Cambridge Judge Business School Business Risk from Climate Change

Applications of Climate Science for Business Risk

Dr Andrew Coburn Chief Scientist Cambridge Centre for Risk Studies

#CamClimateRisk

Centre for **Risk Studies**







British Antarctic Survey



Application of AI to the Study of Environmental Risk

Business Risks From Climate Change

Growing awareness and momentum on climate issues driving a societal response and demand for a low carbon future

Extreme Weather and Business Disruption

California wildfires: how bad are they and is the climate crisis linked?

Firefighters across the state are racing to control flames exacerbated by extreme winds. Is this normal?



Attribution and Liability



Social Attitudinal Change



Changes to Investor Sentiment



Radical Changes to Energy Industry

RENEWABLES | OPINION AND REVIEWS The relentless march of renewables 30 Oct 2019 Dave Elliott



nergy mix: renewable energy now supplies over 26% of global electricity.(Courtesy: Shutterstock/Fotoldee

Stakeholder & Regulator Accountability

Firms ignoring climate crisis will go bankrupt, says Mark Carney

Bank of England governor warns of financial collapse linked to climate emergency Top asset managers oversee \$300bn fossil fuel investments Why are asset managers investing in fossil fuel companies?



A Mark Carney, the Bank of England governor, has led efforts to address the dangers global heating poses to the financial sector. Photograph: Leon Neal/Getty Images

Climate-Related Financial Disclosures

- Companies are being asked to make climate-related financial disclosures
 - Within past 2 years, companies with balance sheets totaling \$120 Trillion have supported this initiative
- Less than 10% of companies currently do so
 - Tend to be the early adopter companies
- Non-financial sectors (energy, transport, building and agriculture) led the way initially
 - Banking now overtaken them
- There is no single methodology for doing this
 - There are many different approaches to TCFD disclosures being offered by Advisory Service companies.
- Potential for TCFD to become mandatory
 - Oct 2019 speech by Mark Carney, Governor of Bank of England, gave corporations two years to agree rules for reporting, before regulators impose their own





Business Risk from Climate Change

Business Risk consist of three broad areas:

- Physical Risks Business disruption and damage to assets from extreme weather events
 - One to five year outlook of unexpected extreme weather events
 - Multi-decadal outlook of changed weather patterns and climatic adaptation
- Liability Risks where the business faces costs, penalties, and reputation damage from
 - Activities of the organisation, past and present, that contribute to the causal mechanisms of climate change (for example carbon emissions)
 - Commitments to reduce carbon emissions
- **Transition Risks** where society's response and adaptation towards a low-carbon economy provides opportunities, but also creates disruption to current processes, economies, and asset valuations









Cambridge Global Risk Index - Disruption Threats to Global Economy



- Cambridge Global Risk Index measures multiple threats to the global economy
- Provides an objective measure of risk of shocks to the global economy
- Cities in the index represent 43% of the total global economy
- Developed a standardized metric 'GDP@Risk' to measure risk from widely disparate threats
- 2020 Cambridge Global Risk Index provides the 6th year of insight into changes over time and from different drivers
- We are creating an additional **Climate Change Business Risk Index**





Cambridge Global Risk Index: Risk Susceptible to Climate Change



Economic Losses from Extreme Weather Events

- 11,708 extreme weather events in past 20 years
- Total reported direct costs of \$3.9 Trillion
 - \$195 Billion a year
 - Direct costs are property damage and business activity loss from disruption
- Economic studies suggest that indirect costs could be an additional multiple of direct costs
 - Studies suggest values from 1.5X to over 10X
 - 2X is a reasonable multiple
 - Indirect costs are reduced economic growth during recovery, counterparty loss, infrastructure utility loss
 - Some recovery programmes may provide economic stimulus to offset some of loss
- Observed extreme weather events cause direct and indirect economic loss that averages more than half a Trillion dollars a year





Data Sources: UN; Munich Re; Swiss Re; EM-DAT; Wang (2020)

Extreme Weather as a Trigger for Other Risks to the Global Economy



Where Extreme Weather Events are Most Likely



Changing Likelihood of Heatwaves in Chicago

Heatwave Impact on Business Activities

Reduced Productivity of Employees

Transportation and Infrastructure Failures

Increased Sales in Retail Stores

5

200% Average Temp 190% Baseline Air Conditioning Load 180% Productivity Manual Factory Work Outdoor Manual 170% Thermal Power Plant Output Retail Footfall 160% 150% 140% 130% 120% 110% 100% 90% 80% 70% 60% 50% 10 -5 15 -10 0 5 20

°C Daily Mean Temperature above Seasonal Average

Increased Air Conditioning Loads in Buildings

Overheating in Data Centres

Power Plants Offline

UNIVERSITY OF CAMBRIDGE Judge Business School

Agricultural Yield Reduction with Temperature

For each one degree Celsius increase in average temperature during growing season:

Wheat Yield Reduced

Maize Yield Reduced

UNIVERSITY OF

CAMBRIDGE

Judge Business School

Centre for

Risk Studies

Rice Yield Reduced

Soybean Yield Reduced

Degree-Celsius increase in Mean Temperature Reduction in Crop Yields

Crop	Yield Reduction
Wheat	6.0%
Rice	3.2%
Maize	7.4%
Soybean	3.1%

Cambridge Climate Change Index of Business Risk Change in Heatwave Risk from Climate Change

1979-2018 compared with 2018-2059 Number of Days a Year with Mean Daily Temperature Above **25**°C Prob of Exceedance **10**% Observed weather records vs Climate Model View CMIP5 RC4.5

Change in Number of Days a Year

T Never 0 >200 Exceeded

0 T Always Exceeded Centre for **Risk Studies**

13

Cambridge Climate Change Index of Business Risk

Areas of High Economic Productivity with Increased Heatwave Risk

2 Weeks of Additional Days Above 25°C by 2040 10% chance per year Climate Model View RCP4.5

GDP>\$5 Billion Over 14 days Increase in T>25°C Days per Year

\$56 Trillion of GDP in 2019 i.e. 65% of Gross World Product of \$87 Trillion 2019 Centre for **Risk Studies**

Cities with the Greatest Increases in Heatwave-Triggered Economic Losses

- Total Annualized Heatwave Economic Losses from major cities more than doubles (123% increase)
 - From around \$3 Bn expected each year to over \$6.7 Bn
- Cities may also see localized additional heat loads
 - Heat island effects of urban conurbations
- Business adaptation will need to incorporate this into siting of key facilities with high-cooling needs

2040 Climate Model View RCP4.5

H.

Flood Losses Will Increase Significantly with Climate Change

- Climate change will result in changed patterns of rainfall, increasing the risk of flooding
- Water vapour increases by 7% for every degree of warming. Volume of precipitation is likely to increase by 1-2% per degree of warming
- Regions with high annual rainfall are going to get wetter
- Dry regions of sub-tropics likely to get drier and shift towards poles
 - Europe can expect wetter winters and drier summers, particularly in central and southern Europe
- Heavier rainfall will increase fewer by more intense events – longer dry spells and higher risk of floods.
- Most of the increased risk over next 20 years is driven by riverine and flash flooding from increased precipitation
 - Coastal flood risk will increase more in the longer term
 - Sea level rise projections are fairly modest in next 20 years, assuming no catastrophic collapse of ice shelves
 - Wind speeds and central pressures from storms that cause storm surges could increase risk of coastal flooding
 - But science is still ambivalent about storm intensification

<u>Cities</u>	with greatest increase	in climate-change flood risk	2020	2040	Increase	as%
1	New York	United States	2.53	2.91	0.37	15%
2	Houston	United States	1.50	1.76	0.26	17%
3	Los Angeles	United States	1.55	1.80	0.24	16%
4	Osaka	Japan	1.59	1.79	0.19	12%
5	Chicago	United States	1.01	1.19	0.18	18%
6	Tokyo	Japan	2.56	2.73	0.17	7%
7	Philadelphia	United States	0.85	1.01	0.16	18%
8	Shanghai	China	0.97	1.11	0.14	14%
9	Paris	France	1.19	1.31	0.12	10%
10	Atlanta	United States	0.57	0.69	0.11	20%
11	São Paulo	Brazil	0.61	0.71	0.10	16%
12	Boston	United States	0.84	0.94	0.10	12%
13	Taipei	Taiwan	0.53	0.63	0.10	18%
14	San Francisco	United States	0.76	0.86	0.10	12%
15	Jakarta	Indonesia	0.28	0.37	0.09	33%
16	Bangalore	India	0.17	0.27	0.09	51%
17	Miami	United States	0.51	0.60	0.09	17%
18	Detroit	United States	0.49	0.58	0.08	17%
19	Seoul	South Korea	0.45	0.53	0.08	17%
20	Nagoya	Japan	0.63	0.70	0.07	11%
21	London	United Kingdom	1.73	1.80	0.07	4%
22	Mumbai	India	0.25	0.31	0.06	24%
23	Mexico City	Mexico	0.44	0.50	0.06	12%
24	Beijing	China	0.39	0.45	0.05	13%
25	Guangzhou	China	0.41	0.47	0.05	12%

INIVERSITY OF

CAMBRIDGE Judge Business School

Hurricanes Will Become Wetter – Maybe More Intense

- We expect storm windspeeds to increase with warmer sea surfaces, but no definitive evidence of this yet.
 - Scientific debate about increased occurrence of stronger storms
- We do expect hurricanes to hold more moisture and produce more intensive rainfall
 - Studies suggest that climate change intensified rainfall in hurricanes Katrina, Irma, and Maria by up to 10%
- Climate simulations of tropical cyclones in Atlantic, Pacific and Indian oceans suggests increased rainfall of 5-10%
- Potential track shifts for Atlantic hurricanes cyclogenesis could potentially occur further midocean, reducing likelihood of US landfall

Centre for Risk Studies

Potential shift north of cyclogenesis in Pacific Ocean could increase landfall frequencies in SE Asia

Climate Change Increases to Economic Loss from Extreme Weather

- The annual average rate of loss from these extreme weather processes will increase with climate change
- We estimate that direct economic losses will increase by 20% over the next 20 years
- With indirect losses, this could add an additional cost to the global economy of over \$100 Billion a year, at today's values
- These estimates of course have highly uncertainties around them, but are indicative of the problem we face
- Businesses will need to adapt their processes to accommodate these changes and understand how their business will be affected
- The indices we are developing are intended to inform this process

		RCP4.5			
		Observed	2040	Increase	
٢	Tropical Windstorm	97.7	106.5	9%	
H.	Flood	69.4	77.3	11%	
\bigcirc	Drought	13.8	32.5	135%	
	Temperate Windstorm	5.8	6.1	5%	
6	Freeze	5.3	4.5	-15%	
	Heatwave	3.0	6.7	123%	
	\$ Billions	195.0	233.6	20%	

Invitation to Business Community

- Help shape these scientific research outputs to be most useful to you
- Help scientists understand what decisions you are trying to make about managing your climate change risk
- Guide and prioritize focus on the things that make a difference to you

Challenge to the Climate Science Community

- Focus research on the time horizons and activities of the business community
- Help businesses understand their tail risk from extremes
- De-mystify the science and improve communication about these complex issues

Centre for **Risk Studies**

