The Risk Management Impact of Climate Change & ESG

Frank Freitas, Four Twenty Seven
Michael Denton, Moody’s Analytics
Cris DeRitis, Moody’s Analytics

Moderator: Sam Malone, Moody’s Analytics

November 5, 2019
Michael Denton  
Director - Risk and Finance Advisory  
Moody’s Analytics

Sam Malone  
Senior Director - Research  
Moody’s Analytics

Cristian deRitis, PhD  
Senior Director - Consumer Credit Analytics  
Moody's Analytics

Mehna Raissi  
Senior Director - Product Management  
Moody’s Analytics

Frank Freitas  
Chief Development Officer  
Four Twenty Seven
Agenda

1. Overview: ESG Investment Strategies
2. Climate Analytics: Quantification of Climate Risk
3. The Macro View: Economic Scenarios based on Climate Change
4. The Micro View: Climate Change and Credit Risk Modeling
5. Key Take-aways
Overview: ESG Investment Strategies
Overview

ESG risk and climate change risk

- ESG and climate risk: connected but distinct
- Growing ESG awareness and quantification: significant capital inflow
- ESG investing: > US$20T in AUM (1/4 of managed assets worldwide) (Forbes, 07/11/18)
- Impact firms’ ability to conduct business

How should investors, firms and banks adapt?
Equity Portfolio Values vs. Time
Based on highest trailing two-year RepRisk ESG Scores*

*Sourced from Bureau van Dijk, a Moody’s Analytics Company
Investment Grade Bond Portfolios
Based on highest trailing two-year RepRisk ESG Scores*

*Sourced from Bureau van Dijk, a Moody’s Analytics Company
High Yield Bond Portfolios

Based on highest trailing two-year RepRisk ESG Scores*

*Sourced from Bureau van Dijk, a Moody’s Analytics Company
Climate Analytics: Quantifying Climate Risk
Climate Change – Pathways to Performance

Direct impacts
- Acute or chronic climate hazards that affect directly corporate operations, supply chain or markets.
- Includes extreme precipitation, heat stress, water stress, cyclones, sea level rise, cold snaps, and winter storms
- Can be measured in physical terms and estimated in financial terms

Indirect impacts
- Climate hazards that affect the broader economic, human or natural environment corporations depend upon
- Transmission pathways from climate hazards to corporations may include ecosystem collapse, migrations, social license to operate, impacts on human health, etc.
- Impacts on the corporate value chain are difficult to predict and quantify

© 2019 Four Twenty Seven – All Rights Reserved
A Grounded Example

Supply Chain Risk
- Country of Origin
- Resources Demand

Operations Risk
- Heat Stress
- Wildfires*
- Extreme precipitation
- Hurricanes & Typhoons
- Sea level rise
- Water Stress
- Socioeconomic Risk

Market Risk
- Country of Sales
- Weather Sensitivity

*Available 2020
Climate Data Presents Unique Challenges

- Terabytes of Data
- Varying Resolutions
- Over A Long Horizon
A Data-Hungry Endeavor

- Climate & weather data
- Environmental risk data
- Corporate & financial data
- Global trade & economic data

427 Analytics Engine

- Equities and Fixed Income
- Corporates & Sovereign
- Real Assets
- Credit portfolios

Partner logos:
- IPCC
- NASA
- ESA
- European Space Agency
- World Meteorological Organization
- CLIMsystems
- AQUEDUCT
- U.S. Geological Survey
- Dartmouth Flood Observatory
- World Resources Institute
- S&P Dow Jones Indices
- FactSet
- GEOPHY
- TruCost
- World Economic Forum
- THE WORLD BANK
- UN Comtrade
- KGM & Associates
- BEA
Risk Indicator Framework

Facility Risk Score

Heat Stress
- Extreme Temperature
- Extreme Heat Days
- Energy Demand
- Rainfall Intensity
- Wet Days
- Flood Frequency
- Flood Severity

Floods
- Very Wet Days
- Cumulative Wind Speed

Cyclones
- Absolute coastal flood exposure
- Relative coastal flood exposure

Sea Level Rise
- Water Supply (% Δ)
- Water Demand (% Δ)
- Water Stress
- Interannual variability

Water Stress
- Water Supply (volume)
- Water Demand (volume)

Earthquakes
- Max Shaking Potential

© 2019 Four Twenty Seven – All rights reserved
Practical Example – Global Water Stress

Company Name: LafargeHolcim Limited
Facility industry: Crushed & Broken Limestone
Facility Risk Score: 15
3

The Macro View: Economic Scenarios Based on Climate Change
Economic Consequences of Climate Change

» Macroeconomic growth (productivity, labor force)
» Regional impacts (e.g. natural disasters)
» Industry impacts (e.g. travel, logistics, energy, health, agriculture)
» Residential and commercial real estate (property values)
» Financial markets and institutions (e.g. bank stress testing)
» Federal, state, local governments (e.g. revenues, costs)
» Geopolitical relationships (e.g. refugee flows)
» Policy responses (e.g. cap & trade, carbon tax)
Africa, Middle East and Southeast Asia Hit Hard

% change in real GDP in 2048 assuming RCP 8.5

Source: Moody’s Analytics
Developed Economies Less Impacted

% change in real GDP in 2048 assuming RCP 8.5

Sources: World Bank, Moody’s Analytics
Natural Disasters Are Expensive

Costliest weather events in U.S. history, $

Sources: NOAA, Moody’s Analytics
The Micro View: Climate Change and Credit Risk Modeling
Enterprise Risk’s activity in Climate Risk
Ongoing research in climate risk and ESG challenges

Two very different assessments

Climate Risk

Concern for lenders and investors

ESG

Concern for many stakeholders

Climate Risk focus

» Financial materiality and credit worthiness impacts
  – credit models (European banks)
    › Scenario conditioning
    › Inclusion of climate factors
    › Scorecarding
  – Increasing regulatory pressure for TCFD reporting, globally

» Primary subject of 427 research
Climate risk modelling and research
Scenario based analyses: critical support for Climate Risk (TCFD) reporting – similar to stress tests

- **Climate Scenarios**
- **Mapping or conversion**
- **Local macro-scenarios**
- **Credit Models**
- **Disclosure & Reporting**

**Transition Risks**
- Atlantic Hurricanes per Season

**Physical Risks**
- RCP 6.0 - Southern New Jersey

**Econometric or qualitative**
- SNJ Macro Scenario
- SNJ Event Risk - 2025 90th%

**Models or Scorecards**
- Balance sheet
- Total loans and leases
- Total securities (HTM)
- Total securities (AFS)
- Total assets
- Total liabilities
- Total equity capital
- Aggregated Charge-offs
- Total loan and lease net charge offs
- Income and Expense
- PPNR
- Net income
- Provisions
- Total gains (losses)
Scorecards will bridge the risk modeling gap
Scorecard notching can be applied in the near term, while more data is gathered, and more analytics are developed.

### Potential Scorecards

<table>
<thead>
<tr>
<th>Climate Risk Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat Stress</td>
</tr>
<tr>
<td>Wildfires</td>
</tr>
<tr>
<td>Extreme Precipitation</td>
</tr>
<tr>
<td>Hurricanes</td>
</tr>
<tr>
<td>Sea Level Rise</td>
</tr>
<tr>
<td>Water Stress</td>
</tr>
<tr>
<td>Socioeconomic</td>
</tr>
</tbody>
</table>

### Hypothetical Scorecard - Wildfires

<table>
<thead>
<tr>
<th>Factor</th>
<th>Weight</th>
<th>Assessment</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location exposure</td>
<td>20%</td>
<td>Direct exposure; 1-2 x / yr</td>
<td>75</td>
</tr>
<tr>
<td>Staff displacement</td>
<td>10%</td>
<td>Non-critical</td>
<td>15</td>
</tr>
<tr>
<td>Facility Replacement</td>
<td>20%</td>
<td>Fully replaceable; 8-12 mo</td>
<td>50</td>
</tr>
<tr>
<td>Business Interruption</td>
<td>25%</td>
<td>Partial redundancy; 6-12 mo</td>
<td>60</td>
</tr>
<tr>
<td>Insurance coverage</td>
<td>25%</td>
<td>Structure and contents only</td>
<td>33</td>
</tr>
</tbody>
</table>

Final Score: 50
Bank Climate Risk activity varies by region
Distinct differences in North American and European bank preparation

**Preliminary survey results**

- MA’s global banking survey of Climate Risk preparation: early results re TCFD
  - Europe: 2/3 of all responding banks have completed some level of climate risk reporting, remaining 1/3 are preparing
  - North America: 57% of responding banks have done no more than discuss internally

- Potential regulatory pressure (and voluntary disclosure) in the US?
5

Key take-aways
Take-aways

1. ESG tools have become indispensable for many investors and risk managers.

2. We now have data-driven, forward-looking climate risk analytics.

3. Macroeconomic scenarios and credit-risk tools that capture climate risk are available and evolving.