CAMBRIDGE GLOBAL RISK INDEX FOR 2018

Jennifer Copic, Research Associate
Centre for Risk Studies
Threat Models

Finance, Economics and Trade
- Market crash
- Sovereign crisis
- Price shock

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
How a Catastrophe Impacts a City’s Economy

Graph showing the impacts of a catastrophe on various economic indicators including population, retail activity, container cargo at Kobe Port, shoe manufacturing, sake brewery output, steel output from Kobe steel mills, and overall economic output from 1992 to 2008.
2018 Global Risk Index

Measure impact of 22 threats on cities that contribute to 41% of global GDP

Annual update of GDP@Risk:

## A History of Urban Economic Shocks

The cities in the Global Risk Index have:

<table>
<thead>
<tr>
<th>Event</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lost more than a million of their citizens to earthquakes</td>
<td></td>
</tr>
<tr>
<td>Seen a third or more of their economic capital wiped out by stock market crashes 5 times</td>
<td></td>
</tr>
<tr>
<td>Experienced thousands of cyber attacks</td>
<td></td>
</tr>
<tr>
<td>Half of them have suffered a serious flood</td>
<td></td>
</tr>
<tr>
<td>A quarter of them have been flooded more than 5 times</td>
<td></td>
</tr>
<tr>
<td>32 cities have had to cope with a volcanic eruption less than 100 km away</td>
<td></td>
</tr>
<tr>
<td>Suffered more than 1,000 terrorist car bombs in city centres</td>
<td></td>
</tr>
<tr>
<td>Financial crisis of their governments defaulting on sovereign debts on 50 occasions</td>
<td></td>
</tr>
<tr>
<td>Had to combat the outbreak of a previously unknown disease five times</td>
<td></td>
</tr>
</tbody>
</table>
2018 Views of Risk

Top 20 Cities at Risk
+Top Risk Type

<table>
<thead>
<tr>
<th>City</th>
<th>Country</th>
<th>GDP@Risk ($bn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tokyo</td>
<td>Japan</td>
<td>24.31</td>
</tr>
<tr>
<td>New York</td>
<td>United States</td>
<td>14.83</td>
</tr>
<tr>
<td>Manila</td>
<td>Philippines</td>
<td>13.27</td>
</tr>
<tr>
<td>Taipei</td>
<td>Taiwan</td>
<td>12.88</td>
</tr>
<tr>
<td>Istanbul</td>
<td>Turkey</td>
<td>12.74</td>
</tr>
<tr>
<td>Osaka</td>
<td>Japan</td>
<td>12.42</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>United States</td>
<td>11.56</td>
</tr>
<tr>
<td>Shanghai</td>
<td>China</td>
<td>8.48</td>
</tr>
<tr>
<td>London</td>
<td>United Kingdom</td>
<td>8.43</td>
</tr>
<tr>
<td>Baghdad</td>
<td>Iraq</td>
<td>7.91</td>
</tr>
<tr>
<td>Mexico City</td>
<td>Mexico</td>
<td>7.78</td>
</tr>
<tr>
<td>Seoul</td>
<td>Korea</td>
<td>7.13</td>
</tr>
<tr>
<td>São Paulo</td>
<td>Brazil</td>
<td>6.55</td>
</tr>
<tr>
<td>Hangzhou</td>
<td>China</td>
<td>6.45</td>
</tr>
<tr>
<td>Jakarta</td>
<td>Indonesia</td>
<td>6.29</td>
</tr>
<tr>
<td>Moscow</td>
<td>Russia</td>
<td>6.27</td>
</tr>
<tr>
<td>Nagoya</td>
<td>Japan</td>
<td>6.15</td>
</tr>
<tr>
<td>Paris</td>
<td>France</td>
<td>5.94</td>
</tr>
<tr>
<td>Cairo</td>
<td>Egypt</td>
<td>5.73</td>
</tr>
<tr>
<td>Suzhou</td>
<td>China</td>
<td>5.73</td>
</tr>
</tbody>
</table>

Top City Threats

<table>
<thead>
<tr>
<th>Top City Threat</th>
<th>GDP@Risk (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interstate Conflict</td>
<td>37%</td>
</tr>
<tr>
<td>Market Crash</td>
<td>21%</td>
</tr>
<tr>
<td>Tropical Windstorm</td>
<td>56%</td>
</tr>
<tr>
<td>Tropical Windstorm</td>
<td>62%</td>
</tr>
<tr>
<td>Interstate Conflict</td>
<td>20%</td>
</tr>
<tr>
<td>Interstate Conflict</td>
<td>30%</td>
</tr>
<tr>
<td>Earthquake</td>
<td>23%</td>
</tr>
<tr>
<td>Tropical Windstorm</td>
<td>28%</td>
</tr>
<tr>
<td>Market Crash</td>
<td>22%</td>
</tr>
<tr>
<td>Interstate Conflict</td>
<td>55%</td>
</tr>
<tr>
<td>Market Crash</td>
<td>35%</td>
</tr>
<tr>
<td>Tropical Windstorm</td>
<td>37%</td>
</tr>
<tr>
<td>Market Crash</td>
<td>46%</td>
</tr>
<tr>
<td>Tropical Windstorm</td>
<td>68%</td>
</tr>
<tr>
<td>Civil Conflict</td>
<td>30%</td>
</tr>
<tr>
<td>Market Crash</td>
<td>44%</td>
</tr>
<tr>
<td>Interstate Conflict</td>
<td>36%</td>
</tr>
<tr>
<td>Market Crash</td>
<td>24%</td>
</tr>
<tr>
<td>Interstate Conflict</td>
<td>55%</td>
</tr>
<tr>
<td>Tropical Windstorm</td>
<td>51%</td>
</tr>
</tbody>
</table>

Ranking of Threats

- Market Crash
- Interstate Conflict
- Tropical Windstorm
- Human Pandemic
- Flood
- Civil Conflict
- Cyber Attack
- Earthquake
- Commodity Price Shock
- Sovereign Default
- Terrorism
- Drought
- Plant Epidemic
- Power Outage
- Volcano
- Solar Storm
- Social Unrest
- Temperate Windstorm
- Freeze
- Heatwave
- Nuclear Accident
- Tsunami

GDP@Risk ($bn)

0 20 40 60 80 100 120

GDP@Risk ($bn)
GDP@Risk - Methodology

City GDP Projection

Threat Vulnerability

Evidence Base

City Resilience

INFORM + Sigma

Threat Assessment

Evidence Base

Expected Loss

Simplify calculation

City GDP Projections

Threat Assessment

Expected Loss

City GDP

Threat Vulnerability

City Resilience

City Definitions and GDP Projections

- How do we define a city?
- Standardize city definition and GDP estimates
  - Oxford Economics City GDP data
  - Detailed specification of city boundaries and estimation methodology
  - Cities defined as larger urban agglomerations which we believe is better suited for economic impact analysis
    - E.g. Tokyo Major Metropolitan Area: Tokyo, Yokohama-shi, Kawasaki-shi, Saitama-shi, Chiba-shi

- **300 cities → 279 cities**
  - Some cities have unreliable GDP data
  - Some cities have been merged
Geographical Mapping of All the Threats

- Earthquake
- Volcano
- Windstorm
- Flood
- Tsunami
- Drought
- Freeze/Heatwave
- Human Epidemic
- Plant Epidemic
- Market Crash
- Sovereign Default
- Oil Price Shock
- Interstate War
- Separatism
- Terrorism
- Social Unrest
- Power Outage
- Cyber Attack
- Solar Storm
- Nuclear Meltdown

UNIVERSITY OF CAMBRIDGE
Judge Business School | Centre for Risk Studies
Vulnerability Ratings

- Determines how significant the initial shock to the city’s economy would be in the case of an event.
- Vulnerability varies by threat type:
  - Market Crash: City Economy’s Reliance on Private Capital
  - Commodity Price Shock: Reliance on fossil fuel per unit of GDP
  - Various threats: Quality of buildings and infrastructure
  - Flood and drought: service versus agriculture oriented economies
  - Cyber Attack: dependence on IT for economic productivity
  - Human Pandemic: Access to healthcare facilities
Resilience – Rate of Recovery

- Each city is assigned a city resilience score based on three core components

**City Resilience Score = Vulnerability^{1/3} * Coping Capacity^{1/3} * Economic capacity^{1/3}**

- City Resilience Scores are grouped into five resilience levels
  - 1 Very Strong, 2 Strong, 3 Moderate, 4 Weak, 5 Very Weak
  - Reflect major step changes and group similar cities

- **Impact estimate:** 2.0% decrease in GDP@Risk (part model-driven, part actual)

---

**Vulnerability**
- Economic, political, social characteristics that can be destabilised

**Coping Capacity**
- Institutional capacity to respond to disasters

**Economic Capacity**
- Insurance and wealth as factors of fiscal resilience

---

**Data Sources:**
- UN Consortium: Index for Risk Management (INFORM)
- Swiss Re: SIGMA Non-Life Insurance Penetration
- Oxford Economics: City GDP/Capita
Change in Risk over Time

- Natural Catastrophe
- Financial, Economics & Trade
- Geopolitics & Security
- Health & Humanity
- Technology & Space

2015  2016  2017  2018
How Risk is Changing

- Increasing threat of geopolitical risk in many parts of the world
  - Threat of civil conflict to emerging economies
  - Potential for interstate war is higher than at any time post-WWII

Geopolitics & Security: GDP-at-risk ($bn)

<table>
<thead>
<tr>
<th>Year</th>
<th>GDP-at-risk ($bn)</th>
<th>Δ GDP</th>
<th>Δ Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRI 2015</td>
<td>$96.1 bn</td>
<td>+10.9%</td>
<td>+8.3%</td>
</tr>
<tr>
<td>GRI 2017</td>
<td>$114.5 bn</td>
<td></td>
<td>+12.1%</td>
</tr>
<tr>
<td>GRI 2018</td>
<td>$133.3 bn</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Geopolitical Risks – Interstate Conflict, Terrorism

- **Interstate Conflict**
  - Data layer: Global Firepower Index; conflict pair identification
  - Ceasefire broken between Armenia and Azerbaijan
  - Heightened tensions between Saudi Arabia and Qatar
  - Tensions between the US and North Korea seem to have cooled down substantially

- **Terrorism**
  - Data layer: Global Terrorism Index
  - Terrorist cells increasingly fragmented giving rise to ‘lone-wolf’ attacks, but potential for large-scale attacks still remain
    - **Syria/Iraq**: ISIS caliphate continues to be eroded through military coalition
    - **Philippines, Malaysia, Indonesia**: Increased presence of ISIS
    - Incidences in **Egypt** (300 killed in November) and **Turkey** have increased
    - Increase in number of ‘low-tech’ attacks in Western European countries including Finland, Denmark, Sweden, Germany, France but counter-terrorism efforts are still strong and interdicts most plots
    - **Myanmar**: Divisive ethnic tensions especially between Muslims and Buddhists. Possibility of IS and other extremist groups exploiting refugee crisis.
Geopolitical Risks – Social Unrest, Civil Conflict

- **Social Unrest**
  - Data Layer: Economist Intelligence Unit’s Social Unrest Index
  - **United States**: experiencing heightened social/racial tensions and increased polarization following Trump election; social media bias playing a role
  - Protests in **Venezuela** and **Iran**
  - **Greece** and **Egypt**: showing signs of stabilization
  - Increasing social unrest in **India** about ethnic, caste and religious issues, labour and employment, and minority and women's rights

- **Civil Conflict (previously Separatism)**
  - Data Layer: Global Internal Violent Conflict Risk Index
  - **Myanmar**: Divisive ethnic tensions have increased significantly in Rakhine state. Over 600,000 Rohingya displaced.
  - Increased separatist activity seen in Kashmir, **India** that has lead to Indian military interventions in 2017
2017 to 2018

GRI 2018
GDP 2018: $35.4 trn
GDP@Risk: $546 bn
%GDP@Risk: 1.54%

Δ GDP@Risk: +6.0%
Δ Resilience: -2.0%
Δ GDP: +3.1%
Δ Risk: +4.9%

GDP@Risk from 2017
Increase in risk from 2017 to 2018
Increasing Resilience

- If all cities increased their resilience by one ranking, GDP@Risk decreases by $38bn to $508bn, a 6.9% reduction in expected loss.

**Asia**
- $20bn reduction from resilience
- $9bn reduction from natural catastrophe risks
  - Shanghai: -17.6%, $1.49bn
  - Taipei: -14.4%, $1.85bn
  - Manila: -12.7%, $1.69bn

**Middle East and Africa**
- 10.6% reduction from increasing resilience
  - Of which 13% comes from geopolitical risks

**North America and Europe**
- Resilience is relatively high
- Largest threats have short term impact to GDP
Lloyd’s City Risk Index 2018

- Launch at Lloyd’s on 6 June
  - Lloyd’s CRI interactive website
  - Viewpoints blog related to the launch
  - Executive Summary of the 2018 Index is available here
Future Work

- Global City Risk Index 2019
  - We will continue to maintain this index with an update this fall
  - Planned updates include:
    - Update 2019+ GDP predictions
    - Complete annual threat review and forecast
    - Improve cyber threat model
    - Improve market crash threat model
    - Refine analysis of climate change trend risk

- Save the date for Global Risk Index 2019 Launch in Dec 2018