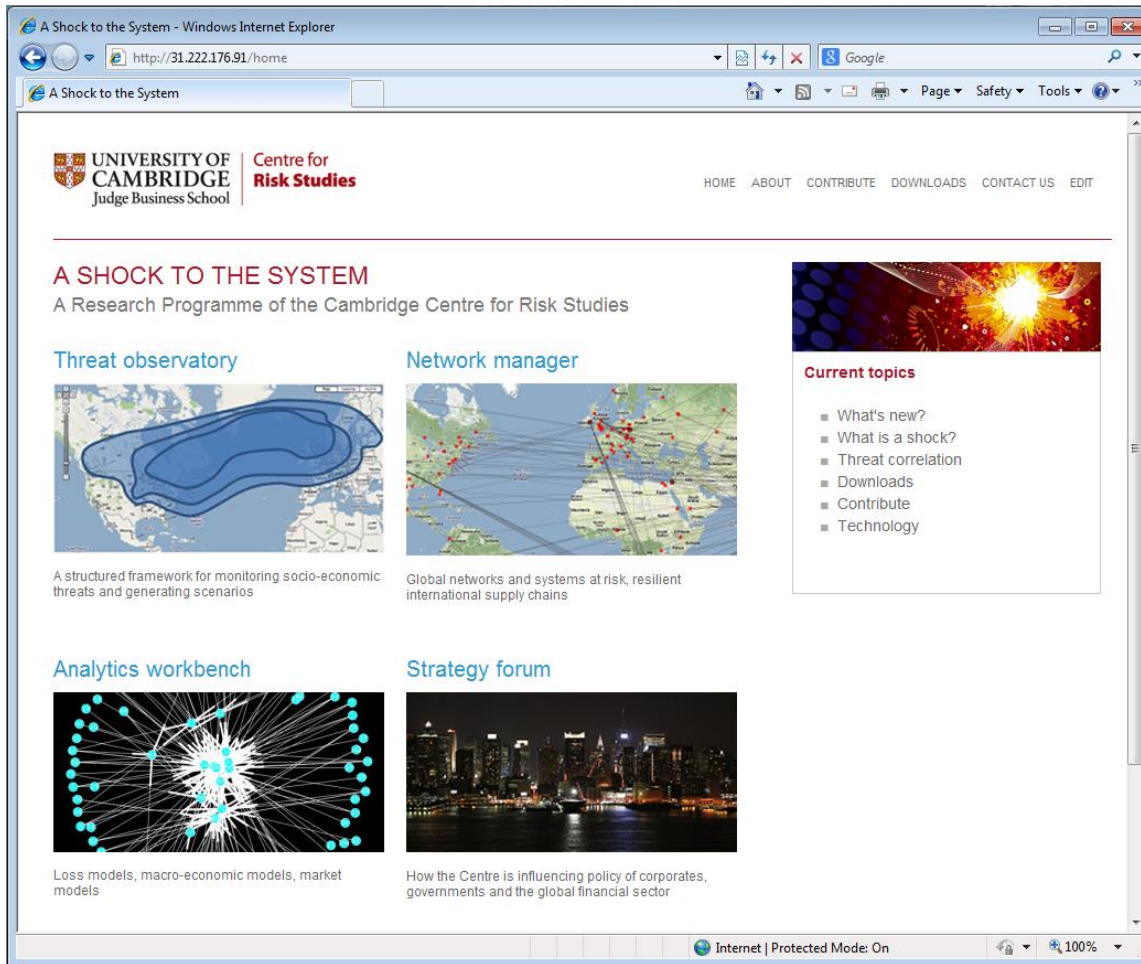
- Using a selection of scenarios to develop methodology for clash, operational impact, and investment assessment
- Using '1-in-100' annual prob of exceedance as risk benchmark
- Would it be useful to develop a suite of commonly-used scenarios?
- Could we produce a standard data structure for these scenarios that would enable companies to share stress tests?

Developing a Standard

- Is there an interest in maintaining a special-interest group to explore these themes more collectively?
- Is there interest in developing a best-practice approach to understanding the global landscape of risk?



Open Research Platform for Cambridge Risk Framework



<http://www.CambridgeRiskFramework.com>

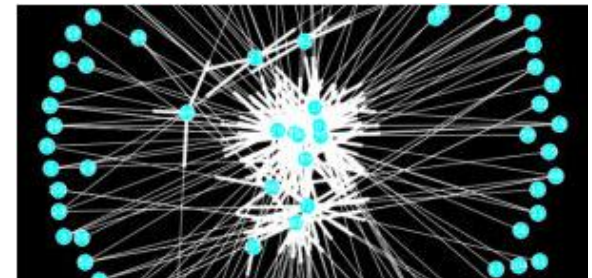
Threat Observatory



Network Manager



Analytics Workbench



Strategy Forum



Future Meetings and Workshops

- TBD: Follow-up workshop on Global Landscape of Risk?
- **20 March 2014:** Seminar on Emerging Risk Scenarios for Insurance Risk Management, Cambridge
- **23 & 24 June 2014:** Risk Summit Conference, Centre for Risk Studies, Cambridge