



Cambridge Global Risk Index 2017
5 December 2016

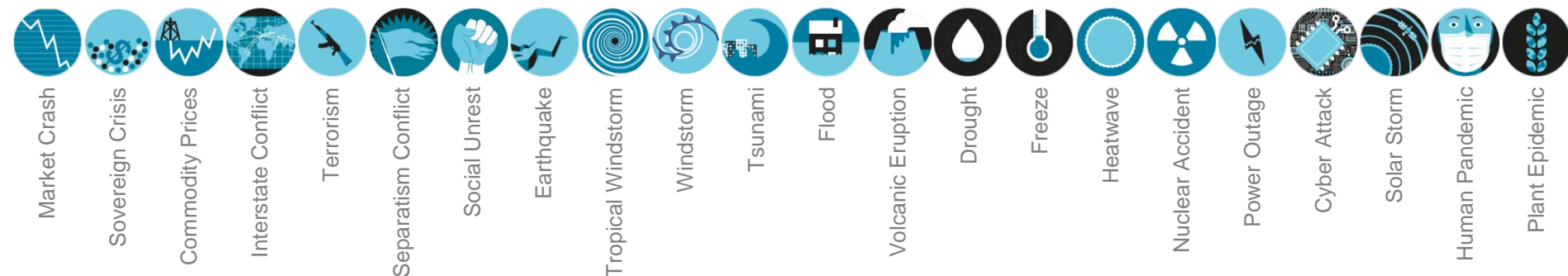
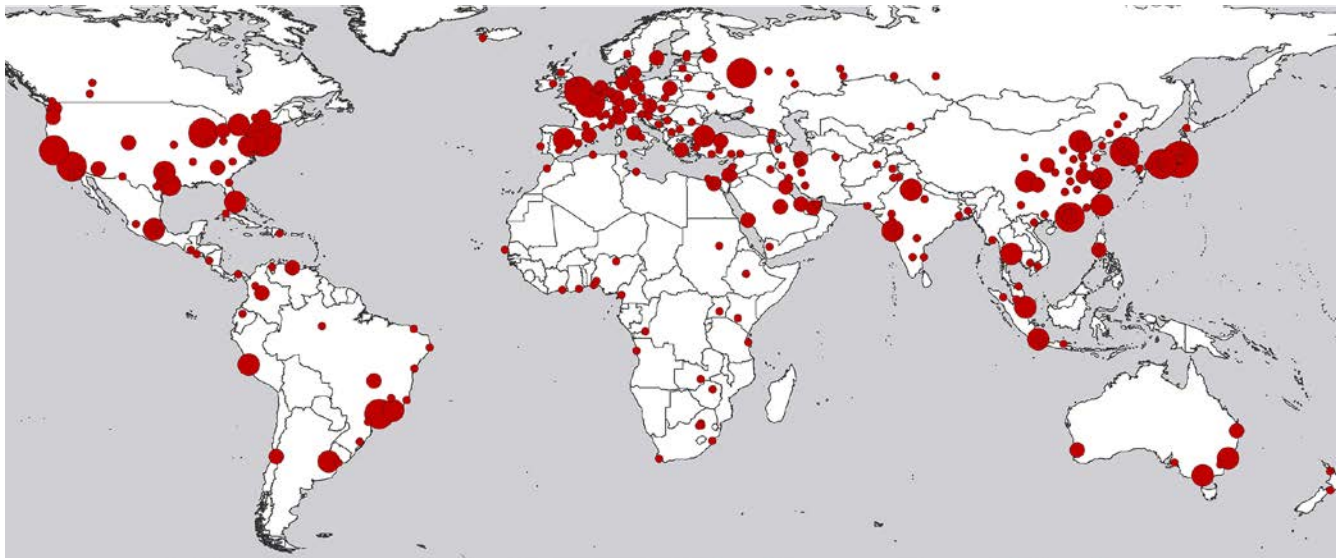
2017 Global Risk Index

Centre for
Risk Studies

 **UNIVERSITY OF
CAMBRIDGE**
Judge Business School

Dr Andrew Coburn
*Director of Advisory Board
Cambridge Centre for Risk Studies
and
Senior Vice President, RMS, Inc.*

Cambridge Global Risk Index



300 Cities

22 Threats

\$1.17 Trillion of GDP@Risk a year

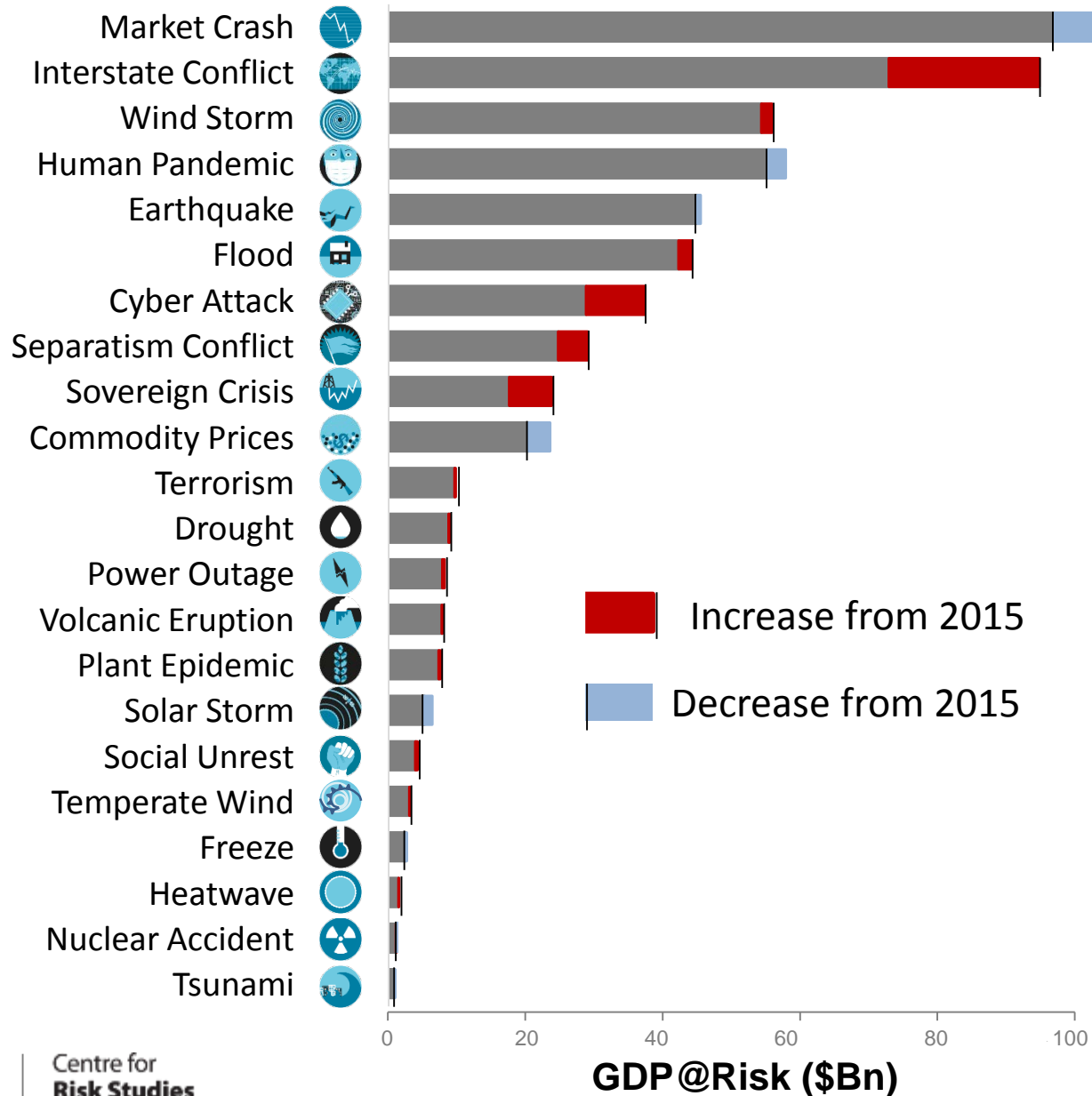
Global Risk is Increasing

- The risk of major catastrophic events to the world's economy is increasing
 - Cambridge Global Risk Index is an annual expected loss from 22 causes of shocks to the economies of 300 leading cities accounting for half of world GDP
- Our 10 year baseline GDP@Risk is **1.48% of economic output** consumed by these shocks

We are adding a short-term outlook to the risk analysis:

- Over the next three years we expect the risk to be **elevated to 1.51%** of annual GDP
- For 2017, with a global GDP of \$78 Trillion, the expected loss is **\$1.17 Trillion**
- But the risk picture by threat is more complicated

2017 Risk Index: Update by Threat



Post-Globalization: The Resurgence of Nationalism

- Overall context of western political change
- VoxPop protest votes
- Rising international tensions and increasing militarism
- Refocus on nationalist interests
- Potential weakening of international alliances and trading agreements



What's New on the Risk Landscape?

Geopolitical & Security Risks



Interstate Conflict

- Russian expansionism and intervention into the Syrian conflict has escalated tensions



Terrorism

- Chinese nationalism in Pacific: tensions with regional neighbours
- Other regional tensions
 - Middle East
 - India subcontinent



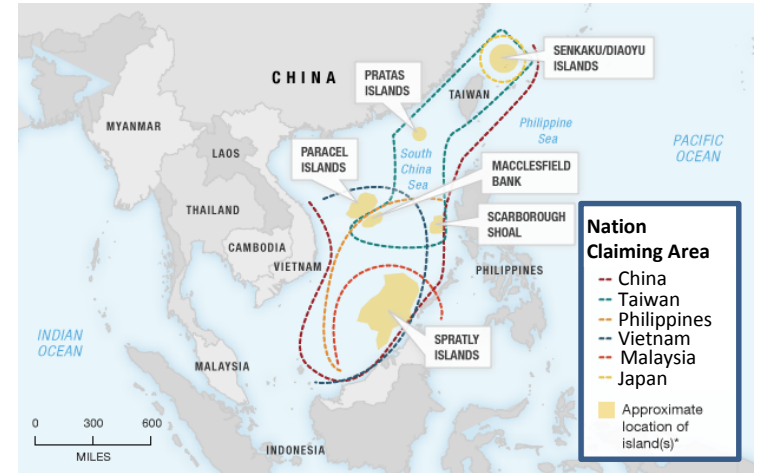
Separatism Conflict

- Terrorism activity in mainland Europe
 - Increased activity but micro attacks
 - Potential for much larger attacks



Social Unrest

- Syria/Iraq/Libya ISIS caliphate being eroded through military coalition
- Localized social unrest incidents
 - US civil rights riots
 - China political protests



Turkey downs Russian fighter jet

Moscow says plane was inside Syrian airspace. 1 pilot dead, 1 missing

Sukhoi Su-24

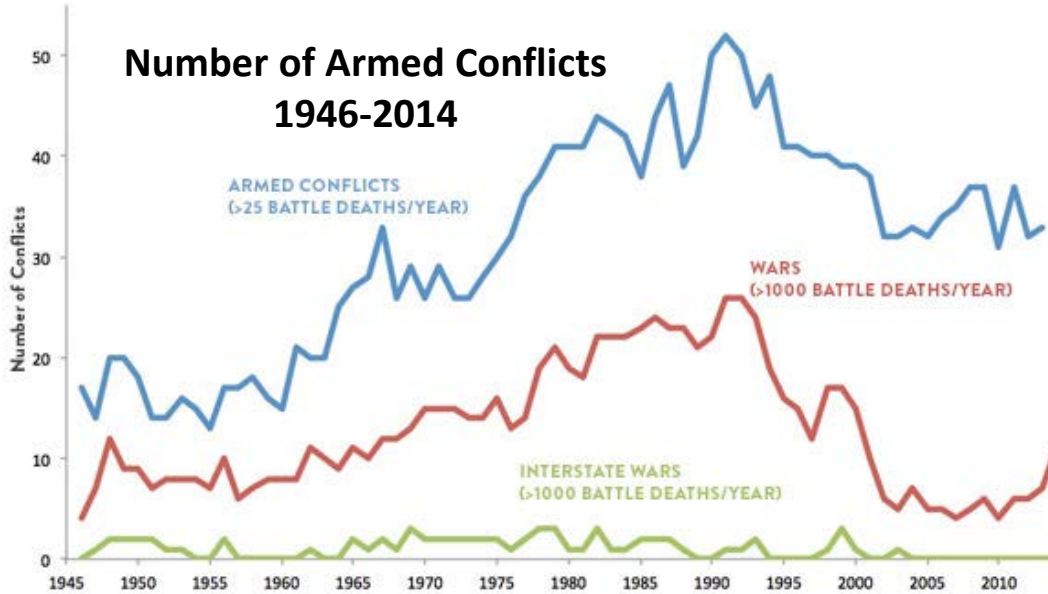
Swing-wing fighter bomber

- First flight: 1975
- Maximum speed: 1,550 kph
- Wingspan: 10.36 to 17.64 m
- Length: 24.6 m
- Height: 6.19 m
- Range: 2,500 km



The Long Peace

Source: Uppsala Data Conflict Programme/
Peace Research Institute Oslo Armed Conflict Dataset



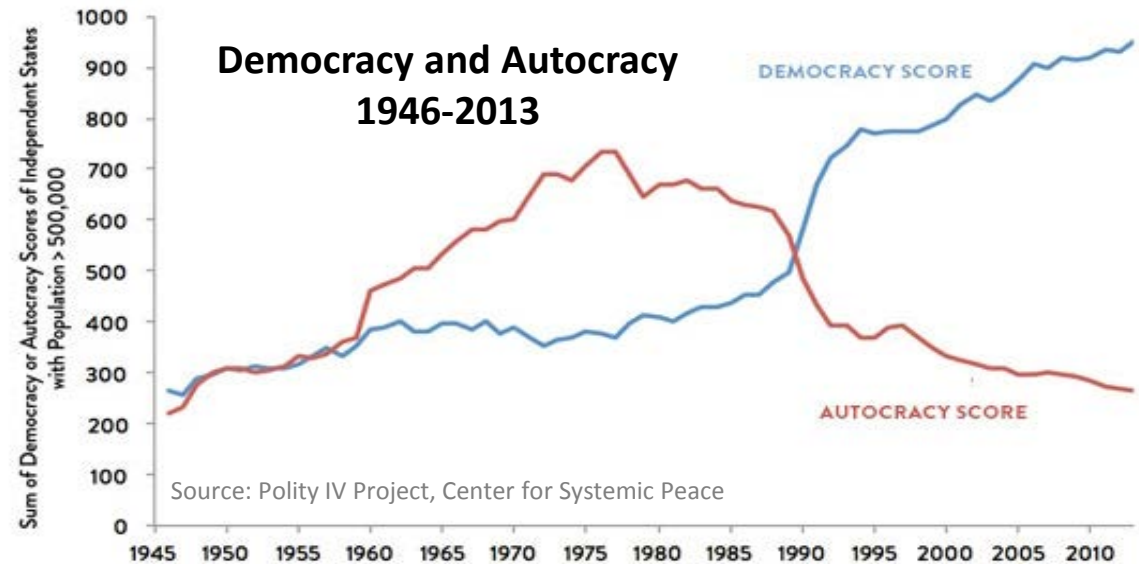
Number of conflicts since 1947

Conflict Level	Between	Number
1	Minor Powers	20
2	Medium and Minor Powers	23
3	Two Medium Powers	4
4	Superpower-Minor Power	9
5	Superpower-Medium/Major	2
6	Superpower-Superpower	0
		58

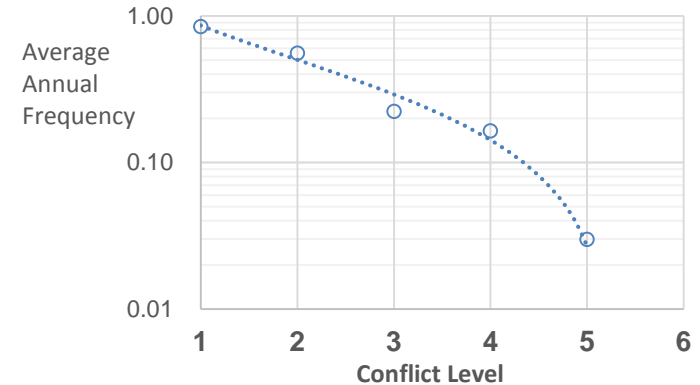
Nations of the world classified into military power class



using military statistics on globalfirepower.com

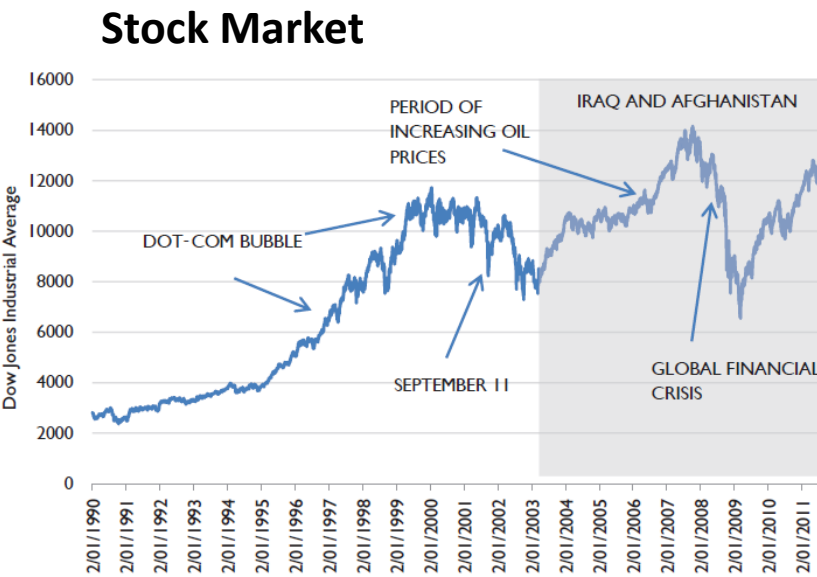
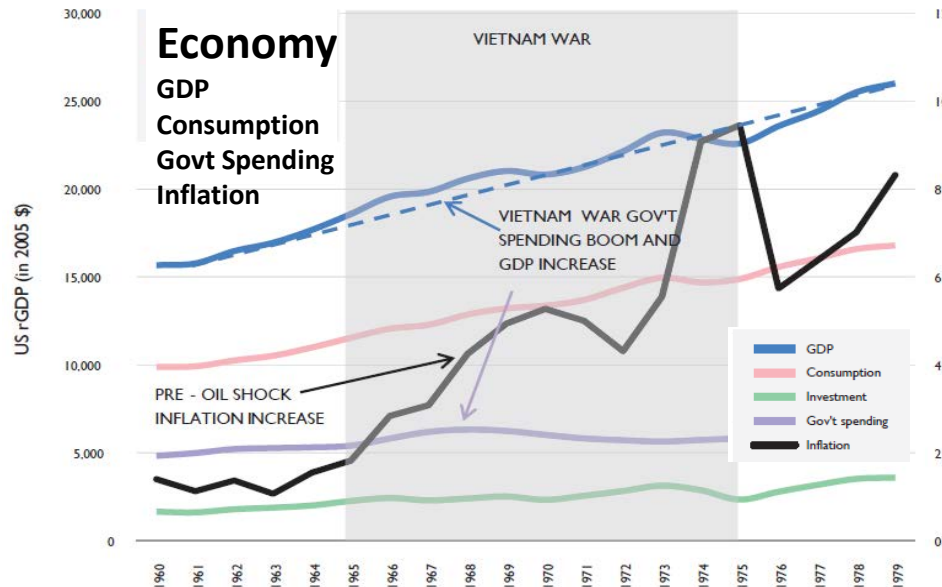
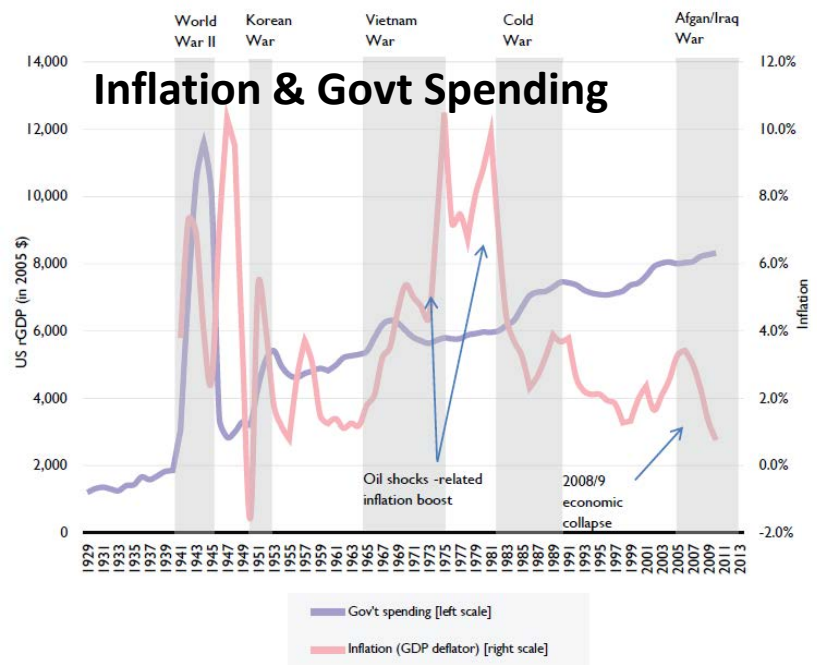
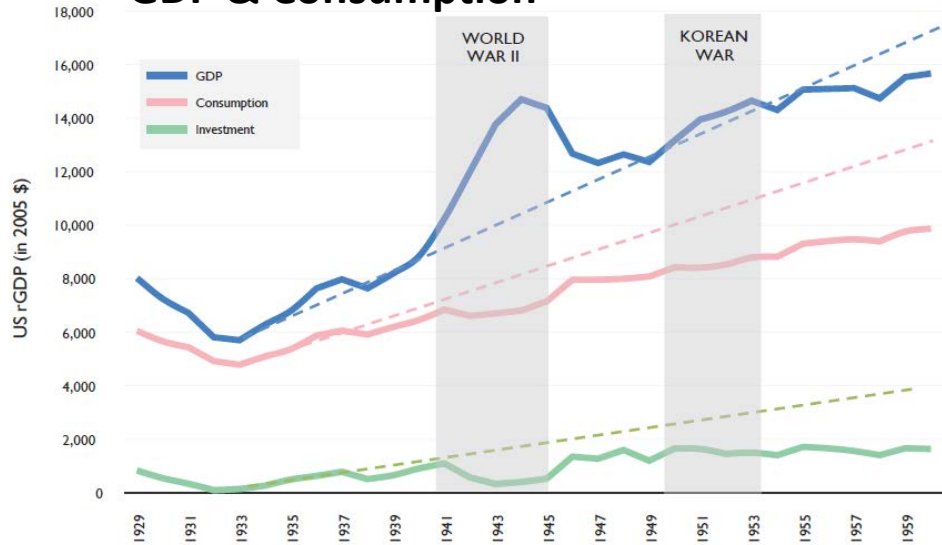


Baseline annual frequency of conflicts worldwide



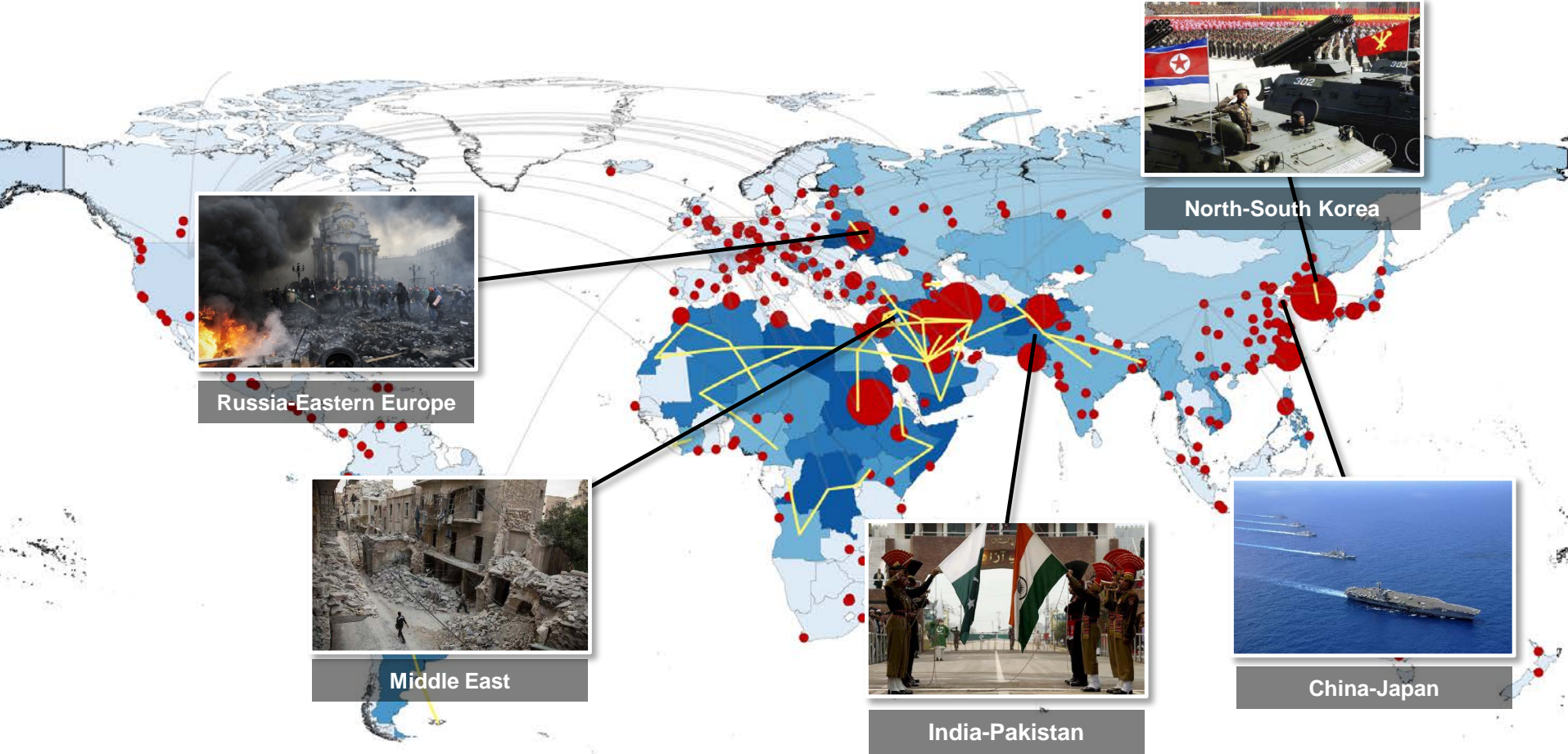
Macroeconomic Effects of Wars

GDP & Consumption





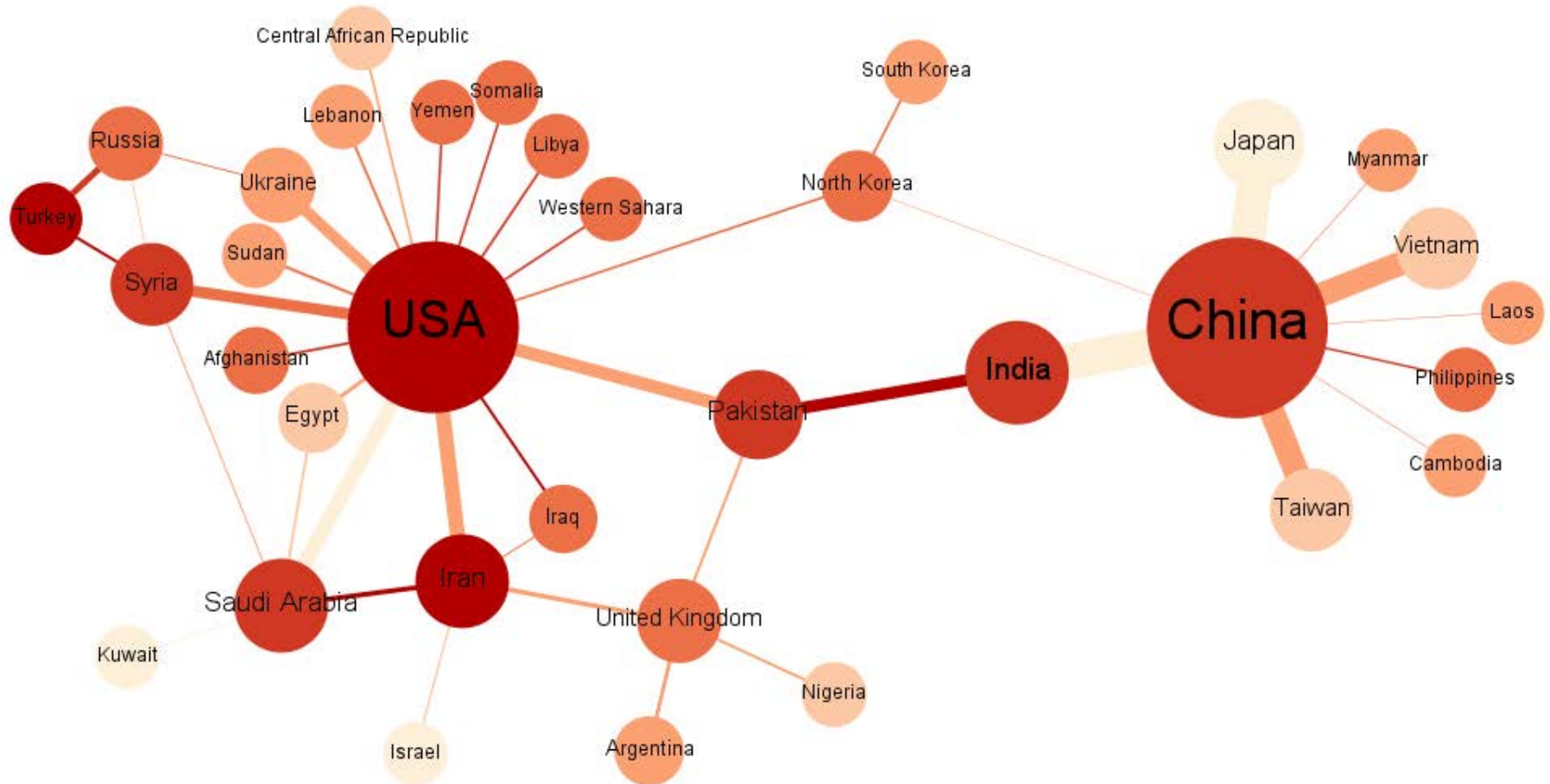
Interstate Conflict Landscape



120 scenarios of potential bilateral conflicts

Identified through diplomatic protest; military skirmish; historical conflict; political posturing

Interstate Conflict - Level 4 Scenario Permutations



Cyber as a New Factor in Interstate Antagonism



JOSE A. BERNAT BACET/GETTY IMAGES

Saudi Arabia Blames Iran For Serious Cyber Attacks

By Julianne Geiger - Dec 02, 2016, 5:48 PM CST



Exclusive / MI5 chief warns of growing Russian threat to UK

• Moscow 'using cyber-warfare' against targets across Europe
• 'About 2,000' violent Islamic in Britain
• 'The first serving spy newspaper interview'

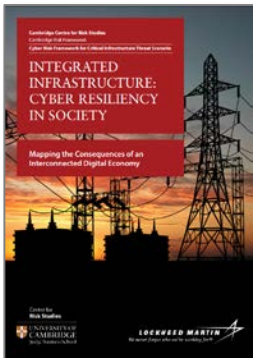


NEWS / WORLD

Did Russia Really Hack the DNC to Support Trump?

The response from Clinton's staff pins blame squarely on Moscow – and on Trump. But some experts have doubts.

By Paul D. Shinkman | Senior National Security Writer July 25, 2016, at 7:39 p.m.



CCRS publications on cyber attacks on CNI

Latest Videos

What's New on the Risk Landscape?

Financial, Economic & Trade Risks

Overarching trend of VoxPop political protest against establishment, wealth inequality, and anti-globalization



Market Crash

Asset Bubble Risk

- Property bubbles continue to build
- Debt reaches record of \$152 Tr Oct 2016
- Zero Interest Rate Policy: 'Everything' Bubble'

Banking Crisis Risk

- Basel III progress – close to TLAC
- Italian banking crisis
- Central banks less likely to bail out

Sovereign Crisis Risk

- BREXIT UK Rating Downgrade
- Continuing Eurozone strain
- Could US opt for default?



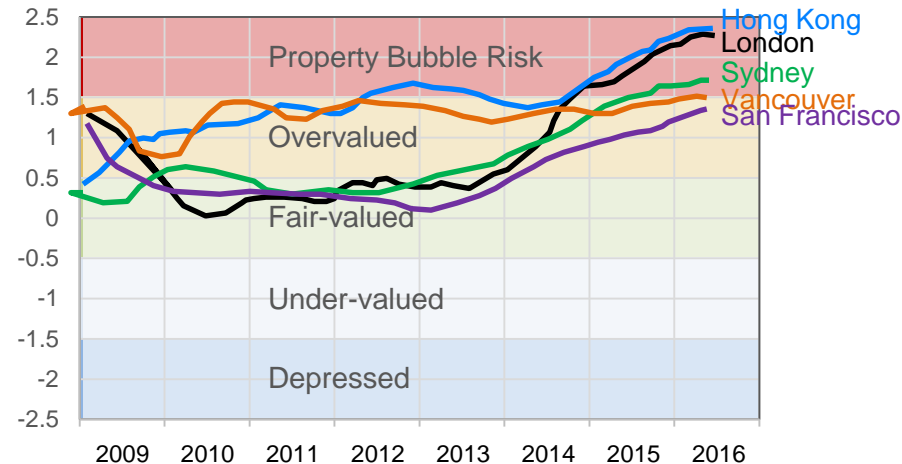
Sovereign Crisis



Commodity Prices

Price Shock Risk

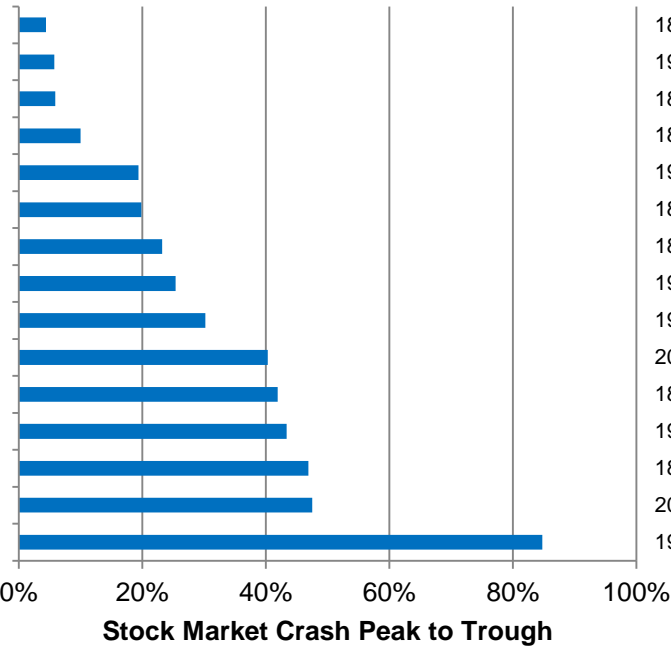
- China slump
- Oil price collapse
- Commodity pricing slump
- Food price volatility



Historical Stock Market Crashes



US Stock Market Crashes Worst events last 200 years



- 1845 Railway Mania...
- 1997 Asian Crisis
- 1866 Collapse of Overend...
- 1825 Latin American Crisis
- 1983 Latin American Debt...
- 1837 Cotton Crisis
- 1857 Railroad Mania...
- 1907 Knickerbocker
- 1987 Black Monday
- 2001 Dotcom
- 1893 Baring Bank Crisis
- 1973 Oil Crisis
- 1873 Long Depression
- 2008 Great Financial Crisis
- 1929 Wall Street Crash

Current world according to market equity capitalization

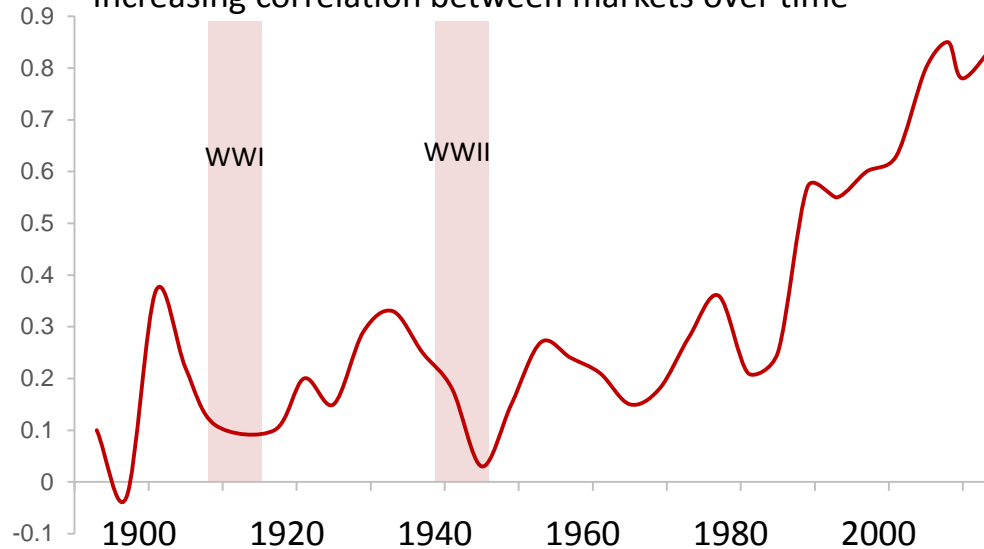


Source: Mapping Worlds; Bloomberg

Observed, last 200 years

Crashes Greater Than	Number of Crises	Average Interval (Yrs)
10%	12	16
20%	9	21
40%	6	32
50%	1	190

Increasing correlation between markets over time



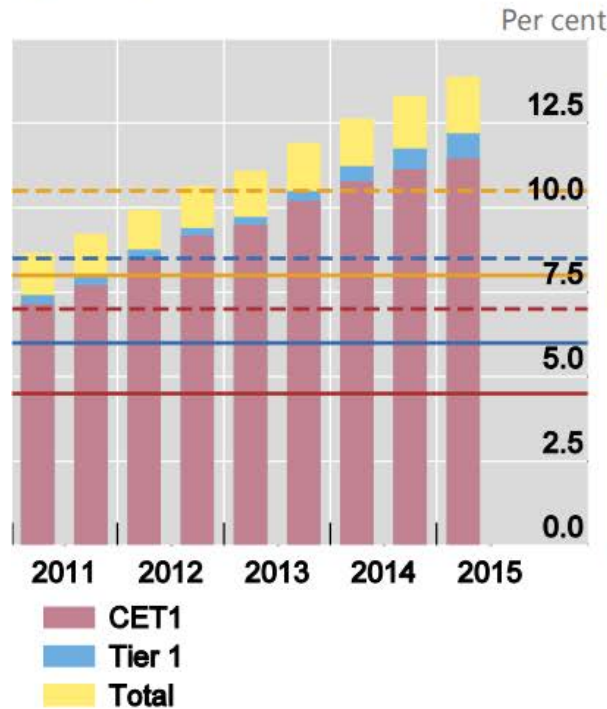
Source: Quinn & Voth, 'A Century of Global Equity Market Correlations'

The Improving Resilience of Banks

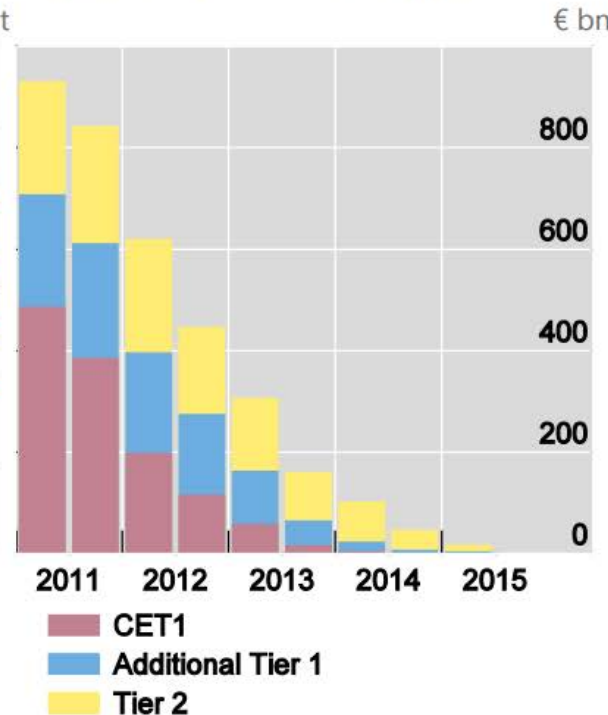
Average Basel III capital ratios, capital shortfall and leverage ratios

Fully phased-in Basel III, samples of large internationally active banks¹

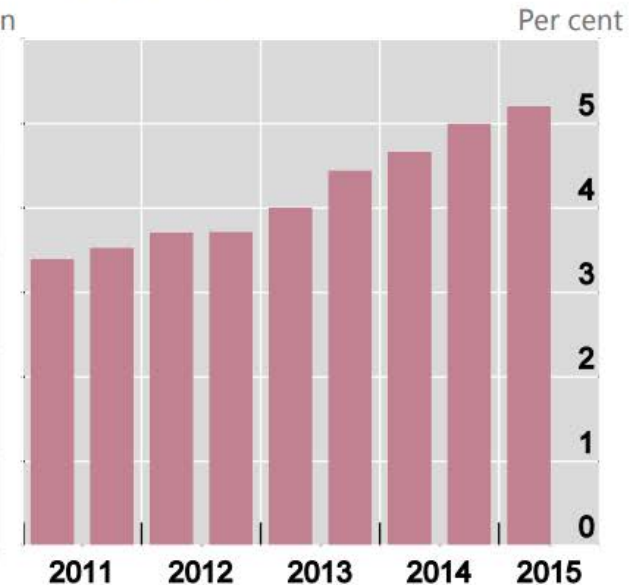
Capital ratio²



Capital shortfall at the target level³



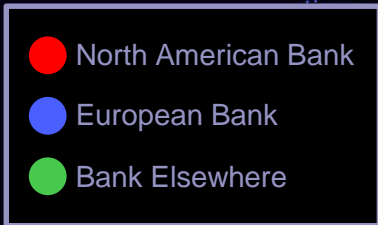
Leverage ratio⁴



- TLAC (Total Loss Absorbing Capacity) of G-SIBs is near completion
- But eight large US banks downgraded by S&P Dec 2015 because now less likely that Federal Reserve will bail them out if they get into difficulties

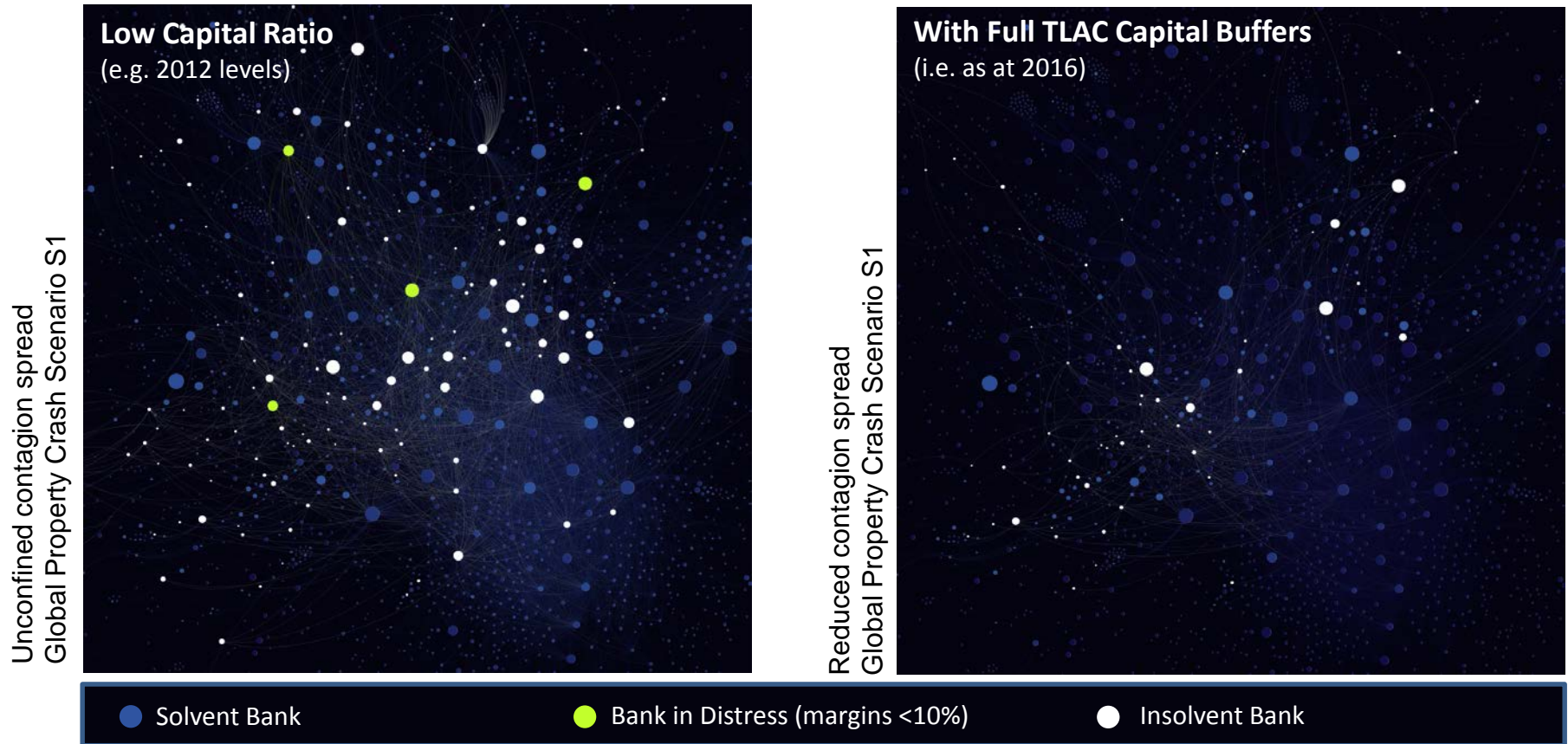
Centre for Risk Studies Network Model of Financial System

- 18,516 banks
 - Total market value of **\$214 Trillion**
 - Estimated interbank lending patterns
- Balance sheet (Capital Ratio) of each bank represented
- Used to model probability of bank distress with financial crisis contagion



Centre for
Risk Studies

How Adding Capital Reduces Contagion Risk



Simulated Financial Crisis: Global Property Crash Scenario Variant S1

- The capital buffer reduces the threshold at which contagion is transmitted to the next institution
- Asset fire-sales are reduced - acts as a virtual circle in limiting the cascade of crisis
- With minor shocks it can prevent a crisis occurring
- With major shocks it has a non-linear damping effect on contagion

What's New on the Risk Landscape?

Technology & Space



Cyber attack

- Cyber attack severities are increasing
- Major recent cyber hacks have consistently broken previous records
 - Largest ever data exfiltration attacks (Yahoo 500m records and Mossack Fonseca 2.6 Tbytes)
 - Largest known attempted cyber bank theft (Lazarus SWIFT \$1Bn attempt)
 - Largest Denial of Service attacks: 1,000 Gbps
 - Shadowbroker hack released NSA cyber weaponry to public



Solar storm

- 2016 saw a cyber attack on Ukrainian power grid cause outage to 225,000
- Cyber security is also increasing in response



Power outage

- Worldwide spending on cybersecurity products and services projected to exceed \$1 trillion over next 5 yrs



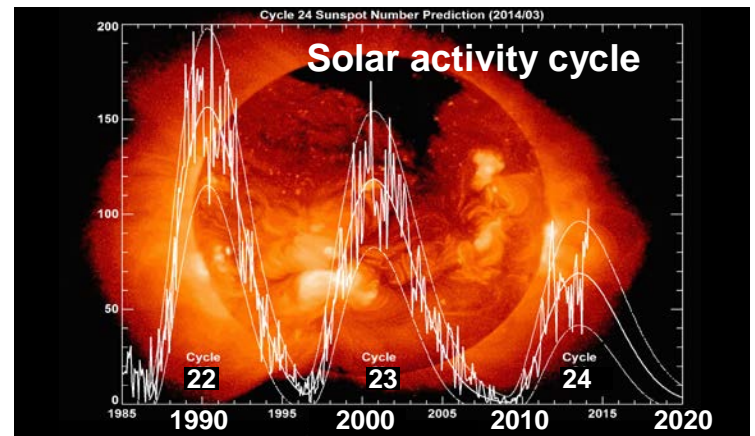
Nuclear accident

- Solar storm has been a major subject of CCRS study in 2015/16 with the release of Helios Solar Storm report
 - Solar cycle may not be a good indicator of threat of CME but we are currently in declining phase of cycle 24 of solar activity
- Nuclear risk diminishing as 3 nuclear plants decommissioned last year



Cyber attack on Ukrainian power grid cut power to 225,000 people; Dec 2015

ShadowBroker cyber hack released NSA exploits to public; Aug 2016



What's New on the Risk Landscape?

Natural Catastrophe & Climate



Earthquake



Tropical Windstorm



Tsunami



Flood



Volcanic eruption



Drought

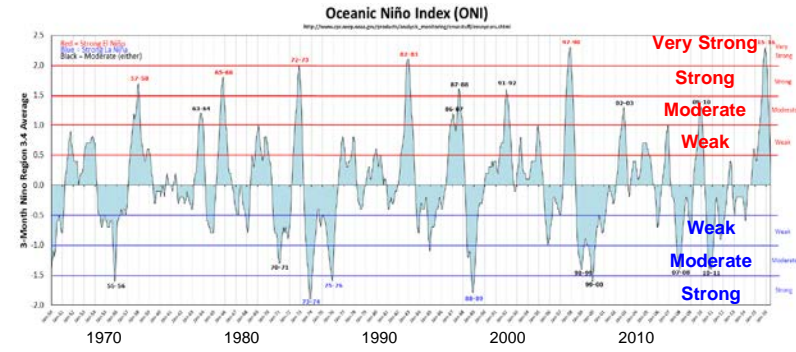


Freeze

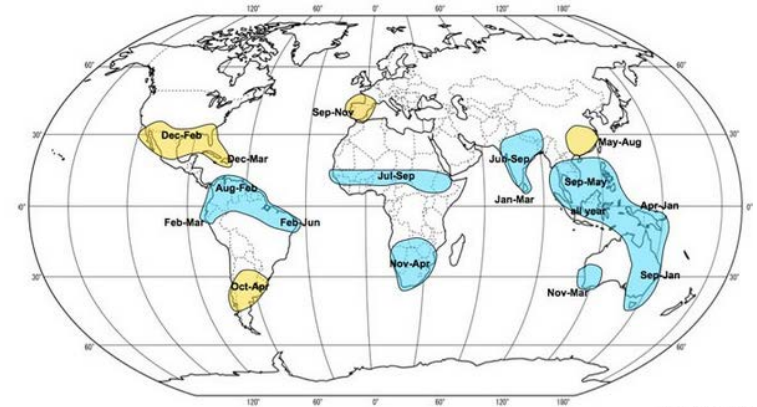


Heatwave

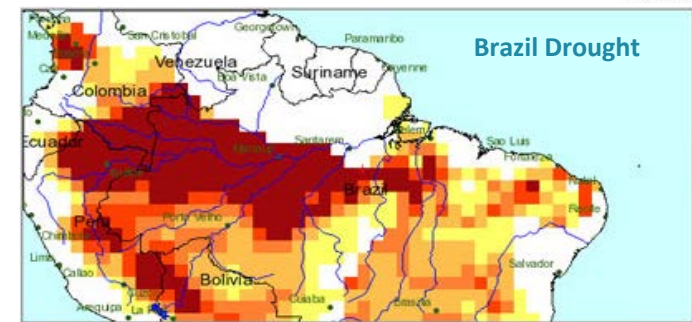
- Natural catastrophe events are not significantly more likely over the next three years than the longer term 10 year outlook
- Meteorological and climatic events may be influenced by La Nina phase of ONI next 3 years
- Past couple of years has had a lower than usual incidence of natural catastrophe events
- But some noteworthy events
 - 2014 super-typhoons in Pacific basin
 - 2016 Italy earthquake
 - 2015 Nepal earthquake (9,000 dead)
 - Air traffic disruption from eruption of Mt Sinabung, Indonesia June 2015
 - Drought continues in West Coast US
 - Severe drought ongoing in Brazil
- Very large NatCat events are a current focus of research ('Trillion Dollar' scenarios)



Met Office La Niña precipitation impact



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Drought Severity: Minor Drought, Moderate Drought, Severe Drought, Extreme Drought, Exceptional Drought

What's New on the Risk Landscape?

Health & Humanity

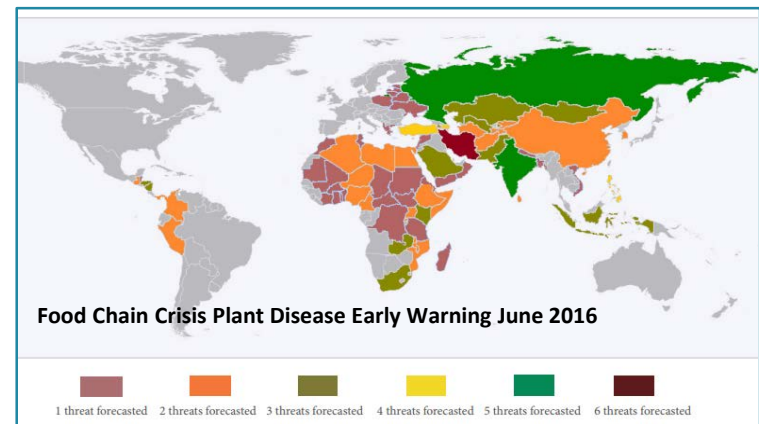
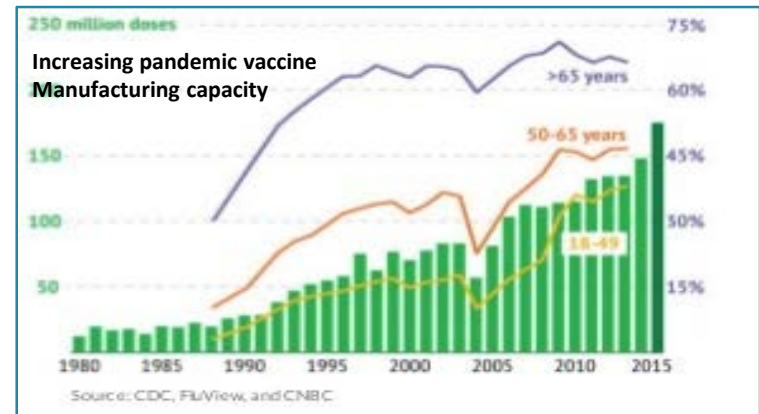
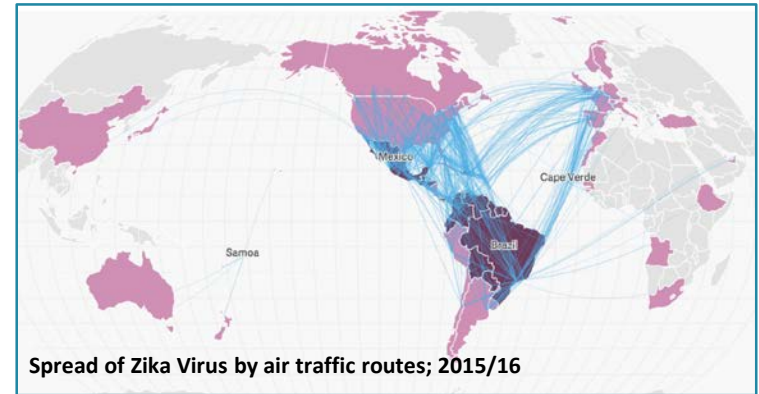


Human pandemic

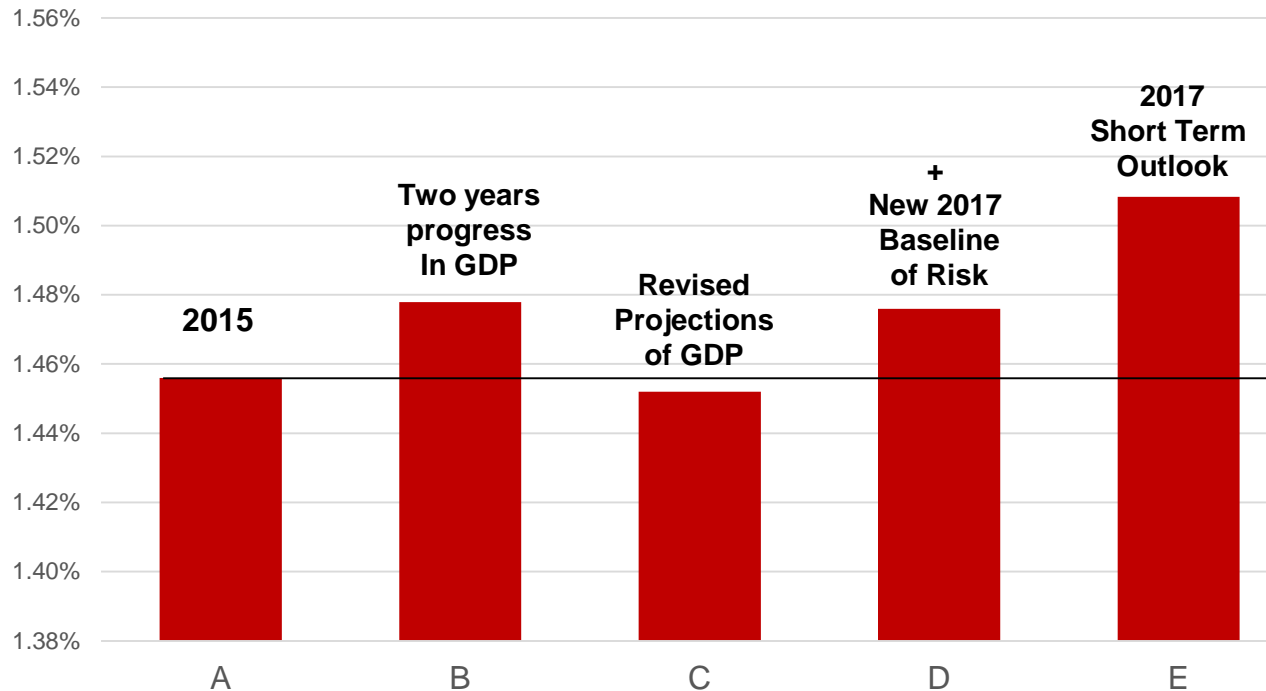
- Recent epidemics that have disrupted economies include:
 - Zika Virus
 - Ebola epidemic has dissipated – now endemic
 - MERS
- Primary healthcare surveillance increased in areas of emergent disease
- Vaccine manufacturing capacity has increased for pandemic influenza
 - Influenza is one of the main drivers of global pandemic risk
 - Increased vaccine capacity means that future pandemics will have less economic impact
- CEPI, the Coalition for Epidemic Preparedness Innovations launched in Aug 2016
 - Intended to reduce the time to vaccine of future emerging infectious diseases
- Plant diseases in coffee, wheat and bananas are forecast to have food security implications for 2016



Plant epidemic

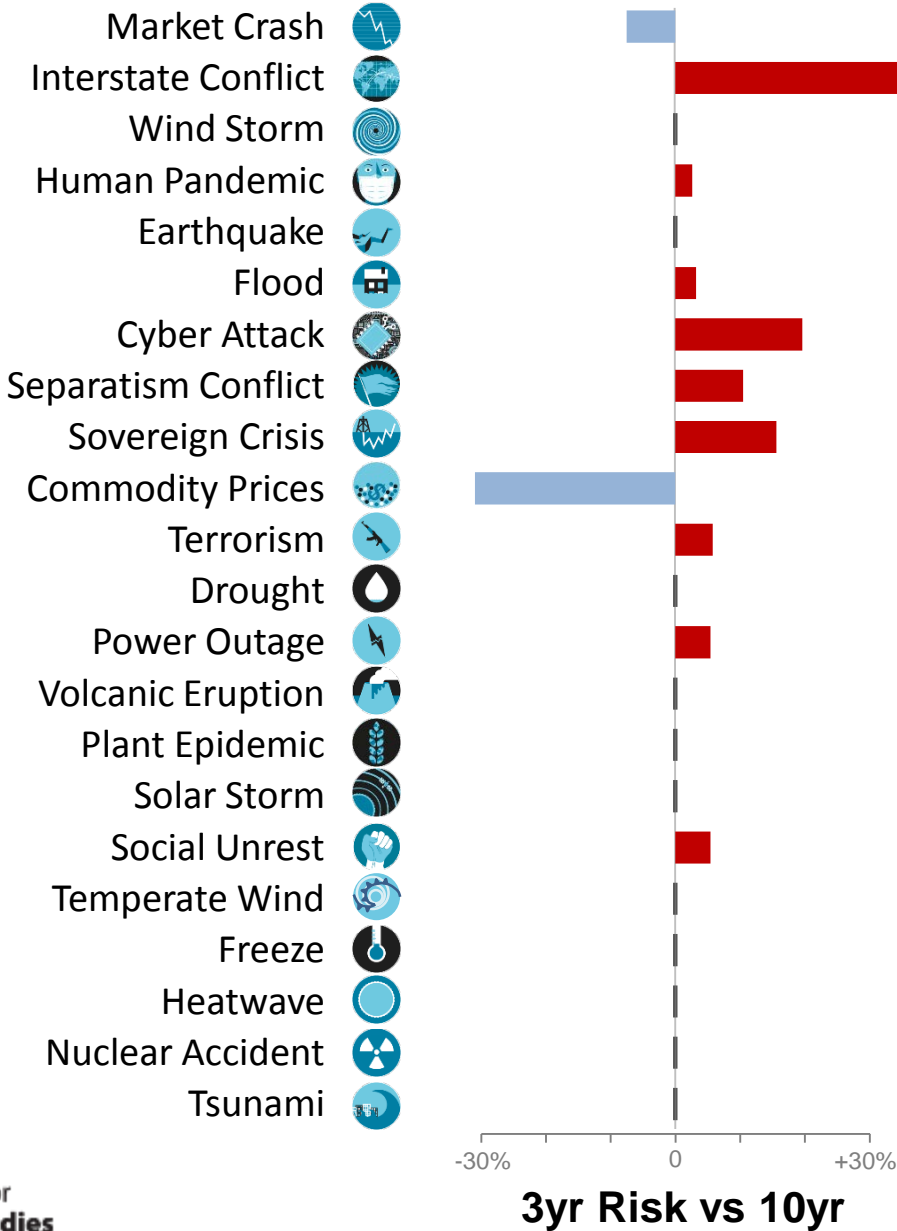


Drivers of Change in 2017 Risk Index



	A	B	C	D	E
Risk View:	2015	2015	2015	2017 Long Term Baseline	2017 Short Term Outlook
GDP Projections	2014 GDP Projections	2014 GDP Projections	2016 GDP Projections	2016 GDP Projections	2016 GDP Projections
Outlook	2015-2024 10 Yr Outlook	2017-2026 10 Yr Outlook	2017-2026 10 Yr Outlook	2017-2026 10 Yr Outlook	2017-2019 3 Yr Outlook
Expected Loss (Average Annual)	542.45	600.42	544.49	553.48	539.97
Annual Global GDP (Average)	37,256	40,627	37,499	37,499	35,799
% of GDP	1.456%	1.478%	1.452%	1.476%	1.508%
Expected Loss Change on 2015		11%	0.4%	2.0%	-0.5%
% of GDP Change on 2015		1.5%	-0.3%	1.4%	3.6%

2017 Short Term Risk Outlook Over Long Term Baseline



2017 City Rankings – Total GDP@Risk

2017 Rank	City Name	GDP@Risk (\$US Bn)	Change in Rank from Baseline	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%

3yr Risk Outlook

2017 Risk Drivers: Selected Cities in Top 30

Rank [Total GDP at Risk]	1	5	9	25
CRS City ID	TWN_5155	TUR_IST	USA_NYO	GBR_LON
City Name	Taipei	Istanbul	New York	London
CRS Country ID	TWN	TUR	USA	GBR
Country Name	Taiwan	Turkey	United States	United Kingdom
Earthquake	14.79%	22.91%	0.05%	0.00%
Volcanic Eruption	3.51%	0.00%	0.00%	0.00%
Wind Storm	40.74%	0.00%	0.00%	0.00%
Temperate Wind Storm	0.00%	0.00%	3.26%	2.12%
Flooding	5.55%	4.55%	14.75%	19.05%
Tsunami	0.00%	0.00%	0.00%	0.00%
Drought	0.39%	1.54%	0.00%	5.35%
Freeze	0.00%	0.00%	2.57%	1.03%
Heatwave	0.00%	0.18%	1.31%	0.52%
Market Crash	13.23%	6.49%	25.80%	25.11%
Sovereign Crisis	0.13%	9.70%	0.69%	0.68%
Commodity Prices	1.95%	3.82%	8.63%	8.41%
Interstate Conflict	11.58%	25.70%	0.71%	0.69%
Separatist Conflict	0.00%	10.05%	0.00%	0.00%
Terrorism	0.00%	1.68%	0.65%	1.11%
Social Unrest	0.08%	2.94%	0.46%	0.45%
Power Outage	0.65%	0.96%	1.92%	1.87%
Cyber Attack	3.36%	2.36%	20.07%	19.54%
Solar Storm	0.00%	0.08%	7.57%	3.99%
Nuclear Accident	0.29%	0.00%	1.56%	0.23%
Human Pandemic	3.45%	6.64%	8.80%	8.99%
Plant Epidemic	0.29%	0.40%	1.19%	0.85%
Expected Loss				
Annual GDP@Risk \$Bn	20.57	12.06	9.23	5.46

Change in Risk in Istanbul

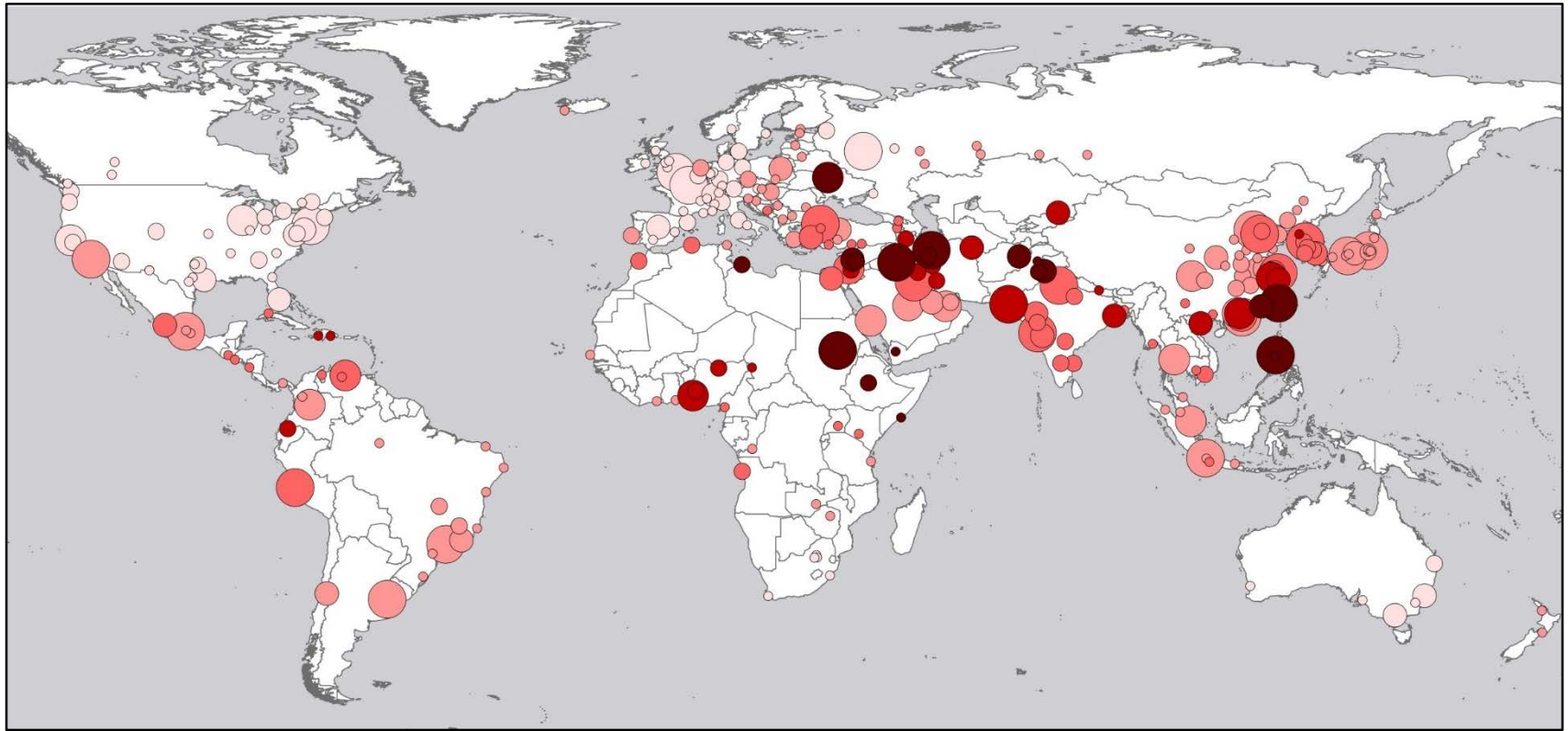
Rank [Total GDP at Risk]		6		5		
	CRS City ID	TUR_IST		TUR_IST		
	City Name	Istanbul		Istanbul		
	CRS Country ID	TUR		TUR		
	Country Name	Turkey		Turkey		
	2015		2017			
Earthquake		28.43%	3.00		22.91%	3.00
Volcanic Eruption		0.00%	-		0.00%	-
Wind Storm		0.00%	-		0.00%	-
Temperate Wind Storm		0.00%	-		0.00%	-
Flooding		5.17%	0.55		4.55%	0.55
Tsunami		0.00%	-		0.00%	-
Drought		1.82%	0.19		1.54%	0.19
Freeze		0.00%	-		0.00%	-
Heatwave		0.21%	0.02		0.18%	0.02
Market Crash		8.07%	0.85		6.49%	0.78
Sovereign Crisis		10.22%	1.08		9.70%	1.33
Commodity Prices		9.03%	0.95		3.82%	0.46
Interstate Conflict		12.78%	1.35		25.70%	3.10
Separatist Conflict		5.83%	0.62		10.05%	1.21
Terrorism		1.94%	0.21		1.68%	0.45
Social Unrest		3.31%	0.35		2.94%	0.40
Power Outage		1.08%	0.11		0.96%	0.15
Cyber Attack		2.18%	0.23		2.36%	0.28
Solar Storm		0.77%	0.08		0.08%	0.01
Nuclear Accident		0.00%	-		0.00%	-
Human Pandemic		8.68%	0.92		6.64%	0.80
Plant Epidemic		0.47%	0.05		0.40%	0.05
Expected Loss						
Annual GDP@Risk \$Bn		10.57		12.06		

Change in Risk in London

Rank [Total GDP at Risk]	19	25		
CRS City ID	GBR_LON	GBR_LON		
City Name	London	London		
CRS Country ID	GBR	GBR		
Country Name	United Kingdom	United Kingdom		
	Baseline	Short Term		
Earthquake	0.00%	0.00%	-	0%
Volcanic Eruption	0.00%	0.00%	-	0%
Wind Storm	0.00%	0.00%	-	0%
Temperate Wind Storm	2.10%	2.12%	-	0%
Flooding	18.34%	19.05%	0.30	-59%
Tsunami	0.00%	0.00%	-	0%
Drought	5.30%	5.35%	-	0%
Freeze	1.02%	1.03%	-	0%
Heatwave	0.52%	0.52%	-	0%
Market Crash	26.58%	25.11%	- 0.94	188%
Sovereign Crisis	0.58%	0.68%	0.05	-10%
Commodity Prices	11.67%	8.41%	- 1.83	368%
Interstate Conflict	0.52%	0.69%	0.09	-19%
Separatist Conflict	0.00%	0.00%	-	0%
Terrorism	1.10%	1.11%	-	0%
Social Unrest	0.42%	0.45%	0.01	-2%
Power Outage	1.77%	1.87%	0.05	-10%
Cyber Attack	16.38%	19.54%	1.64	-329%
Solar Storm	3.96%	3.99%	-	0%
Nuclear Accident	0.23%	0.23%	-	0%
Human Pandemic	8.66%	8.99%	0.14	-28%
Plant Epidemic	0.84%	0.85%	-	0%
Expected Loss				
Annual GDP@Risk \$Bn	55.05	54.55	- 0.50	100%

Cambridge Global Risk Index 2017

Baseline View of Risk



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

Percentage of 2017 GDP (%)

City GDP@Risk
2017 10yr Risk Outlook (\$Bn)

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

As % of Annual GDP
Using 2017 GDP

- 0 to 1%
- 1% to 2%
- 2% to 3.5%
- 3.5% to 5%
- 5% to 13%

Cambridge Global Risk Index 2017

Baseline Long Term 10yr Risk Outlook

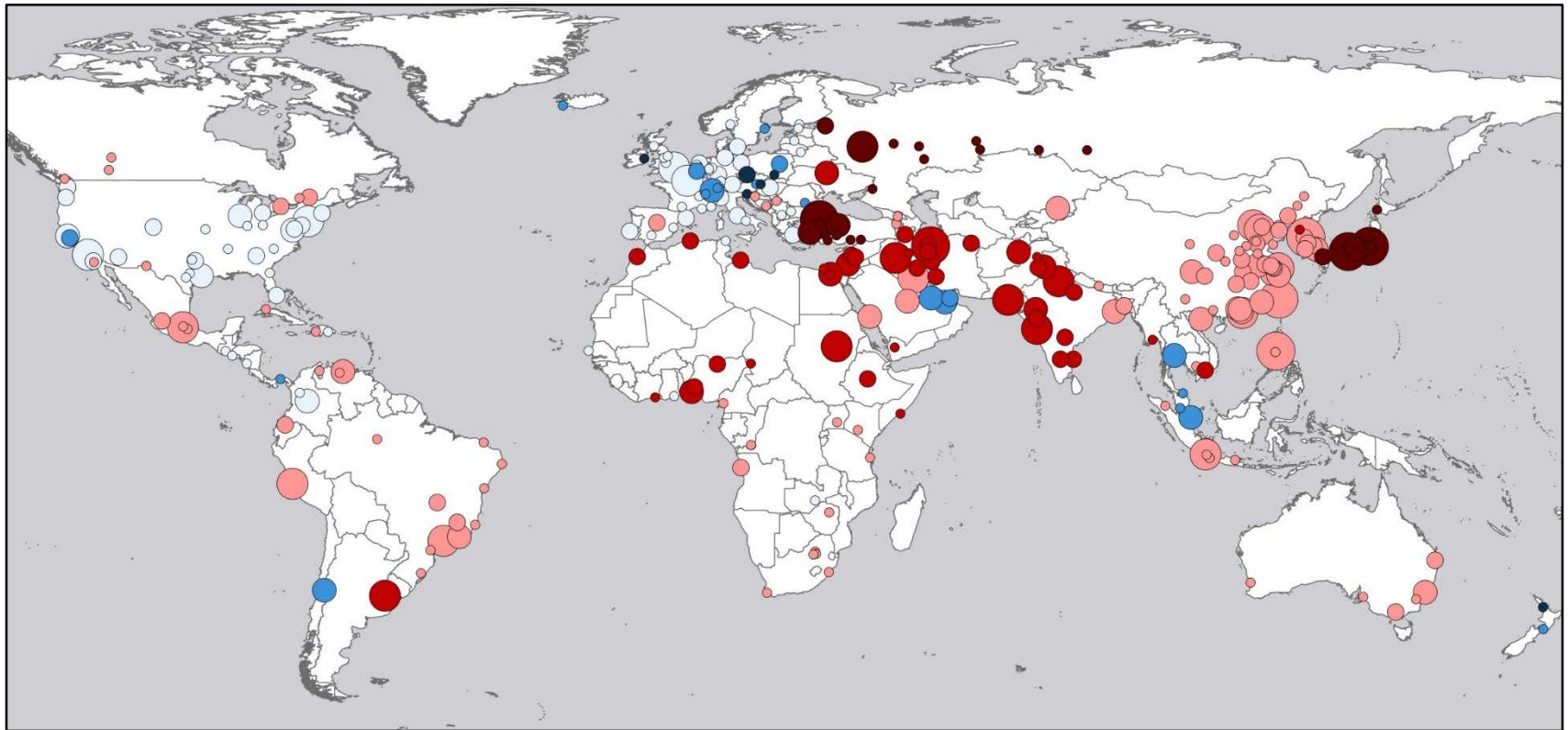
2017 to 2026 10yr Risk Outlook

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

GDP@Risk as a % of city's annual GDP economic output

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Short Term Outlook Relative to Baseline Risk



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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.

Variation in 2017 Risk Outlook in short term relative to the longer term baseline view of risk, comparing 3yr Risk Outlook to 10 yr Risk Outlook

Conclusions

- We provide an objective, quantified index of risk
- The metric provides useful relativities between
 - Locations: “Where might my business operations suffer disruptions?”
 - Threats: “What should I be most concerned to protect against?”
 - Timelines: “How might my business plan be impacted?”
- Our analysis provides a long-term baseline view of economic shock risk as a 10-year outlook
 - an average of **1.48%** of global GDP lost each year
- Our shorter term risk outlook for the **next 3 years** suggests that risk will be **elevated above baseline**
 - an average of **1.51%** of global GDP lost each year
- Risk is changing as a result of
 - Different exposure (GDP changes)
 - Changes in patterns of threat
 - Changes in the resilience of business activities

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