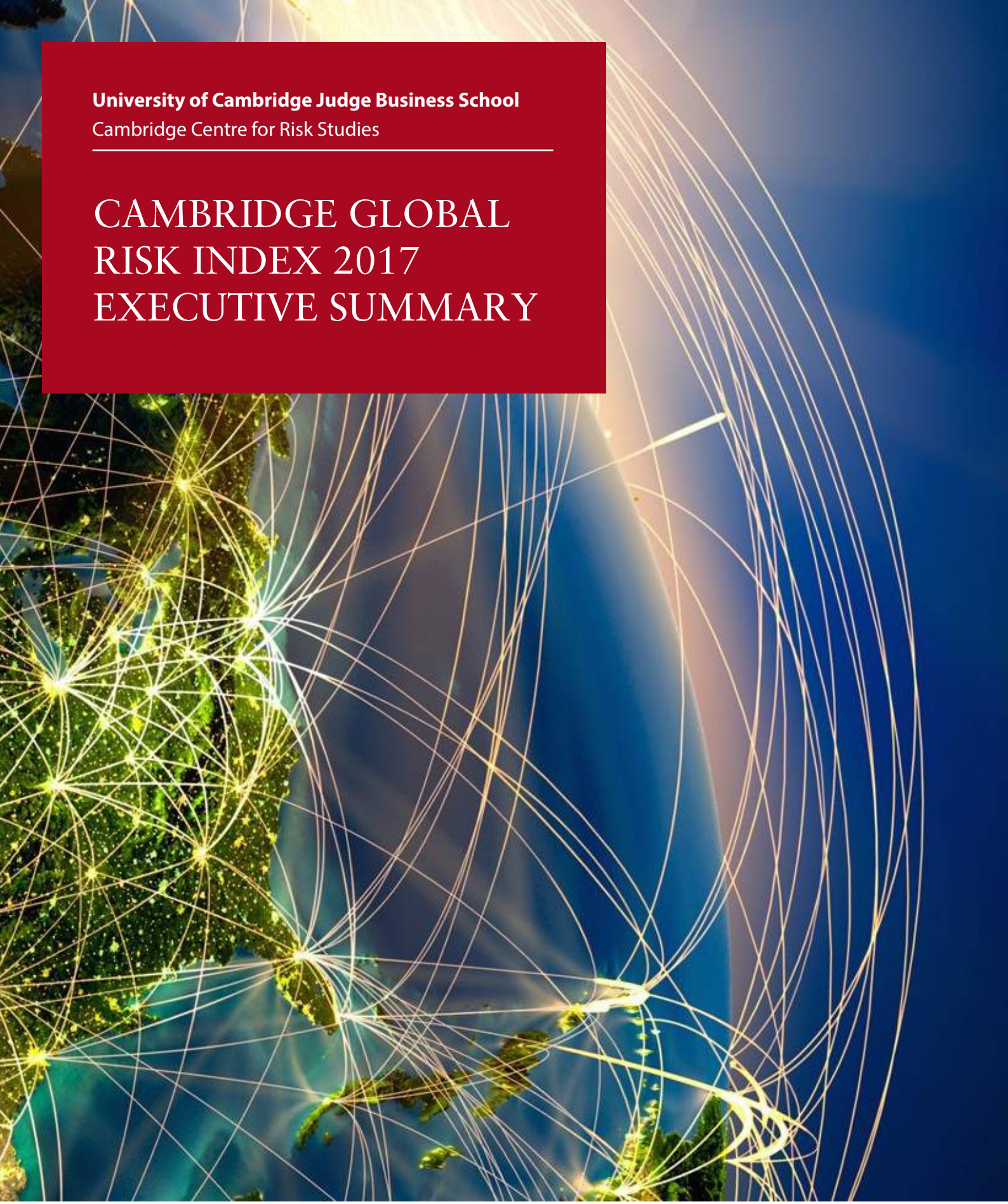


**University of Cambridge Judge Business School**
Cambridge Centre for Risk Studies

# CAMBRIDGE GLOBAL RISK INDEX 2017 EXECUTIVE SUMMARY

Centre for
**Risk Studies**

UNIVERSITY OF CAMBRIDGE
Judge Business School

Cambridge Centre for Risk Studies acknowledges the generous support provided for this research by the following organisations:








**Paper Citation:**

Cambridge Centre for Risk Studies, 2016; *Cambridge Global Risk Index 2017*, Cambridge Centre for Risk Studies, University of Cambridge.

## A period of heightened risk lies ahead

The risk of major shocks to the global economy is increasing. Over the next three years, we estimate that that risk will be significantly elevated over its long-term baseline.

The baseline itself - a ten-year projection - is trending upwards. Our Global Risk Index of GDP@ Risk for 300 of the world's leading cities as well as the probability-weighted expected losses from 22 different types of shocks is estimated to be **1.48%** of annual global domestic production (GDP). Between 2017-19, the Index is estimated to be elevated above the ten-year baseline at around **1.51%** of annual GDP. With nominal GDP for 2017 forecast expected to reach around $77.7 trillion, the Global Risk Index of 1.51% means an expected loss of **$1.17 trillion**.

This increase in global risk is driven by various forces. Firstly, the world's economy is growing, meaning that there there is more output to be disrupted. Secondly, geopolitical risks are increasing, technology risks are proliferating, and some types of financial crises are more likely now than they have been since the recovery from the Great Financial Crisis.

Other threat-types are reducing: pandemic risk and banking crisis contagion are being managed downwards, and violent political separatism is becoming less common. Natural catastrophes and climatic disasters are expected to continue to occur at their historical frequency.

This report summarises the Cambridge Centre for Risk Studies' analysis of global risk outlook for 2017 to the world's economy from 22 threats in five broad categories. Using available evidence and data on the underlying processes and consequences to guide these assessments and combines information on threat processes, we gather economics of cities, scenarios, and consequence estimates to provide an assessment of future risk.

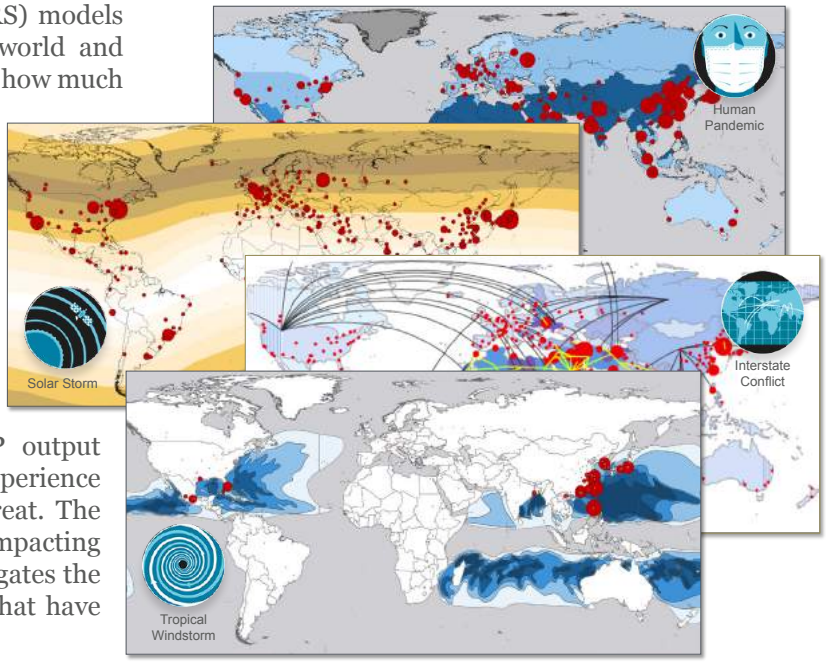
As the world's trading networks become more interconnected, shocks in one place create consequences in many other parts of the world, affecting supply chains, customers, investors, and counterparts elsewhere. The impact of a shock that occurs today is more widespread and costly than a decade ago.

We last produced our Global Risk Index analysis in 2014 in partnership with Lloyd's as the ten-year outlook Lloyd's City Risk Index 2015-2024. In that analysis we estimated that 1.46% of global GDP was at risk over the next decade. This report summarises our update for 2017.

In response to sponsor requests, and in addition to revising the ten-year outlook for 2017 to 2026 as a baseline view, we also analyse a shorter term three-year outlook from 2017 to 2019 to identify risks which might be elevated above their long-term baseline. For consistency, all results are shown as a one-year average loss index.

Cambridge Centre for Risk Studies (CCRS) models shocks to the major economies of the world and estimates how likely they are to occur and how much output is at stake.

We analyse the risk to 300 of the world's leading cities, responsible for half of global GDP, and consider a wide range of potential causes of future shocks by modelling around 12,000 scenarios. Economic shock models have been developed for 22 different threats types. The economy of each city is analysed by sector, size, and demography, and the analysis estimates how much GDP output would be lost if each city were to experience different scenarios of shock for each threat. The model considers scenarios of events impacting multiple cities across a region, and propagates the consequences to other unaffected cities that have trading links or economic codependence.




At present we analyse the loss of output as a measure of economic 'flow'. We recognise that these catastrophes also cause loss to infrastructure, assets and the 'stock'. Flow and stock are interrelated but this Index represents the risk to flow.

### *Expected loss*

We do not predict that crises and shock events will occur. Each event is rare and unlikely. We analyse the small likelihood of each shock occurring and combine the chances of a rare catastrophe with its consequences to estimate the '*expected loss*' – the average probability-weighted amount of lost GDP, which produces the Cambridge Global Risk Index that can be used to compare different types of loss in various places and over alternative time horizons. The actual amount of lost economic production that would occur from a shock is many times larger than the probability-weighted expected loss index values that we present in this report.

We do not attempt to forecast which city will be hit by what type of events, but we assume that crises will continue to happen and that the risks of crises can be measured.

### *Threat analysis*

The analysis of each threat consists of a geographical risk map, threat assessments for each of the 300 cities, adoption of standardized metrics for frequency and severity of occurrence, localized impact severity scenarios, and economic impacts analyses. CCRS gratefully acknowledges the expertise of our external subject matter specialists who have provided insights into each threat.

### *How were the threats selected?*

The 22 threats were identified as the most significant risks to the global economy through an extensive study of the shocks that have impacted society and the economy over the past thousand years, combined with reviews of published catastrophe typologies, emerging risk registers, and scientific conjectures of potential future threats. This was developed into the *Cambridge Taxonomy of Threats*, published in 2014. Some of these threats have been studied in detail, and published as stress test scenarios in the publication suite of the CCRS, available from our website.

### Project Pandora

The Pandora global risk research programme at Cambridge Centre for Risk Studies is named after the Greek myth of the first woman created by the gods, who opened a forbidden container and accidentally released all the world's evils upon humanity. The wide range of threat models being incorporated in the risk analysis represents the contents of Pandora's box.

### *Economic growth is punctuated by periodic crises*

The 300 cities featured in the Cambridge Global Risk Index are the world's greatest economic engines. Over the past 50 years these cities have not had a smooth historical ride to economic prosperity.

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 five times

Experienced thousands of cyber attacks

Been involved in more than 50 wars, with more than a dozen cities bombed to ruins

Seen political instability through riots, protests and social unrest of its citizens

Been embroiled in over a dozen civil wars

Half of them have suffered a serious flood

A quarter of them have been flooded more than five 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

## Economic Trends

The future growth of the global economy is an important part of the risk estimate. The expected projection of economic output provides a baseline trend that threats could potentially disrupt.

The analysis considers the economic output for the major cities of the world, with projections of future GDP each year for the next decade. This is based on the economic sectoral breakdown of the city's economy, its population demographics, and the dynamics of its national economy.

The economy of the world grew at an average rate of around 3% per year consistently from 1980 to around 2008, taking the world's annual output from $22.5 trillion to $63 trillion until the credit crisis. Global GDP fell to $59.8 trillion in 2009 in the Great Financial Crisis, and resumed growth from 2010 onwards, with annual growth rates of around 2.5% in the past few years.

Our advisors Oxford Economics, and other leading economists now expect that future GDP growth will not be as fast as their forecasts from two years ago. They have downgraded their expectations for most of the world's leading economies, although projections for some countries' economies have improved. There is significant variation in the forecasts for different countries, with some emerging economies growing at rates between 4% and 7% a year, and many of the more developed economies seeing annual growth rates well below 2%.

Overall the latest projections suggest that by 2020 global GDP will have reached around $92 trillion. This is a significant reduction from the projections of two years ago, which estimated 2020 global GDP would reach $108 trillion. The latest projections suggest that GDP in 2020 will be only 85% of the level that was previously forecast. Overall, risk as the level of potential loss, is reduced with a lower levels of economic output.

**Men clear rubble in Bhaktapur following the 2015 Nepal earthquake**

Market Crash

Sovereign Crisis

Commodity Prices

## Finance, Economics and Trade Risks

Banking regulation is forcing major financial institutions to hold more risk capital and to de-leverage, making the financial system more stable and less likely for a crisis to spread and amplify through contagion processes. Basel III regulations have been under implementation since 2013 and most major institutions have now completed their compliance. This will not completely prevent future market crashes from occurring but it will mitigate the spread and severity of minor and moderate financial crises.

Recent economic shocks include the collapse in oil price in early 2015 and the subsequent slump in commodity prices in the months following. The Shanghai 'Black Monday' stock exchange crash of 24 August 2015 saw simultaneous corrections to many of the world's stock markets on a single day. Technology-related financial crises such as the flash crash accentuation of sterling devaluation following Brexit in June 2016, Bitcoin and block chain currency hack losses in April 2016, and the SWIFT 'Lazarus' attempted $1bn cyber heist in May 2016 indicate that algorithmic trading and technology innovation are growing vulnerabilities in the financial trading systems.

Financial crises are still likely to occur at the kind of frequencies that have been seen historically, and possibly more frequently because markets are becoming more interdependent and correlated, so that failures that originate any part of the global financial system are quickly felt everywhere.

Asset bubbles, banking runs, and credit liquidity failures are the main historical triggers in past crises, and there are signs that each of these could potentially trigger new crises in the next few years. Italian and other European banks are among those on watch for potential difficulties. According to the IMF, global debt is growing, and reached a record $152 trillion in October 2016. The continuing low interest rate environment has fed the development of asset bubbles in real estate and debt markets. The potential for property price crashes in overinflated markets is a potential trigger for a future financial crisis.

▼ Overall the expected loss from **market crash** threats is below its long-term average. The likelihood of a financial crisis being triggered by an asset bubble, banking run, or debt crisis remains elevated. Future financial crises will have reduced impact and spread due to the higher funding ratios held by financial institutions with Basel III compliance. Pressures for investment growth may see these protections eroded over time.

▲ **Sovereign crisis** risk is elevated, with particular countries on heightened credit watch, mirroring rating agency assessments. The recent past has seen record numbers of sovereign downgrades by rating agencies

▼ **Commodity price hikes** from their current low levels are more likely, but these will be less impactful unless they reach levels well above their pre-2014 levels. This risk is below its long-term average.


Interstate Conflict


Terrorism


Separatism Conflict


Social Unrest

## Geopolitics and Security

We are in an era of increased geopolitical risk and uncertainty as commentators see growing nationalism trends and a re-examination of the benefits from globalisation. This has resulted in democratic shocks, military tensions, social unrest, and a rise in anti-Western terrorism. These trends suggest that we may be entering a period of increased likelihood of conflicts and civil disorder.

The 'Long Peace' between major military powers that has prevailed since 1945 is unlikely to end anytime soon, but proxy wars and adventurism could make smaller scale conflicts more common, and increase the chances of escalating into a major conflict. Each of the potential interstate conflict scenarios in the analysis have very low probabilities, but are adjusted to reflect increased evidence of belligerence. The threshold of starting an interstate conflict may be eroded through cyber wars between nation-backed hacker units, escalating the common practice of interstate cyber espionage and vulnerability probing.

An increase in military tensions between major powers, with recent sabre-rattling between various antagonists in multiple theatres. The formal entry of Russia into the Syrian civil war has boosted Middle Eastern tensions, and created a potential flashpoint with Turkey. Russia's willingness to expand her influence has caused fears in Europe, questions over NATO commitments, and increased military spending by Western powers. In the Pacific rim, China's territorial disputes with Japan, Vietnam, Malaysia, and the Philippines have created instability. Recent military incidents highlight potential flashpoints between India and Pakistan; and the nuclear armament of North Korean threatens to destabilize the extended standoff with South Korea.

Terrorism is potentially entering a new phase with IS losing ground militarily to the anti-IS coalition in its self-proclaimed caliphate in Syrian and Iraq, and having its leadership eroded. It is beginning to disperse to other 'wilayets', including Libya, Yemen, and central Africa, and is transitioning to a virtual organization, raising the future spectre of cyber terrorism. The dispersal of IS could potentially lead to an increase in terrorist attack frequency in the West, such as those seen in France and Germany in 2016. The potential resolution of the leadership rivalry between IS and Al Qaeda could lead to reconciliation between the two groups and to a stronger allied attack force against the West.

While recorded incidences of social unrest such as protests, strikes, and riots have diminished worldwide since their peak in 2012-13, it continues to be a significant threat and may increase again in the near term. Separatism conflict has generally diminished – one example is the potential ending of the Colombia FARC war. Social unrest is potentially becoming more localised and issue-specific, such as civil rights protests in US, and reform-based political protest in China and other countries.

- **Interstate conflict** risk is elevated, with growing military tensions in a number of geopolitical theatres, and potentially lower threshold for destructive conflict through cyber war.
- **Terrorism** risk is elevated, with IS dispersal and intent to attack the West.
- **Social Unrest** risk is similar to its long-term baseline, potentially slightly elevated, with reduced incidences of recorded strikes and riots.
- **Separatism Conflict** risk is on a par with or below its long-term baseline.


Earthquake


Tropical Windstorm


Temperate Windstorm


Tsunami


Flood


Volcano


Drought


Freeze


Heatwave

## Natural Catastrophe and Climate

Natural catastrophes continue to cause destruction and localised economic disruption. Recent years have seen a lower than usual incidence of high-cost meteorological and geophysical disasters but notable events have included super-typhoons in the Pacific basin in 2014, earthquakes in Nepal (April, 2015) and Italy (August, 2016), air traffic disruption in the eruption of Mt Sinabung, Indonesia (June, 2015), and floods in UK and Northern Europe. Droughts continue in western US, southern Africa, and Brazil Cantareira.

The Cambridge Global Risk Index incorporates the geographical zoning of natural hazards and the return periods of them impacting the economies of each of the 300 cities.

There is a noticeable trend of increasing cost of natural catastrophes, due to the increasing exposure of more built property and higher value of infrastructure. There is also evidence that extreme climatic conditions are occurring more frequently as a result of climate change, although there is insufficient science to determine how future climate conditions will influence the frequency and severity of natural catastrophes, such as flooding, changing rainfall patterns and intensities, rising sea levels, and more extreme heatwaves, freezes and droughts, and possibly increasing severity of tropical windstorms. Most estimates suggest that these changes will take several decades to become significant, although it is possible that tipping points and non-linearity could produce surprises.

The most notable changes in occurrence of extreme weather come from climatic cycles such as El Niño Southern Oscillation (ENSO): phases of increased (El Niño) and decreased (La Niña) sea surface temperatures in the equatorial Pacific ocean. El Niño phases are associated with warmer weather, heatwaves and droughts in the southern hemisphere and potentially more severe hurricanes in the Atlantic. La Niña phases are associated with cooler regimes in the southern hemisphere and increases in rainfall in the South Pacific and southern Asia.

El Niño and La Niña phases are irregular and strong phases last between 9 and 12 months and occur on average every two to 12 years. 2015 and 2016 saw an El Niño cycle and most predictions suggest that the next three years will be more likely to have periods of La Niña characteristics than El Niño, suggesting more risk of flooding in Latin America, Africa, India and Southeast Asia. However the predictive science is too uncertain to make a strong risk projection for the next three years above the long-term baseline.

- **Earthquake** hazard generally does not vary over time so the chances of earthquake occurrence is consistent with the long-term baseline
- **Tropical Windstorm** risk over the next three years is consistent with the 10 year baseline risk
- **Temperate Windstorm** risk is consistent with the long-term baseline risk
- **Tsunami** risk is not dependent on any short term factors so is consistent with the long-term baseline risk assessment
- **Flood** risk is likely to be consistent with the long-term baseline risk. If a strong La Niña phase emerges then flood risk in certain regions (Latin America, Africa, India, Southeast Asia, Australia) could be elevated
- **Volcano** risk is not time-variable, so is consistent with the long-term baseline risk
- **Drought** risk over the next three years is consistent with the 10 year baseline risk, unless there is a strong El Niño phase, when drought risk could be elevated
- **Freeze** risk in short term is consistent with the long-term baseline view of cold weather event likelihoods
- **Heatwave** risk is unchanged from the long-term baseline risk

Nuclear Accident

Power Outage

Cyber Attack

Solar Storm

## Technology and Space

Technology threats are one of the fastest changing risks to the global and local economies.

Cyber attacks and disruption of the digital economy by malevolent actors is a growing problem that changes in technique and capability every month. The past year has seen a number of record-breaking cyber attacks, ranging from increasingly larger volumes of data stolen by hackers, to the unprecedented intensity of denial of service attacks, and scale of financial crime attempts.

The cyber attack on the Ukranian power grid that caused power loss to 225,000 people in December 2015 showed what economic and social damage future destructive cyber attacks might cause. IT specialists, law enforcement agencies, and national security organizations are now investing heavily to curb cyber threat. The non-jurisdictional nature of cyber hacking organizations will take some years of collective international effort to combat.

CCRS research into the threat of solar storm in 2016 has improved estimates of economic disruption. This has enabled us to upgrade our model of solar storm risk and to refine the geographical potential impact, which has reduced our risk estimates at lower latitudes. Significant efforts are underway by power grid operators in many countries at risk to reduce the vulnerability of their EHV transformer systems that should reduce this risk in the long-term. Large coronal mass ejections (CMEs) appear to be associated with the peak periods of the eleven year solar cycle, although a destructive CME could occur at any time. Cycle 24 of the sun activity phase peaked in 2013-14 and although the coming three years are in a declining phase of activity there is insufficient science to suggest that the likelihood of experiencing a solar storm will be reduced.

Power outage from accidental causes or weather remains a major risk of disruption in modern economies that rely on continuity of utilities and information technology. Technology threats of solar storm and cyber attacks similarly are ultimately most disruptive when they impact the grid and result in power outage. The power grid, spinning reserves, capacity, and system architecture ultimately control the geographical extent of potential outages and determine how rapidly power might be restored.

In many countries the increasing demand for power is exceeding the amount of new capacity being brought on line, resulting in power deficits that make extensive power outages more likely. Major blackouts have occurred recently in Turkey (March, 2015, 90% of the country); Pakistan (January, 2015, 80% of population); Kuwait (February, 2015, most of country) with other significant blackout events in Egypt, Bangladesh; South Africa; New Zealand; Malta; and the Philippines. Other countries, such as India, have invested heavily in building new generation capacity and improving grid infrastructure have reduced their chances of power outage.

▲ **Cyber Attack** risk is increasing rapidly and is likely to remain highly elevated in the short term, with high uncertainty in the pattern of future risk. In the longer term international cooperation and law enforcement will reduce risk of economic disruption from cyber hackers

◢ **Solar Storm** risk is on a long-term baseline decline as power grid operators reduce their vulnerability to geomagnetic damage. Cambridge modelling improvements have refined the geographical extent of risk of severe economic disruption from solar storm

◥ **Power Outage** risk is trending to increase in countries with power deficits. In longer term, nations that invest in increased power capacity and improved resilience are expected to reduce their power outage risk

▼ **Nuclear Accident** risk is relatively unchanged. Six nuclear power plants were decommissioned in 2015



Human Pandemic


Plant Disease

## Health and Humanity

Recent disease outbreaks have illustrated the potential for epidemics to cause international economic disruption. The Zika virus outbreak in 2016 has affected over 20 countries in Latin America and Southeast Asia. The Ebola outbreak of 2014-15 has finally been contained. Other emerging infectious diseases with a medical cure continue to generate occasional cases, such as MERS, Avian Flu (H5N1), and new virus strains emerge such as influenza H7N9.

Pandemic risk in the future is decreasing: Public health analysts have improved identification of potential epicentres of future pandemic outbreaks and primary health care surveillance has improved in these areas. Other factors such as improvements in vaccine capacity, stockpiles, and pandemic preparedness planning are also making gradual improvements in our ability to contain and mitigate pandemic outbreaks.

Some factors are increasing the potential for human epidemics. Major public health concern remains the potential emergence drug resistant strains of endemic diseases, such as malaria and XDR tuberculosis, whose untreatable outbreaks would generate high economic shock impact, from diseases that are generally assumed conquered. Laboratory 'gain-of-function' experiments to improve our understanding of pathogen mutation have an added risk of accidental release of an artificially-cultured disease.

Plant disease risk is stable because it is geographically constrained and slow spreading. Diseases pose a significant risk to some of the major staple crops that provide most of the nutrition of the world's population. Risk is enhanced by modern agricultural practices that have reduced biodiversity of strains cultivated.

- ▼ **Human Pandemic** risk is reducing. The chances of a new emerging infectious disease are increasing with growing populations of closely farmed poultry and swine worldwide, but improved surveillance, vaccine availability, and pandemic preparedness are likely to mitigate the potential impact of an outbreak.
- ▶ **Plant Disease** risk is relatively unchanged.

**Decade volcano Mount Rainier viewed over the Seattle skyline**

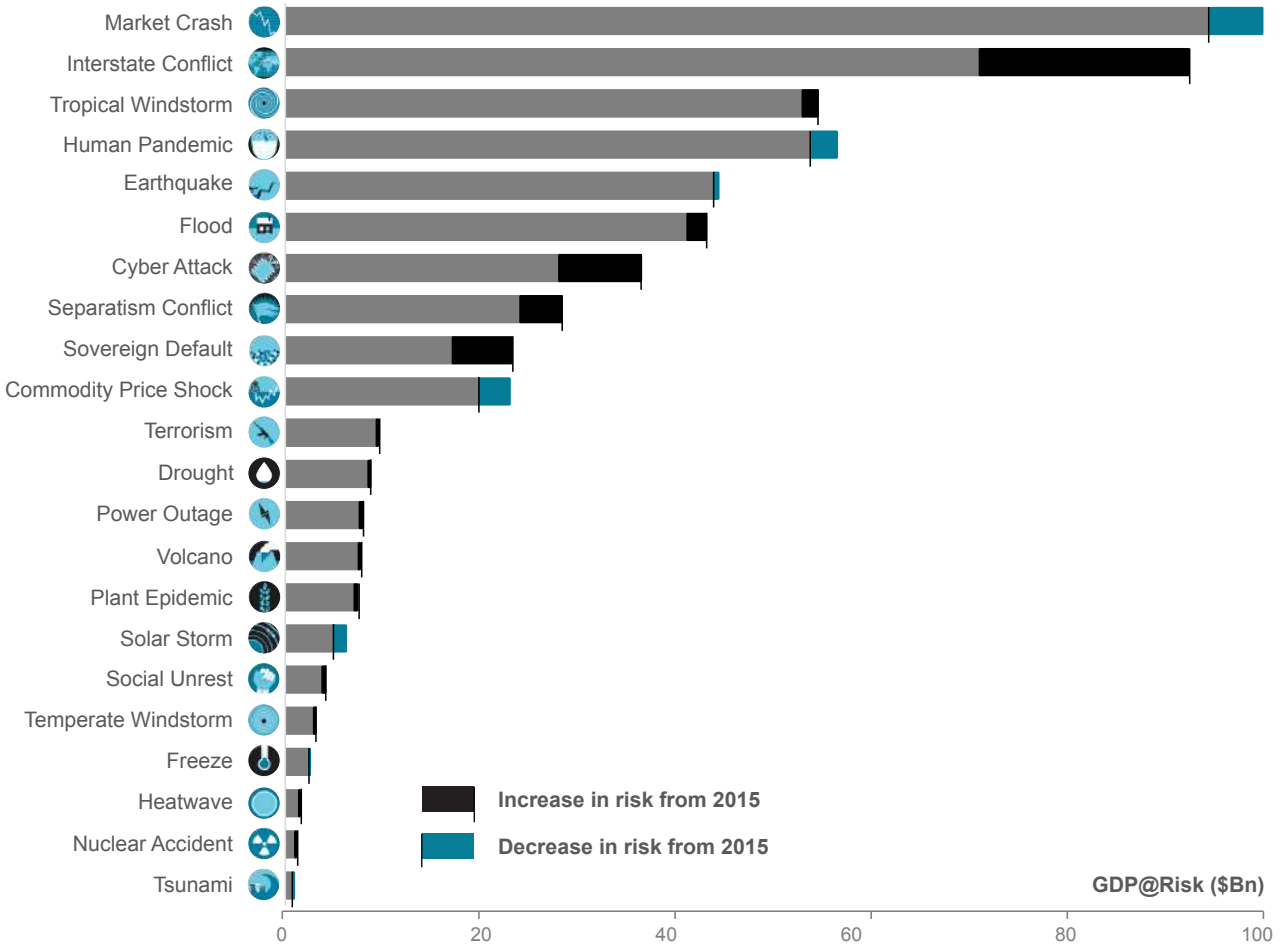



**Figure 1: 2017 Global Risk Index by Threat Type**

### *Changes in Threat Risks*

The changes in risk by threat is shown in Figure 1.

The remote but increased possibility of interstate conflict in theatres of the world, causes a significant addition of risk. The reduction in likely severity of future financial crises, as a result of improved banking liquidity, means that interstate conflict risk is now almost as severe a threat to the global economy as a market crash from another financial crisis.

Reductions in the risk of economic disruption from human pandemic, as a result of improved surveillance and medical preparedness, have downgraded this threat to below the ranking of wind storm, which has stayed as a constant threat in tropical regions.

Risk of major economic shocks from cyber attacks is increasing, and is elevated by 20% above baseline as we face a period of increased risk. Commodity price risk sees a significant reduction as future hikes are expected, although these will be from a much lower baseline, therefore cause less economic shock loss when they occur.

Many of the other threats see significant changes, but not sufficient to change their ranking from our 2015 assessment.

### *World Map of City Risk 2017*

The Risk Index map of cities across the world (Figure 2, page 15), shows how these risk changes are reflected geographically. The GDP@Risk for each city is a composite of all of the threat probabilities and consequences, and are separate risk estimates maps and outcomes for each individual threat type.

The dynamics of change in risk for each city is the net result of risk adjustments to each threat type across the world. In aggregate, the risks are above baseline, growing in emerging market and below baseline or reducing in many parts of the more developed economies. Certain regions of the world such as the Pacific rim, the Middle East, the Indian subcontinent and Latin America have heightened risks.

## *City Risk Rankings*

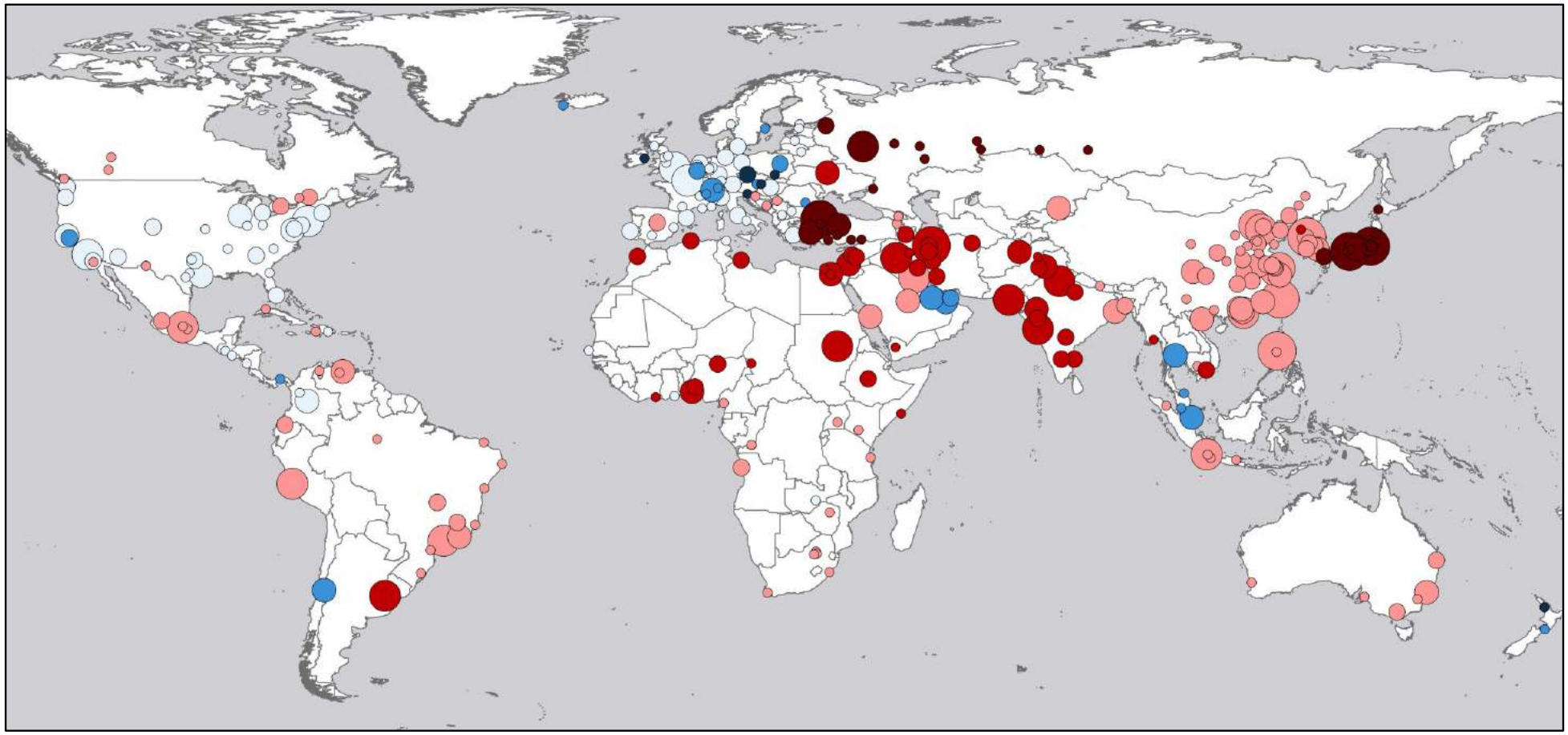
The shifting landscape of risk affects the ranking of cities across the world by their total and individual risks. Table 1 shows the top 30 cities ranked by their annual GDP@Risk.

Table 1 shows the ranking of cities and the change in rank from long term to short term risk outlook.

The changes in risk for these cities are a result of the individual threat risk profile that prevail in each. Geopolitical risks are the primary drivers of change for most of the large changes in the higher ranking cities, with cyber, sovereign crisis, and other technology threats influencing the changes in several of the cities.

**Table 1: Top 30 Cities most at risk from economic shocks 2017**

| Short-Term 2017 Rank | City Name | Short-Term GDP@Risk ($US bn) | Change in Rank from Baseline Ranking | Change in GDP@Risk from Baseline |
|---|---|---|---|---|
| 1 | **Taipei** | 20.57 | 0 ▪ | 0.4% ▲↘ |
| 2 | **Tokyo** | 20.44 | 0 ▪ | 24.4% ▲⇢ |
| 3 | **Seoul** | 13.76 | 0 ▪ | 2.0% ▲↘ |
| 4 | **Manila** | 13.10 | 0 ▪ | 1.6% ▲↘ |
| 5 | **Istanbul** | 12.06 | 0 ▪ | 19.5% ▲↳ |
| 6 | **Tehran** | 10.66 | 0 ▪ | 6.9% ▲↘ |
| 7 | **Osaka** | 10.02 | 7 ▲ | 20.6% ▲⇟ |
| 8 | **Mumbai** | 9.72 | 0 ▪ | 5.4% ▲↘ |
| 9 | **New York** | 9.23 | -2 ▼ | -1.1% ▼↔ |
| 10 | **Delhi** | 9.22 | 0 ▪ | 5.2% ▲↘ |
| 11 | **Shanghai** | 8.75 | 0 ▪ | 0.5% ▲↘ |
| 12 | **Los Angeles** | 8.73 | -3 ▼ | -0.8% ▼⇟ |
| 13 | **Lima** | 8.65 | -1 ▼ | 0.8% ▲↘ |
| 14 | **Hong Kong** | 8.57 | -1 ▼ | 0.1% ▲↘ |
| 15 | **Buenos Aires** | 7.70 | 0 ▪ | 7.4% ▲↘ |
| 16 | **Moscow** | 7.25 | 5 ▲ | 34.0% ▲⇢ |
| 17 | **Sao Paulo** | 7.09 | -1 ▼ | 2.8% ▲↘ |
| 18 | **Mexico City** | 6.19 | -1 ▼ | 1.5% ▲↘ |
| 19 | **Kuwait City** | 5.89 | -1 ▼ | 2.0% ▲↘ |
| 20 | **Khartoum** | 5.86 | 4 ▲ | 11.2% ▲↔ |
| 21 | **Baghdad** | 5.72 | 5 ▲ | 10.0% ▲⇟ |
| 22 | **Karachi** | 5.68 | 3 ▲ | 8.4% ▲↘ |
| 23 | **Jakarta** | 5.57 | -1 ▼ | 3.4% ▲↘ |
| 24 | **Beijing** | 5.47 | -4 ▼ | 0.5% ▲↘ |
| 25 | **London** | 5.46 | -6 ▼ | -0.9% ▼⇟ |
| 26 | **Paris** | 5.22 | -3 ▼ | -1.1% ▼↔ |
| 27 | **Tianjin** | 5.02 | 0 ▪ | 0.3% ▲↘ |
| 28 | **Tel Aviv** | 4.94 | 5 ▲ | 5.0% ▲↘ |
| 29 | **Guangzhou** | 4.91 | -1 ▼ | 0.4% ▲↘ |
| 30 | **Chengtu** | 4.87 | -1 ▼ | 0.5% ▲↘ |



**City GDP@Risk**
**2017 3yr Risk Outlook ($Bn)**

- 0.03 to 1
- 1 to 2.5
- 2.5 to 5
- 5 to 10
- 10 to 21 Bn

**Short Term vs Long Term Risk Outlook**
**2017 3yr / 2017 10yr**

- -7% to -5%
- -5% to -2.5%
- -2.5% to 0
- 0 to +5%
- +5% to +15%
- +15% to +35%

## Cambridge Global Risk Index 2017

### Short Term Risk Outlook Variation from Baseline Long Term Outlook

2017 to 2019 3yr Risk Outlook

GDP@Risk: Probability-weighted expected annual loss in economic output from disruptive shocks from 22 threat categories for 300 leading cities of the world.

Short term Risk Outlook relative to the longer term baseline view of risk, comparing 3yr Risk Outlook to 10 yr Risk Outlook

**Figure 2: Cambridge Global Risk Index 2017, elevation from baseline**

The analysis involves simulating scenarios of shock events on cities of the world. CCRS has developed techniques of scenario modelling for a wide range of emerging and unconventional threat types, in our past publications.

The Cambridge Global Risk Index framework is being expanded to identify potential events that would impact regions of multiple cities, and have wide ranging impact on trading and international business activities. We focus on identifying events that would cause a loss of over a trillion dollars of GDP output to the global economy (see examples, Figure 3). Shock events of this size cause stock markets corrections which impact investment portfolios and cause wider systemic impacts.

The event set provides representative scenarios of a wide range of different types of threats, geographies, and localised impacts. It provides an extensive representation of plausible shocks that have a low likelihood of occurring and collectively represent extreme events that are important for resilience. Each threat type has been systematically explored to identify the initiating trigger events that cause loss over the chosen threshold, to ensure that 'correlation' – the likelihood of multiple locations being impacted in the same event – is well represented.

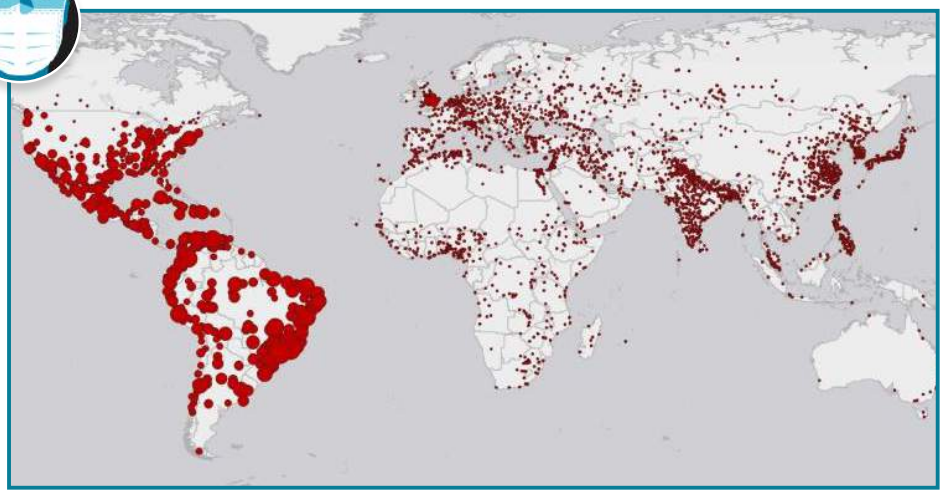
**Table 2: Examples of Trillion Dollar Shock Scenarios**

| Threat Type | Event ID | Event Name | Origin |
|---|---|---|---|
| Market Crash | MC005 | **Contained Eurocrash** | Italy |
| | MC025 | **US-Led Crash Impacts European Markets** | US |
| | MC073 | **China & Western Financial Market Crash** | China |
| Sovereign Crisis | SD001 | **South America Sovereign Crisis** | Brazil |
| | SD007 | **US Default** | US |
| | SD033 | **China & Hong Kong Default** | China |
| Geopolitical Conflict | IW023 | **China-Japan War** | SE Asia |
| | IW024 | **Korean Pensinsular War** | SE Asia |
| | IW025 | **Middle East Regional War** | Middle East |
| | IW026 | **Russia Eastern Europe Conflict** | East Europe |
| Social Unrest | SU002 | **SE Asia 'Arab Spring' Youth Uprising** | SE Asia |
| | SU003 | **Southern Europe Youth Uprising** | South Europe |
| Terrorism | TR045 | **European severe terrorism campaign** | West Europe |
| | TR056 | **Terror WMD attacks on West** | US & Europe |
| Earthquake | EQ024 | **Tokyo Mw8.3 Earthquake & Tsunami** | Japan |
| Volcanic Eruption | VE128 | **Mount Rainier Volcanic Eruption VEI VII** | US |
| Flood | FL003 | **Central Europe Basin Flood** | Central Europe |
| Windstorm | HU005 | **South China Tropical Windstorm** | South China |
| Nuclear Accident | NP206 | **Three Mile Island NPP Meltdown INES 7** | US |
| Power Outage | PO122 | **Europe Electricity Generation Shortfall** | Europe |
| Solar Storm | SS001 | **North America Solar Storm -1200 dst** | N America |
| | SS002 | **Europe Solar Storm -1200 dst** | Europe |
| Cyber | CY022 | **Systemic cyber attack "IT Malaise"** | Global |
| | CY043 | **Cyber attack Critical Infrastructure** | US & Europe |
| Pandemic | HE092 | **Global pandemic influenza Genetic Shift** | Global |
| | HE049 | **Emergent Infectious Disease S America** | S America |
| Plant Epidemic | PE003 | **Wheat Rust Blight North America** | N America |

### *Cascading interactions between threats*

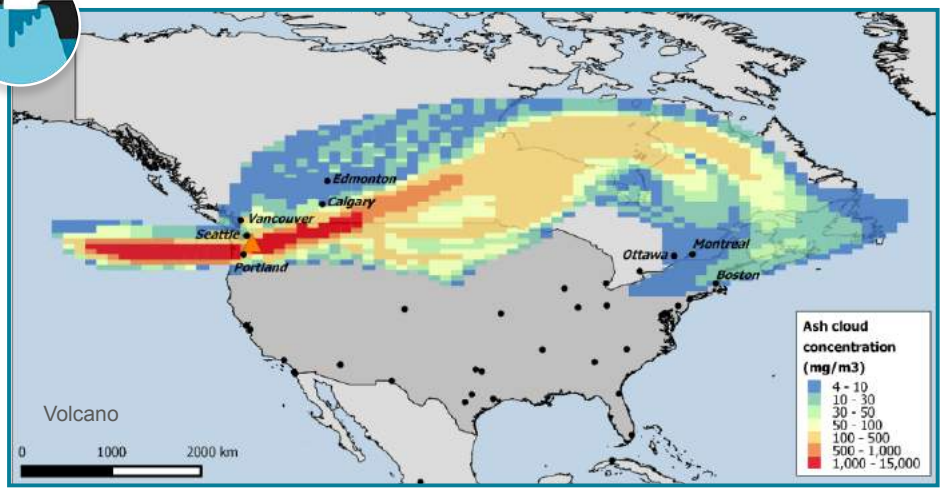
Some of the most catastrophic shocks of the past have been initiated of one threat which then triggers subsequent threat events in a cascade of escalating consequences. Examples include a war provoking a sovereign crisis, or a natural catastrophe causing a power outage which causes social unrest. The permutations of cascading events are explored systematically from threat to threat.

Human Pandemic



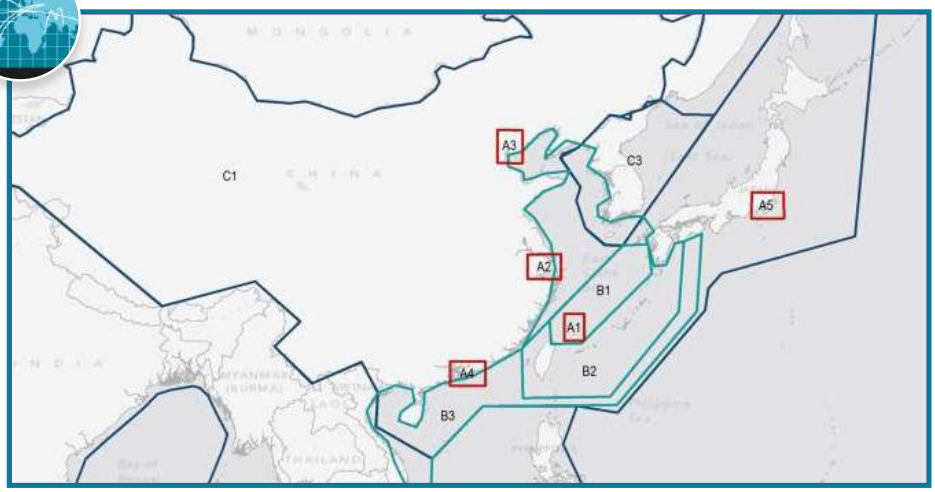
Infectious epidemic of moderate virulence in North and South America

Volcano




VEI VII Eruption of Mount Rainier, Seattle, United States

Interstate Conflict




Military conflict between China and Japan focused on islands in the South China Sea

**Figure 3: Example of footprints of Trillion Dollar Scenarios**

**Table 3: Threat Correlation Matrix, how one shock might cascade into another**

| Primary Trigger | Market Crash | Sovereign Crash | Price Shock | Interstate War | Terrorism | Separatism Conflict | Social Unrest | Earthquake | Volcano | Tropical Windstorm | Temperate Windstorm | Flood | Tsunami | Drought | Freeze | Heatwave | Power Outage | Cyber Attack | Solar Storm | Nuclear Accident | Human Epidemic | Plant Epidemic |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Market Crash | 4 | 3 | 3 | 2 | 3 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Sovereign Crash | 3 | 4 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Price Shock | 2 | 2 | 4 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Interstate War | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 3 | 1 | 2 | 2 | 2 |
| Terrorism | 2 | 2 | 2 | 2 | 4 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 2 |
| Separatism Conflict | 2 | 3 | 3 | 3 | 3 | 4 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 1 |
| Social Unrest | 2 | 2 | 2 | 2 | 3 | 3 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 1 |
| Earthquake | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 0 | 0 | 1 | 1 | 1 | 3 | 0 | 0 | 0 | 3 | 0 | 0 | 3 | 2 | 1 |
| Volcano | 2 | 2 | 2 | 1 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 2 | 1 |
| Tropical Windstorm | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 1 | 1 | 0 |
| Temperate Windstorm | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 3 | 0 | 1 | 0 | 0 | 0 |
| Flood | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 2 | 0 |
| Tsunami | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 3 | 0 | 0 |
| Drought | 1 | 2 | 3 | 2 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 |
| Freeze | 1 | 1 | 2 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 1 | 1 | 1 |
| Heatwave | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| Power Outage | 1 | 2 | 2 | 1 | 0 | 0 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 4 | 0 | 0 | 2 | 1 | 1 |
| Cyber Attack | 1 | 2 | 1 | 2 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 0 | 2 | 0 | 0 |
| Solar Storm | 2 | 2 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 0 |  | 2 | 0 | 0 |
| Nuclear Accident | 2 | 2 | 1 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| Human Epidemic | 3 | 3 | 3 | 1 | 1 | 0 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 0 |
| Plant Epidemic | 2 | 2 | 3 | 2 | 1 | 2 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 2 |

**Consequential Threat**

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

The risk landscape is changing. The Cambridge Global Risk Index provides an objective, evidence-based analysis of the risk of future economic shocks for use by business managers, policy makers, and financial risk decision-makers.

The Index provides guidance on where future disruptions to revenues and economic activity are most likely to occur. It provides a framework for incorporating the frequency and severity of future shocks into resilience planning, and inputs into risk registers and formal reporting of risks to shareholders and regulators.

The Index is structured to help with the cost benefit justification of improving resilience. Policy makers can use the Index for civic continuity, economic security, and preparedness, particularly city administrations in identifying the key drivers of risk to the economic prosperity of their metropolis.

Financial services companies providing risk capital can incorporate this type of analysis into their own techniques and country threat assessments. Some risks included in the analysis are not incorporated in conventional risk management products and standard perils covered in traditional insurance. Better understanding of these risks may provide opportunities for insurers to create new product offerings and address new markets.

## Emerging Risk Trends

Our analysis identifies three important emerging trends in the global risk landscape:

1. Emerging economies will shoulder an increasing proportion of risk-related economic loss as a result of both their accelerating economic growth and their increasing risk environment. Their risk environment is less stable.
2. There is a growing prominence of man-made risks
3. We see a heavy contribution from new or emerging risks, such as cyber attacks and infrastructure vulnerabilities.

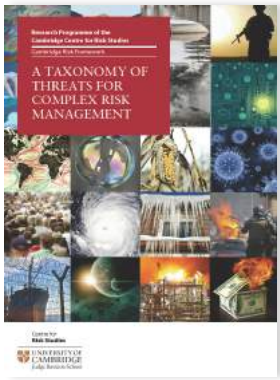
A number of the evolving risks are supra-national – they transcend the ability of any individual country to deal with the risk or contain it on their own. It is only by international collaborative efforts that these systemic connected risks can be mitigated.

## A Map of the Future Risk Landscape

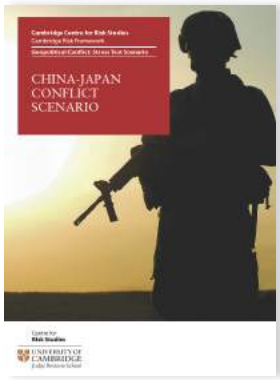
The Index provides a map of the risk landscape ahead. Understanding the patterns of future risk is the key to successful risk management. We provide these analytics to help businesses, policy-makers, financial services providers, insurers, and other professional risk managers gauge their planning decisions, strategies and investments. We estimate that over half of this risk can be mitigated by improvements in resilience and investment in risk management.

Heightened awareness and improved understanding of risks is the key to building resilience. The Cambridge Global Risk Index 2017 is offered as a contribution towards reducing risk for a sustainable society.

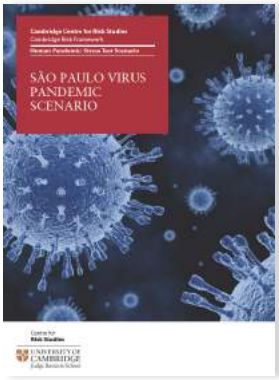
## Cambridge Centre for Risk Studies Publications



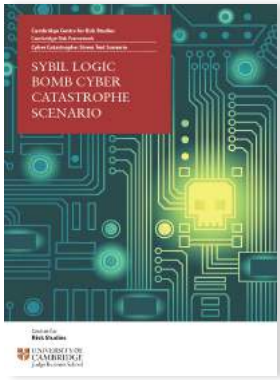

**Taxonomy of Threats**



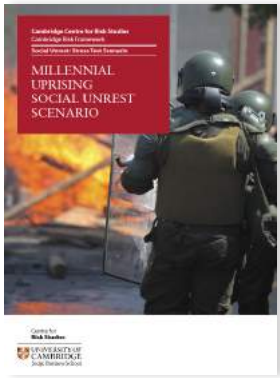

**Geopolitical Conflict**
Emerging Risk Scenario



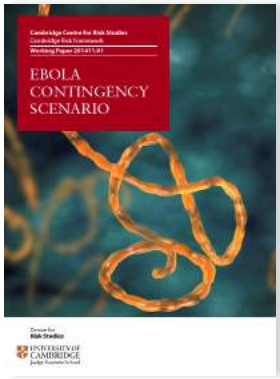

**Pandemic**
Emerging Risk Scenario



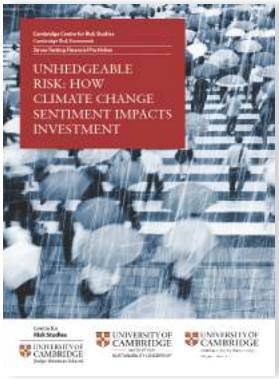

**Cyber Catastrophe**
Emerging Risk Scenario



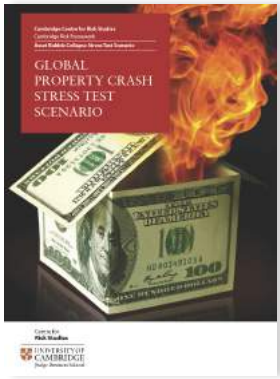

**Social Unrest**
Emerging Risk Scenario




**Ebola**
Emerging Risk Scenario

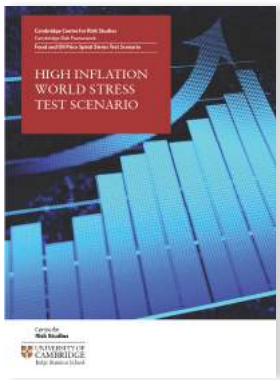



**Climate Change**
Investor Sentiment Shock

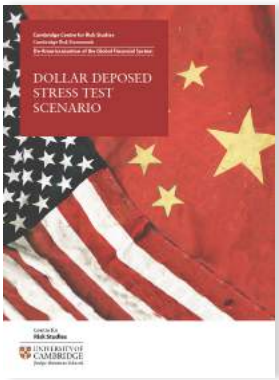



**Global Property Crash**
Financial Risk Scenario


**Eurozone Meltdown**
Financial Risk Scenario

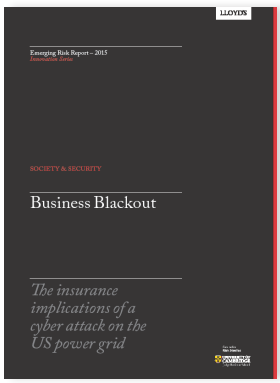



**High Inflation World**
Financial Risk Scenario

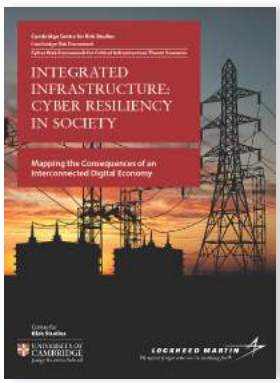



**Dollar Deposed**
Financial Risk Scenario

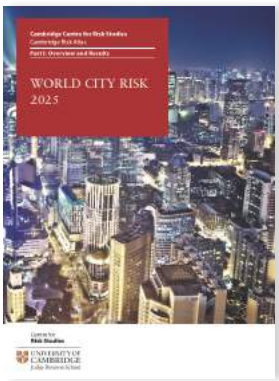

**Cyber Accumulation**
Insurance Risk Report



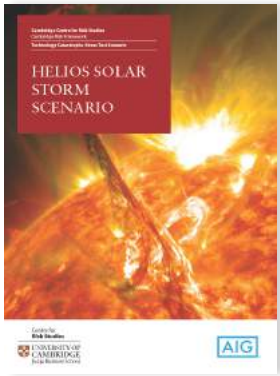

**Business Blackout**
Lloyd's Emerging Risk Report




**UK Cyber Blackout**
Lockheed Martin UK co-branded report




**World City Risk 2025**
Lloyd's co-branded report




**Helios Solar Storm**
Emerging Risk Scenario

Cambridge Centre for Risk Studies gratefully acknowledges the expertise provided for the Pandora global risk research programme by our subject matter specialists. Any misinterpretation in use of the advice provided is entirely the responsibility of Cambridge Centre for Risk Studies.

### Finance, Economics and Trade Risks

- **Cambridge Centre for Financial History**, Dr Duncan Needham, *Director*
- **Oxford Economics**, Keith Church, *Senior Economist*
- **Financial Networks Analytics Ltd.**, Dr Kimmo Soramaki, *CEO and Founder*
- **Office of Financial Research, US Federal Reserve**, Dr Mark Flood, *Director*

### Geopolitics and Society

- **Cytora Ltd.**, Richard Hartley, *CEO* and Joshua Wallace, *Product Director*

### Terrorism

- **International Centre for Political Violence and Terrorism Research**, S. Rajaratnam School of International Studies (RSIS) at Nanyang Technological University, Singapore, Prof. Rohan Gunaratna, *Director*
- **Risk Management Solutions Inc.**, Dr Gordon Woo, *Catastrophist*

### Natural Catastrophe and Climate

- **Risk Management Solutions Inc.**
- **Cambridge Architectural Research Ltd**, Dr Robin Spence, *Director*; Luca Leone, *Director*, Antonios Pomonis, *Director*, Hannah Baker, *Associate*
- **CatInsight**, Dr Richard Dixon, *Director*

### Cyber and Technology

- **Concinnity Risks Ltd.**, Eireann Leverett, *CEO*
- **University of Cambridge Computer Labs,** Dr Frank Stajano, *Reader in Security and Privacy*, Graham Rymer, *Ethical hacker and penetration tester*
- **CyberCrime Centre**, Dr Alice Hutchins, *Criminologist and Senior Research Associate*, Dr Julia Powles, *Postdoctoral Researcher*

### Space Weather

- **British Antarctic Survey**, Dr Richard Horne, *Science Leader, Space Weather and Atmosphere team*; Dr Mark Clilverd, *Senior Scientist, Space Weather and Atmosphere Team.*
- **Department of Applied Mathematics and Theoretical Physics**, University of Cambridge, Dr Helen Mason, *Assistant Director of Research.*

### Infrastructure

- **Infrastructure Transitions Research Consortium**, University of Oxford, Scott Thacker, *Infrastructure Systems Modeller,* Dr Raghav Pant, *Senior Postdoctoral Researcher - Infrastructure Risk Analyst*, Professor Jim W Hall, *Professor of Climate and Environmental Risks, Director of the Environmental Change Institute*

## Health and Disease

- **Cambridge Infectious Disease Interdisciplinary Research Centre**, Dr Colin Russell, *Royal Society Research Fellow*, *Department of Veterinary Medicine*

- **Department of Plant Sciences**, University of Cambridge, Dr Matt Castle, *Senior Research Fellow*

- **AgRisk**, Dr Claire Souch, *Product Manager*

Centre for
**Risk Studies**

UNIVERSITY OF CAMBRIDGE
Judge Business School

## Cambridge Centre for Risk Studies Research Team

**Executive Team**
Dr Michelle Tuveson, *Executive Director*
Professor Daniel Ralph, *Academic Director*
Dr Andrew Coburn, *Director of Advisory Board*
Simon Ruffle, *Executive Director of Research & Innovation*

**Research Associates**
Dr Shahzeb Malik, *Research Associate*
Dr Edward Oughton, *Research Associate*
Dr Andrew Skelton, *Research Associate*

**Research Team**
Dr Jay Chan Do Jung, *Risk Researcher*
Eireann Leverett, *Senior Risk Researcher*
Kristen MacAskill, *Risk Researcher*
Dr Duncan Needham, *Senior Risk Researcher*

**Research Assistants**
Jennifer Copic, *Research Assistant*
Tamara Evan, *Research Assistant*
Arjun Mahalingam, *Research Assistant*
Dr Ali Shaghaghi, *Research Assistant*
Kayla Strong, *Research Assistant*
Jessica Tsang, *Research Assistant*

**Advisors and Fellows**
Professor Kern Alexander, *Professor of Banking and Financial Market Regulation, University of Zurich*
Andrew Freeman, *Risk Fellow*
Lee Coppack, *Senior Advisor, Risk Communication*
Professor Alan Punter, *Senior Advisor, Insurance Applications*
Dr Ruth Whaley, *Senior Advisor, Corporations and Boards*

**Centre Operations**
Shaheera Asante, *Editorial Assistant*
Soña Kraciova, *Centre Administrator*

**Cambridge Centre for Risk Studies**
**Website and Research Platform**

**http://risk.jbs.cam.ac.uk/**

**Cambridge Centre for Risk Studies**
Cambridge Judge Business School
University of Cambridge
Trumpington Street
Cambridge
CB2 1AG

T: +44 (0) 1223 768386
F: +44 (0) 1223 339701
enquiries.risk@jbs.cam.ac.uk
www.risk.jbs.cam.ac.uk

Join our LinkedIn group at Cambridge Centre for Risk Studies

Follow us @Risk_Cambridge