Cambridge Global Risk Index 2017

5 December 2016

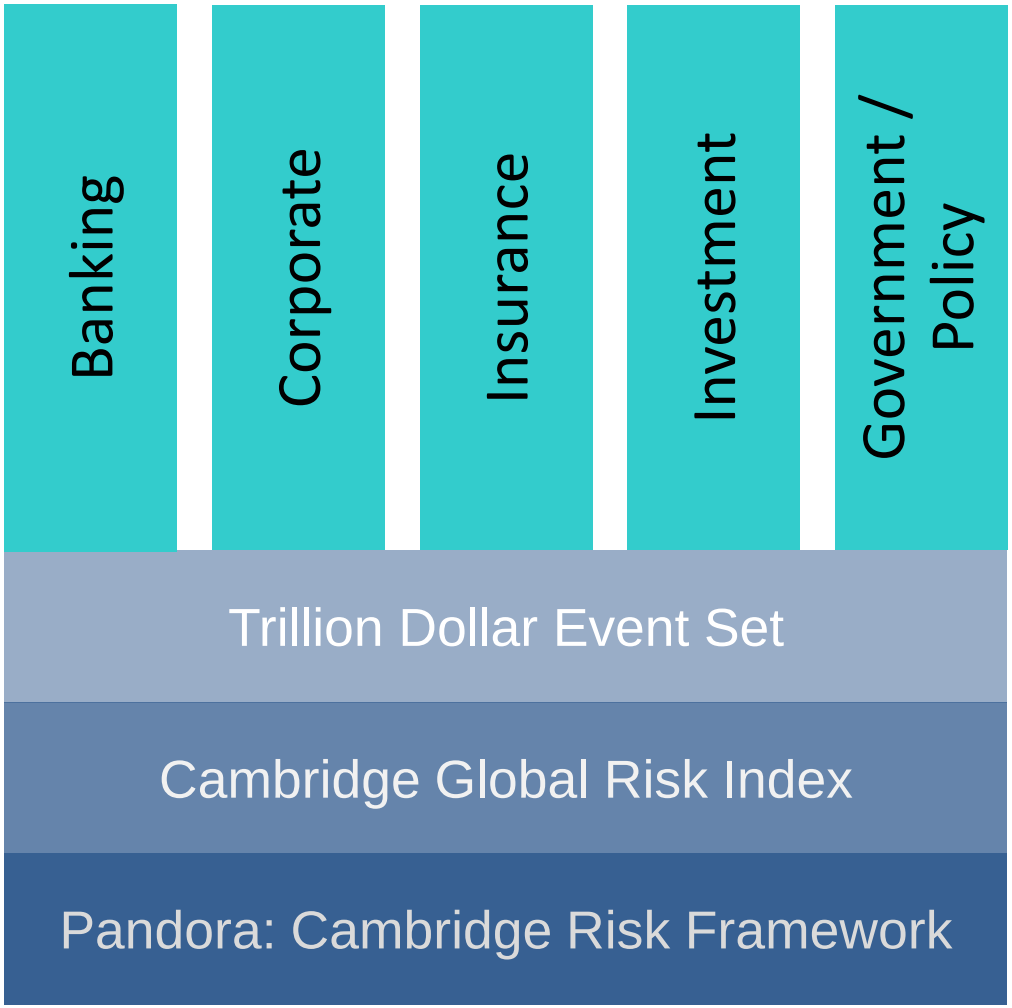
Cambridge Global Risk Vision

Centre for Risk Studies

UNIVERSITY OF CAMBRIDGE
Judge Business School

Prof Danny Ralph
Academic Director
Cambridge Centre for Risk Studies

Vision for Cambridge Risk Framework: Risk Science for Resilience



Cambridge Centre for Risk Studies Research Team 2016

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1. Catastronomics: The Economics of Catastrophe
2. Cities: A Foundation for Cambridge Global Risk Analytics
3. Project Pandora: The Management of Tail Risk
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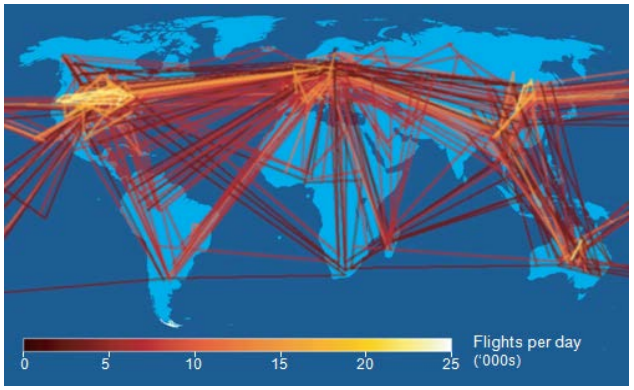
Catastrophic Failures of Complex Systems

- Motivated to understand
  - Catastrophe modeling and extreme risk analytics
  - Failure of complex systems and networks
  - Science of resilience to catastrophic failures
- To answer questions such as:

How would
[War in China] affect [Trade Networks] and impact [Global Economy]?

Regional Conflict **Scenario**

System@Risk: Air Travel Network

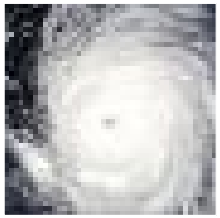


Loss metrics

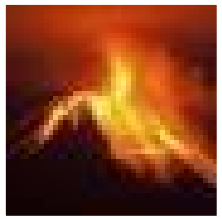
Beyond NatCat: Cambridge Taxonomy of Threats

Natural Catastrophe

Earthquake



Windstorm

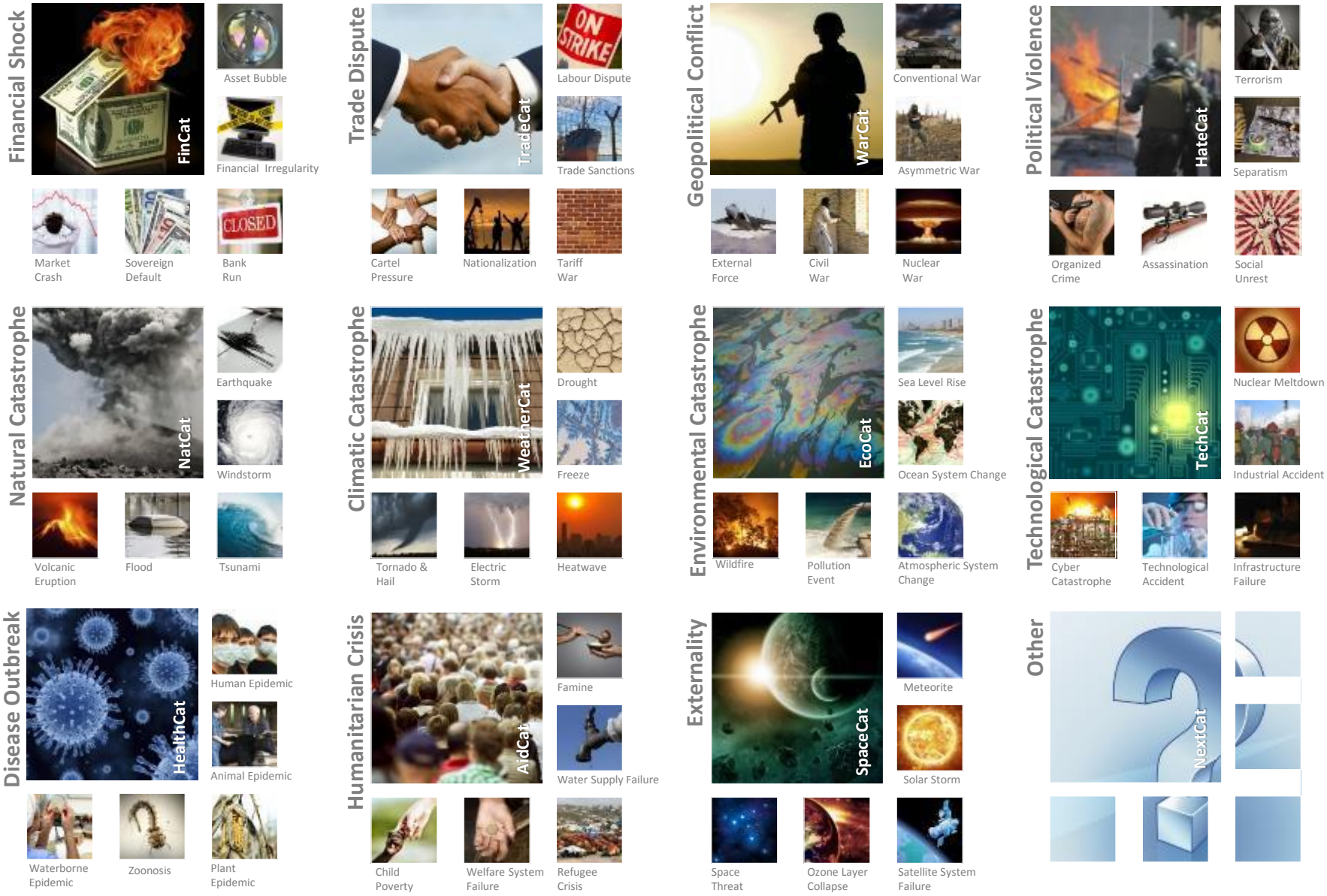


Volcanic Eruption

Flood

Tsunami

Beyond NatCat: Cambridge Taxonomy of Threats



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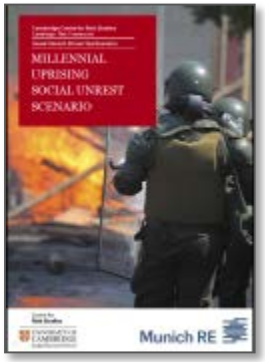
CCRS Research Outputs: Explorations of individual threats

Taxonomy of Threats

Geopolitical Conflict
Emerging Risk Scenario

Pandemic
Emerging Risk Scenario

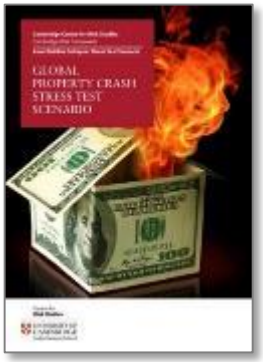
Cyber Catastrophe
Emerging Risk Scenario



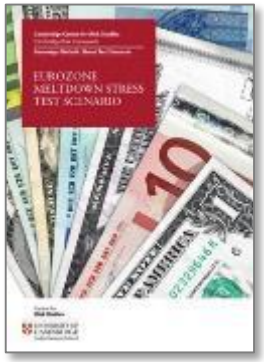
Social Unrest
Emerging Risk Scenario

Ebola
Emerging Risk Scenario

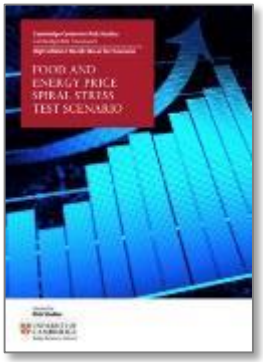
Financial Catastrophes



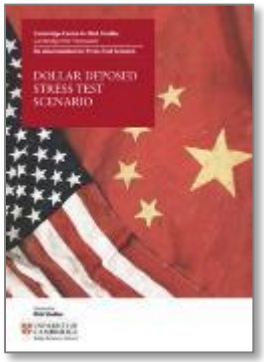
Global Property Crash
Financial Risk Scenario



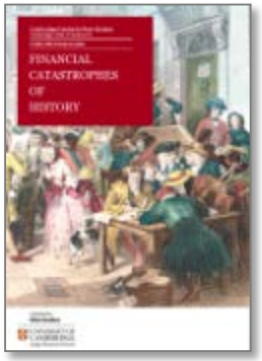
Eurozone Meltdown
Financial Risk Scenario



High Inflation
Financial Risk Scenario



Dollar Dethroned
Financial Risk Scenario



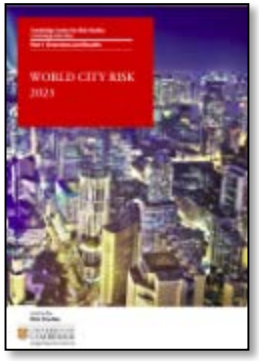
Historical Crises
Financial Risk

Cyber Accumulation
Insurance Risk Report

NatCat FinCats
Clash Report

Business Blackout
Lloyds Emerging Risk Report

Climate Change
Investor Sentiment Shock

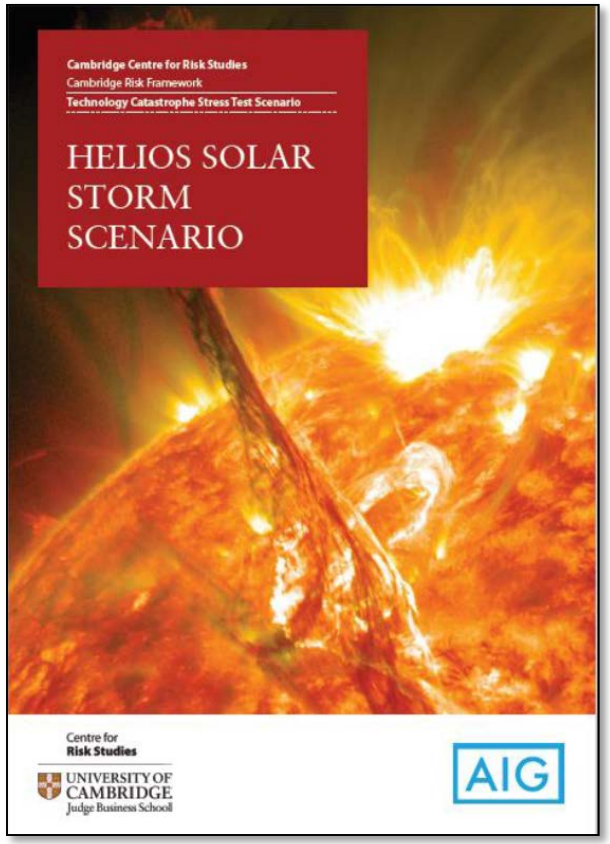


World City Risk 2025
Lloyds Co-Branded Report

Solar Storm
Emerging Risk Scenario

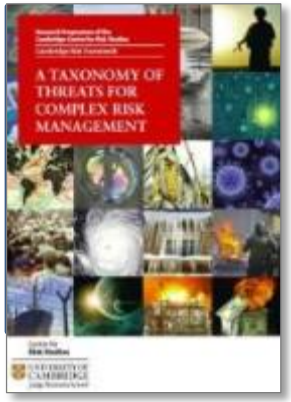
Recent Publication: Solar Storm Scenario

- National power grids suffer damage from electromagnetic flux
- Damage to 6% of EHV transformers in US
- Catastrophic US power outage
  - **2-9 Billion person-days of lost power**
  - **5%** of the population is out for **5 months**
- Cost to US economy
  $200 Bn – $1.2 Tn (1.4% - 8%)
- Cost to global economy
  $500 Bn – $2.7 Tn (0.7% - 4%)
- US insurance payouts
  $60–300+ Bn



Why are These the Threats to Worry About?

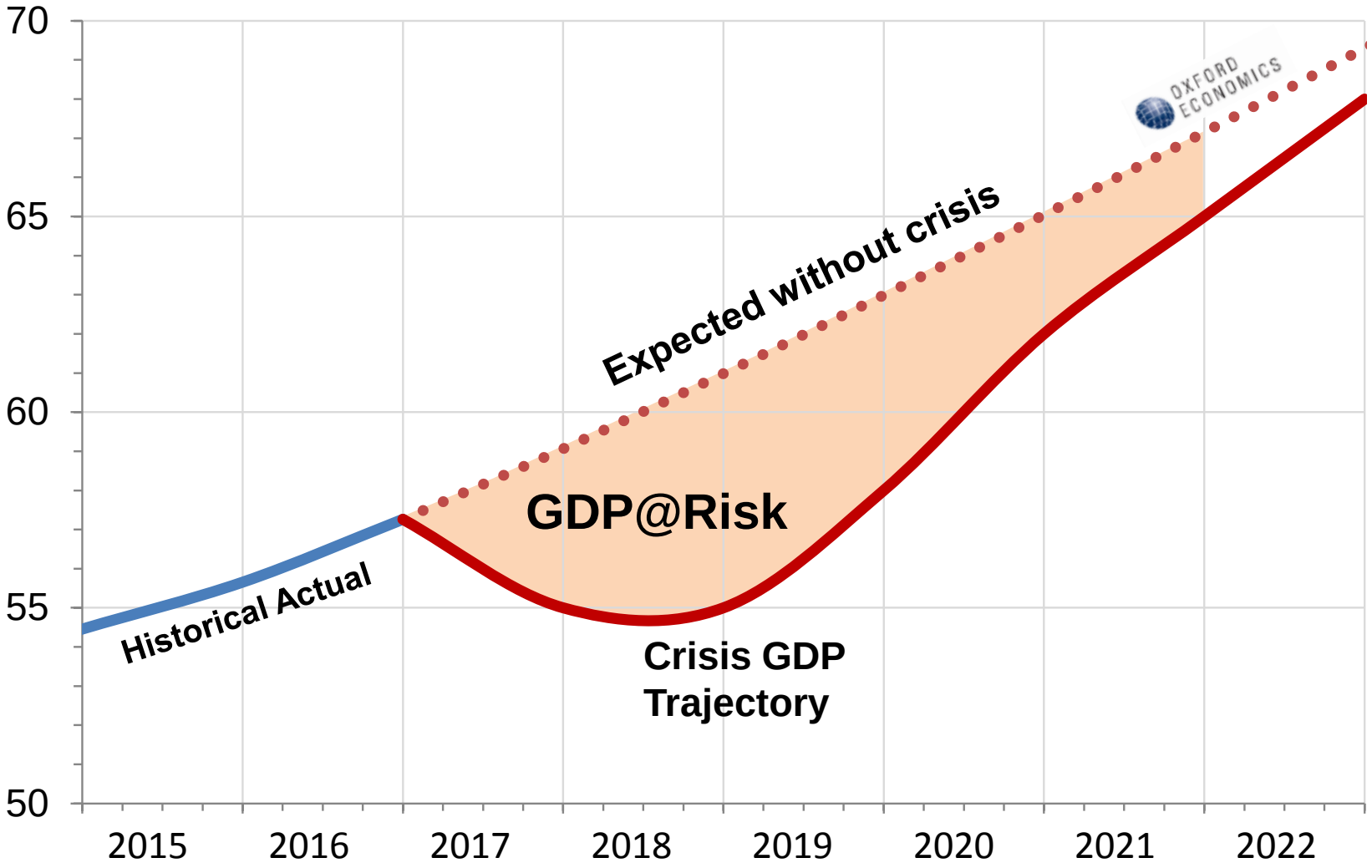
- Extensive review of potential causes of macroeconomic shocks
  - Used 1000 years of historical records
- The review included
  - A. Chronological Histories
  - B. Disaster Catalogues
  - C. Counter-factual evidence
  - D. Scientific conjecture
  - E. Peer review
  - F. Other Approaches
- 11 broad families of threat with around 50 threat types. Focus:
  - 20+ threats from taxonomy
  - Most important risks from known threat universe



The Cambridge Centre for Risk Studies publication that describes the development of the Cambridge Threat Taxonomy

Available for Download from Website: CambridgeRiskFramework.com

Catastronomics
GDP@Risk as a metric for comparing impacts



Single Threat Scenario GDP@Risk

	GDP@Risk ($Trillion)
Cambridge Single Threat Scenarios	**Standard Scenario**
 Geopolitical Conflict **China-Japan Conflict**	**17**
 Asset Bubble Shock **Global Property Crash**	**13**
 Pandemic **Sao Paolo Virus**	**7**
 Sovereign Default Shock **Eurozone Meltdown**	**11**
 Food and energy price spiral **High Inflation World**	**5**
 Cyber Catastrophe **Sybil Logic Bomb**	**5**
 Social Unrest **Millennial Uprising**	**2**
 De-Americanisation of Financial System **Dollar Deposed**	**2**
2008 Great Financial Crisis	**18**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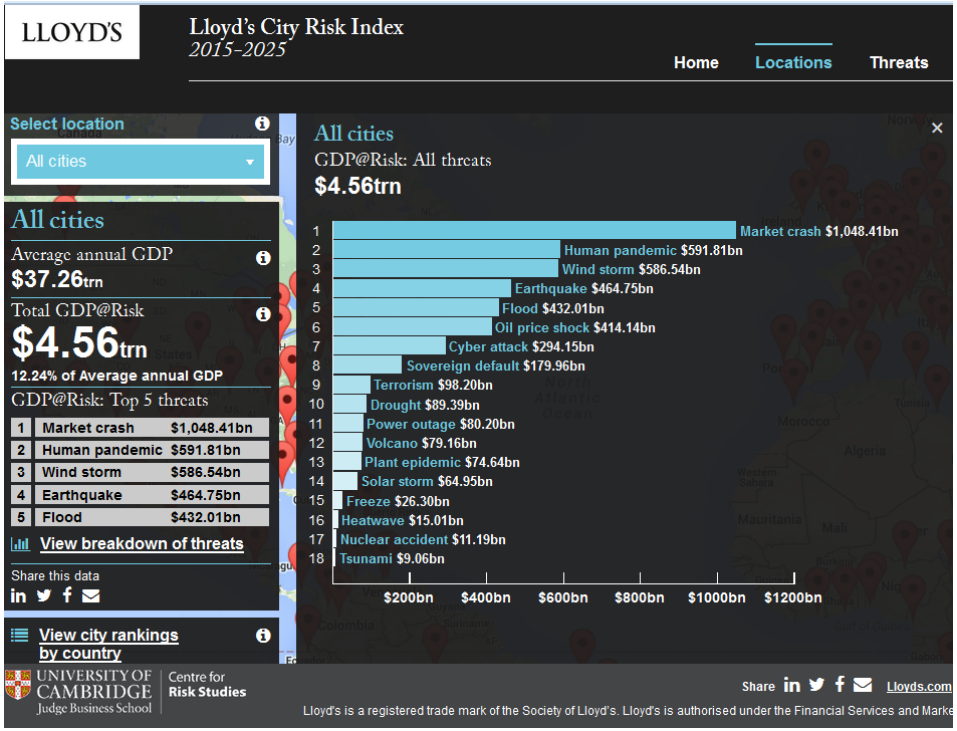
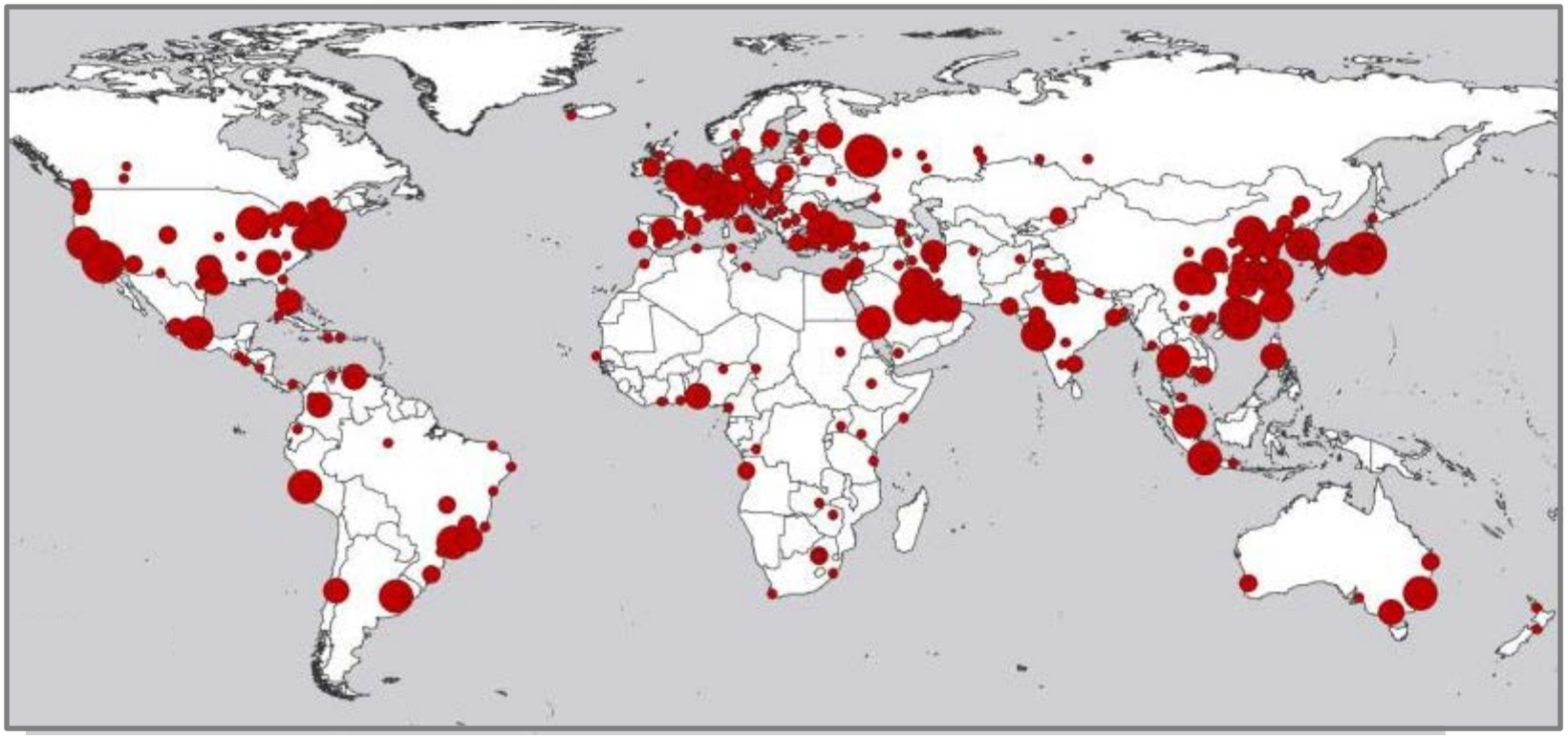
Lloyd's Cities Risk Index 2015-2025

- Launch at Lloyd's, 3 September 2015
- Cities Risk Index assesses the GDP@Risk for 300 cities and 18 threats
- http://www.lloyds.com/cityriskindex/



The 300



We picked the ‘A List’ of the world’s cities for this analysis, which:

- Are responsible for **half** of the World’s GDP today
- Will be responsible for **two-thirds** of the World’s GDP in **2025**
- Are the largest cities in the 50 largest economies in the world
  - Top 25 cities in US (#1 economy) and top 32 cities in China (#2 economy)
  - Between 5 and 12 top cities for each of the rest of the top 17 economies
- Include all cities over 3m population in the world
- Consist of half of the world’s capital cities

A History of Urban Economic Shocks

Select a case study

The 300 cities have experienced many catastrophes over the past 50 years

Lost more than a million of their citizens to earthquakes

Seen a third or more of their economic capital wiped out by stock market crashes 5 times

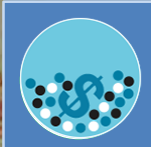
Experienced thousands of cyber attacks

Half of them have suffered a serious flood

A quarter of them have been flooded more than 5 times

32 cities have had to cope with a volcanic eruption less than 100 km away

Suffered more than 1,000 terrorist car bombs in city centres

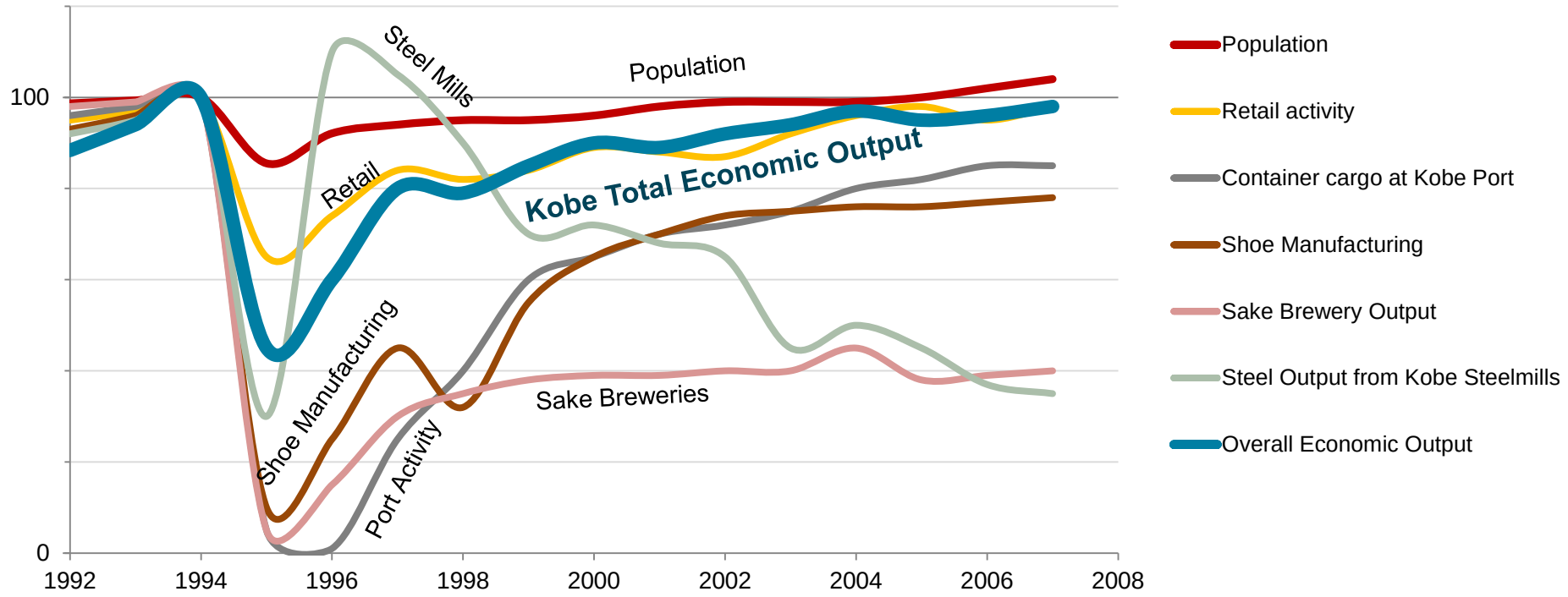


Financial crisis of their governments defaulting on sovereign debts on 50 occasions

Had to combat the outbreak of a previously unknown disease five times

Catastronomics for Cities

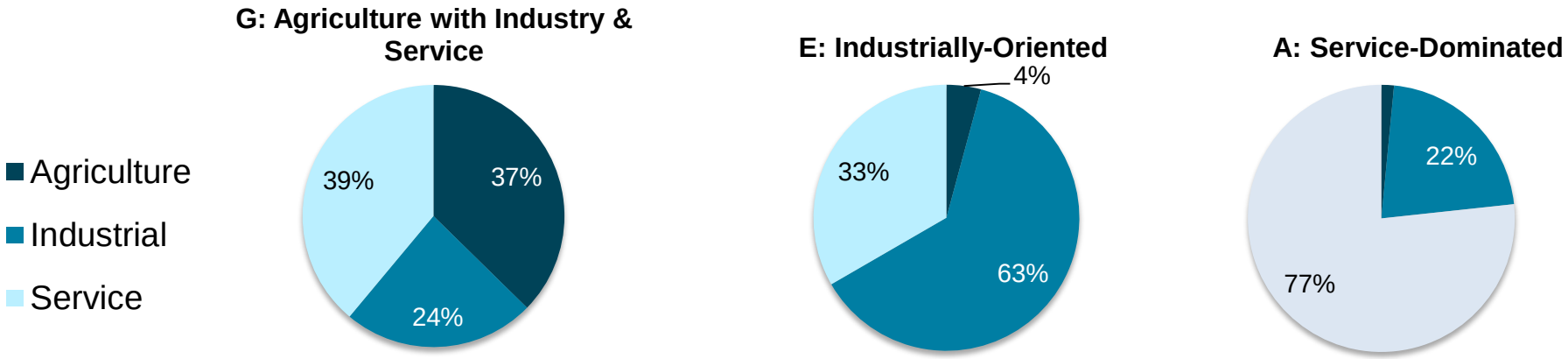
Impact of 1995 Earthquake on Kobe, Japan



- Great Hanshin earthquake January 17, 1995, Magnitude 7.3
- Death toll 6,400; Direct damage costs $100 billion
- The port of Kobe, one of the world's busiest, was destroyed
- Kobe Steel Ltd, major steel maker, heavily damaged
- 80% of shoe factories damaged
- 50% of the region's sake breweries put out of action
- Kobe's economic output halved in 1995, reducing Japan's total industrial output by 2.6 percent

A Standardized Economic Profile of Each City

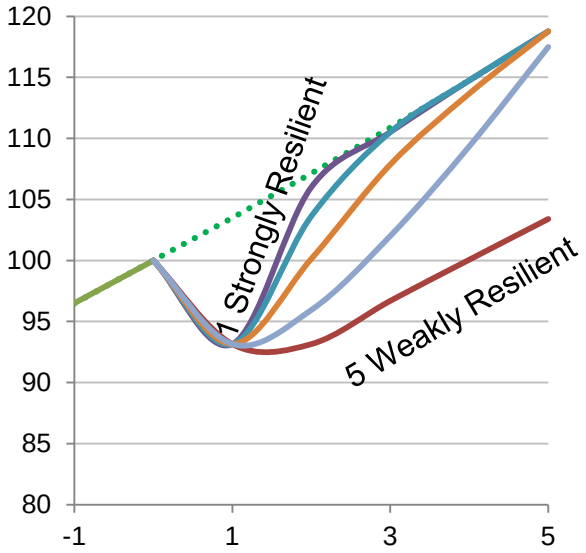
- City economy is categorized by type



- City resilience assessment

Resilience index (1-5) for cities based on four factors (cf, ND-GAIN)

Governance; Social coherence; Economic strength; Infrastructure



Standardized Approach to All Threats

Finance, Economics and Trade


Market Crash


Sovereign Crisis


Commodity Prices

Geopolitics and Security


Interstate Conflict


Terrorism


Separatism Conflict


Social Unrest

Natural Catastrophe and Climate


Earthquake


Tropical Windstorm


Temperate Windstorm


Tsunami


Flood


Volcanic Eruption


Drought

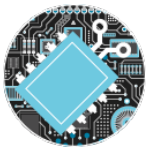

Freeze


Heatwave

Technology and Space


Nuclear Accident


Power Outage


Cyber Attack


Solar Storm

Health and Humanity


Human Pandemic

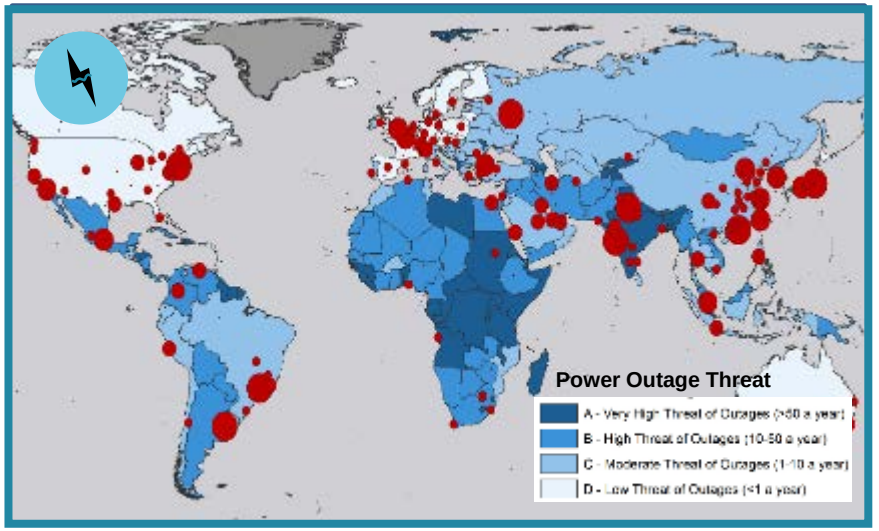

Plant Epidemic

Delhi Example: Threat Event Analysis of Expected Loss

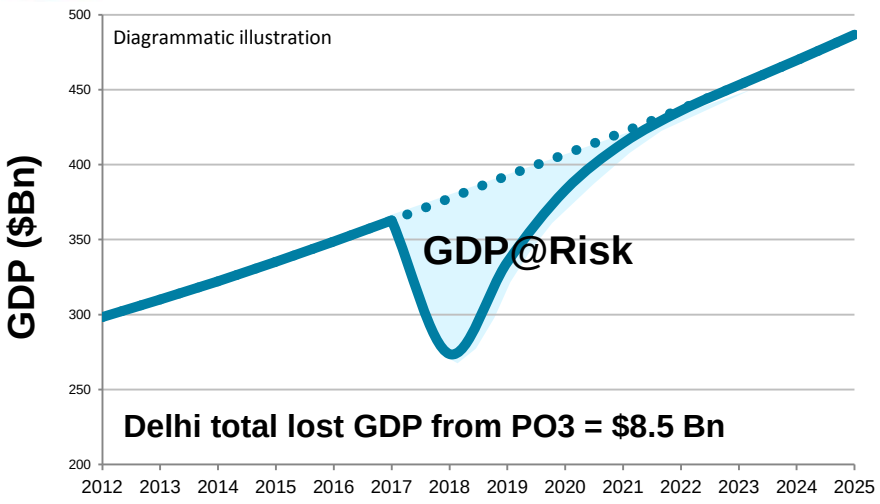
Power Outage

Localized Impact Severity

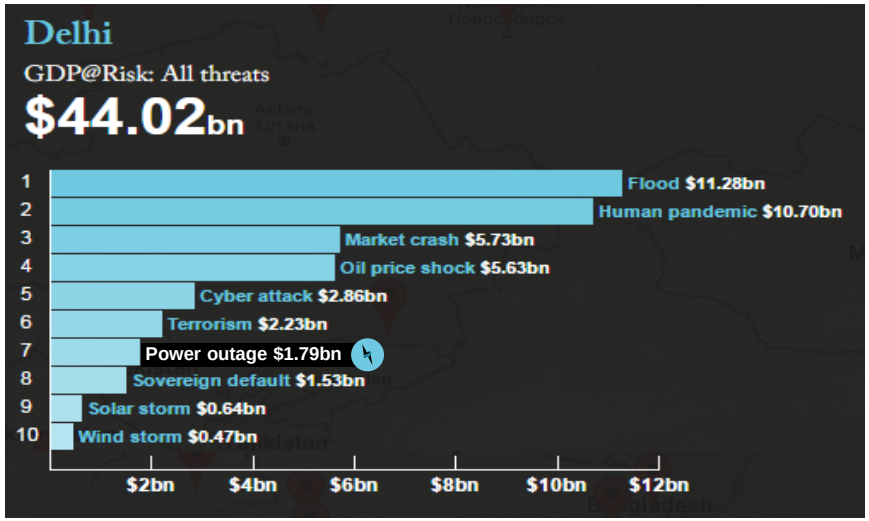
PO1	One City-Day of Power Loss (100% of city loses power for 1 day or 50% of city loses power for 2 days, etc.)
PO2	A 5-City-Day event (100% of city loses power for 5 days, 50% of city loses power for 10 days, etc.)
PO3	A 10 City-Day event (100% of city loses power for 10 days)



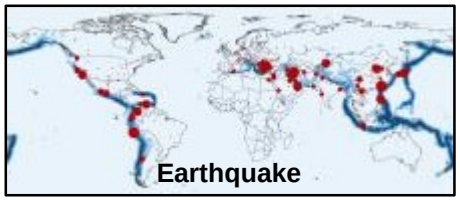
The Impact of a Power Outage Event PO3 on Delhi occurring in 2017

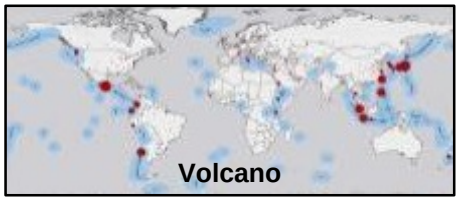


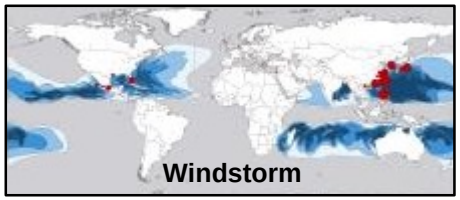
Delhi total lost GDP from PO3 = $8.5 Bn

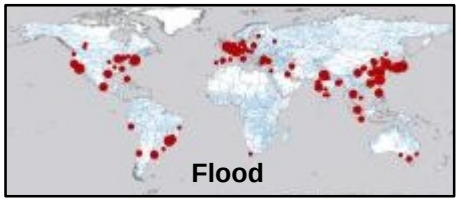


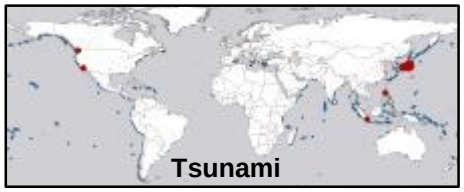
Geographical Mapping of All the Threats

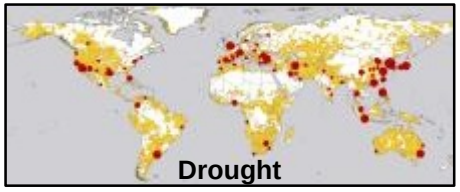


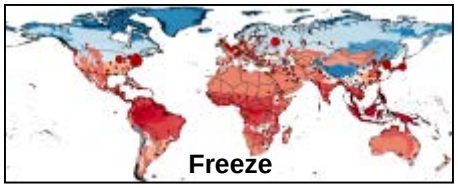


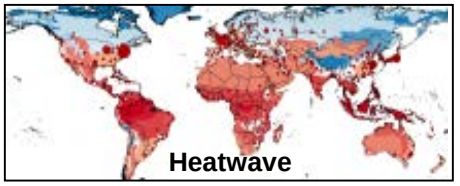


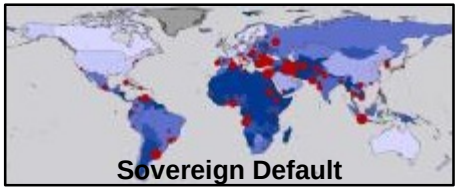


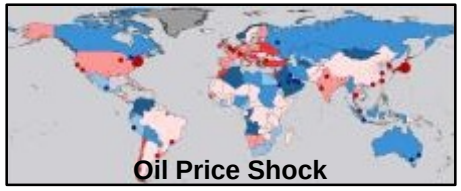


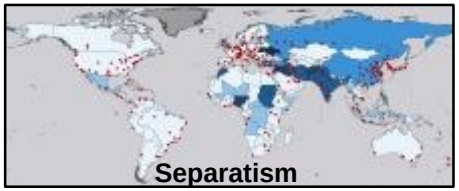


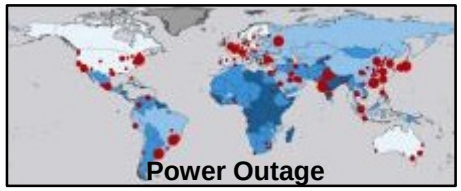


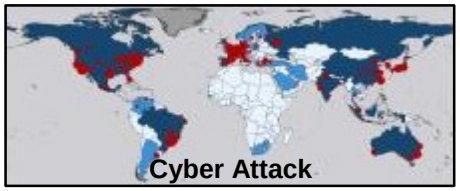


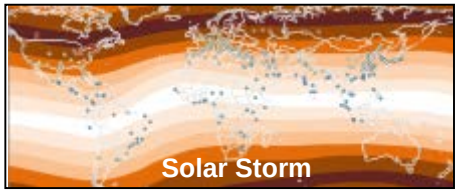


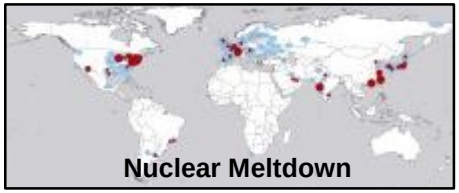










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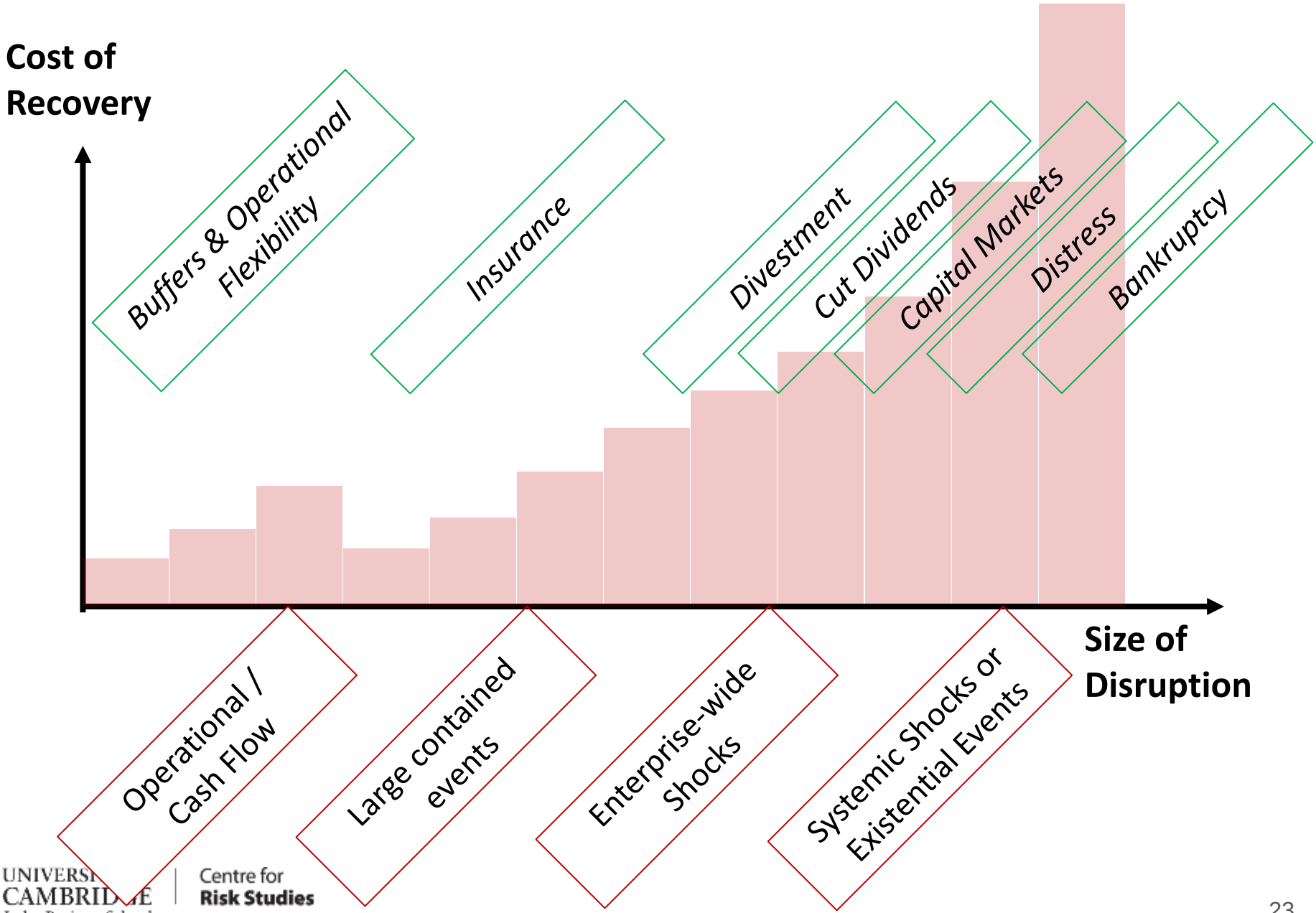
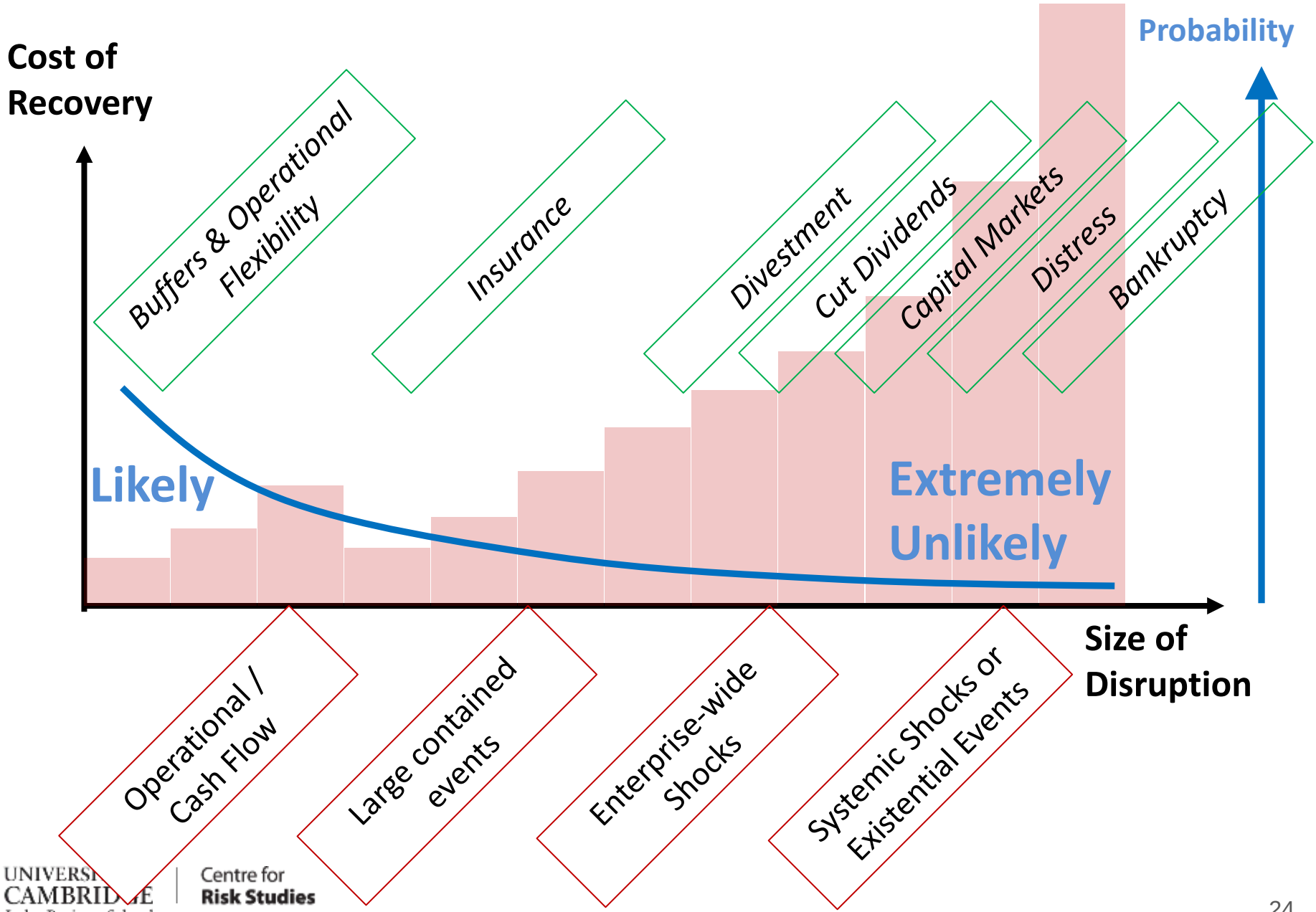
Tail Risks and Top Risks



Tail Risks and Top Risks



“Recurring damage from non-recurring events”

Take 22 categories of threats [and the rest!]

For your organisation, looking beyond

- ordinary or acceptable cash flow shocks,
- large but insured disasters – painful but manageable:

How often do you experience

- a dividend threatening event?
- a downgrade to your credit rating?
- … or worse?

A trillion dollar global economic shock every 8 years !!

Developing Business Ready Tools: “Use Cases”

- A major innovation of Centre for Risk Studies has been to standardise shock assessment
  - Express costs & benefits of resilience via financial metrics for risk, like GDP@Risk
- “Corporate Risk Profiling” for quantifying balance sheet risk

⇨ “Assets@Risk” for manufacturing and finance

⇨ “Revenue@Risk” for disruption of markets

- Insurance & Finance

⇨ “Insurance@Risk” for probable maximal loss

⇨ “Underwriting@Risk” for (new) insurance products

⇨ “Investments@Risk” for financial portfolios

- Government policy

⇨ “Infrastructure@Risk”

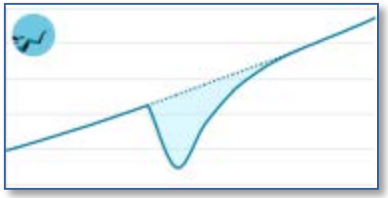
- International capital markets

⇨ Accounting standards for expected losses from shocks

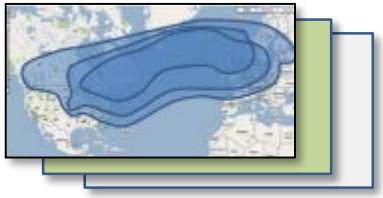
A Toolkit for Risk Science: Quantifying Resilience

Threat Maps

Risk Models & Output Data



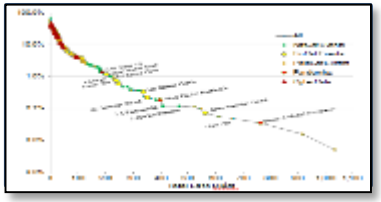
Scenarios



Software Platform (Cambridge Risk Framework)

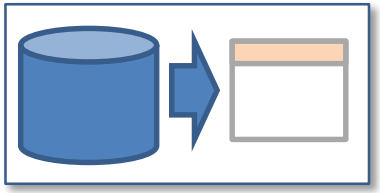
Exposure Data

Use Cases – Business Applications



Network Models

Private Portals, APIs and modeling interfaces



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