Regional and Macro Implications of the Global Energy Transition

Emilie Mazzacurati, Global Head of Climate Solutions  November 2021
Providing trusted insights and integrated analytics leveraging our deep domain and risk expertise

Credit Ratings
- Credit Ratings & Research
- ESG Credit Scores
- ESG Classification
- Heat Maps

Risk Management Solutions
- Real Estate Solutions
- Moodys.com
- Risk Analytics & regulatory reporting
- Lending solutions and tools
- APIs, and Data Feeds

ESG Solutions
- ESG Measures
- Climate Solutions
- Index Solutions
- SME Solutions
- Sustainable Finance
Climate Risk and Financial Systemic Risk

Climate risks
- Transition risks
  - Policy and regulation
  - Technology development
  - Consumer preferences
- Physical risks
  - Chronic (e.g., temperature, precipitation, agricultural productivity, sea levels)
  - Acute (e.g., heatwaves, floods, cyclones and wildfires)

Economic transmission channels
- Micro
  - Affecting individual businesses and households
  - Businesses
    - Property damage and business disruption from severe weather
    - Stranded assets and new capital expenditure due to transition
    - Changing demand and costs
    - Legal liability (from failure to mitigate or adapt)
  - Households
    - Loss of income (from weather disruption and health impacts, labour market frictions)
    - Property damage (from severe weather) or restrictions (from low-carbon policies) increasing costs and affecting valuations
- Macro
  - Aggregate impacts on the macroeconomy
    - Capital depreciation and increased investment
    - Shifts in prices (from structural changes, supply shocks)
    - Productivity changes (from severe heat, diversion of investment to mitigation and adaptation, higher risk aversion)
    - Labour market frictions (from physical and transition risks)
    - Socioeconomic changes (from changing consumption patterns, migration, conflict)
    - Other impacts on international trade, government revenues, fiscal space, output, interest rates and exchange rates

Financial risks
- Credit risk
  - Defaults by businesses and households
  - Collateral depreciation
- Market risk
  - Repricing of equities, fixed income, commodities etc.
- Underwriting risk
  - Increased insured losses
  - Increased insurance gap
- Operational risk
  - Supply chain disruption
  - Forced facility closure
- Liquidity risk
  - Increased demand for liquidity
  - Refinancing risk

Which Climate Scenarios to Analyze?

One important set of climate scenarios are the NGFS scenarios, which underpin the 2021 Bank of England’s Climate Biennial Exploratory Scenario (CBES) exercise:

Figure 3.1 Illustrative variable pathways in each scenario
Economic and Financial Impacts of Climate Change

Moody’s conceptual framework

Physical Risks
(Extreme weather events, gradual climate change)

- Business disruption
- Asset destruction
- Productivity loss

Transition Risks
(Policy, technology, consumer preferences)

- Reconstruction / replacement
- Lower value of stranded assets
- Increase in energy prices

Economy

Financial Impacts
Cash flows and business risk impacted by physical and transition risk

Capital / Collateral / Risk Premium
Impacted by change in asset valuation

Risk Metrics
- Credit Risk
  PD/LGD, Internal Rating, Expected Loss, Spreads, etc.

Portfolio Impacts
Concentration and correlation risk, VAR and Tail Risk
The Bank of England Provided GDP for CBES

U.K. GDP, cumulative decline from counterfactual scenario, %

- Early Action
- Late Action
- No Additional Action

Real GDP growth, %

<table>
<thead>
<tr>
<th></th>
<th>U.K.</th>
<th>U.S.</th>
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<tbody>
<tr>
<td>Early Action</td>
<td>-0.05</td>
<td>-0.05</td>
</tr>
<tr>
<td>Late Action</td>
<td>-0.15</td>
<td>-0.13</td>
</tr>
<tr>
<td>No New Action</td>
<td>-0.27</td>
<td>-0.37</td>
</tr>
</tbody>
</table>

Sources: CBES, Moody's Analytics
As Well as Carbon Prices

Carbon price, 2010 $ per metric ton

- U.K.
- U.S.
- Euro zone
- China
- Canada
- Japan

Sources: BoE, Moody's Analytics
Moody’s Analytics Enhanced Global Macroeconomic Model

- Carbon Prices
- Fossil Fuel Prices
- Fossil Fuel Demand
- Inflation Rate
- CO2 Emissions
- FX Rate
- Carbon Revenues
- Balance of Trade
- Government Spending
- GDP
Real GDP Impact of BOE CBES Scenario

% Decline, No Additional Action Scenario, 2050

US = -17.4
Europe = -17.1

> -13.7
> -17.1 to -13.7
-18.5 to -17.1
<-18.5

Sources: CBES, Moody’s Analytics
...Including Energy Consumption Paths

U.S. energy consumption, 2020=100, late policy action scenario

Sources: CBES, NGFS, Moody's Analytics

MOODY'S

Economic Impacts of Climate Risk
Early Action Limits Manufacturing Losses

Germany, GVA in manufacturing, cumulative decline from counterfactual scenario, %

Sources: CBES, Moody's Analytics
Inaction Maximizes Financial Stress

U.S., 10-yr Treasury yield, %

Source: Moody's Analytics
Climate Risk Affects the Drivers of Creditworthiness

- Transition Risk
- Physical Risk

- Equity
- Asset Volatility
- Liability

- Market Asset
- Default Point

Distance to Default

Climate-Adjusted Probability of Default

- Bond Valuation
- Term Structure
- Implied Rating

MOODY'S
Economic Impacts of Climate Risk
Transition Risk: Quantifying Scenario-Conditional Cash Flows

Effect on Global Economy
- Effect on Fossil-Fuel Energy Sector: Earnings ↓10%
- Effect on Utility Sector: Earnings ↓7%
- Effect on Automotive Sector: Earnings ↓5%
- Effect on Renewable Energy Sector: Earnings ↑17%
- Effect on "Other" Sectors: Earnings ↓2%

Component 2: Granularizing Sector Effect to Firms in Sector
- Effect on Firm 1 Cash Flows: Earnings ↓8%
- Effect on Firm 2 Cash Flows: Earnings ↑2%
- Effect on Firm 3 Cash Flows: Earnings ↓22%

Component 1: Global/Sectoral Economic Impact Model
- Carbon Tax = X
- Technology Progress = Y
- Socioeconomic Trends = Z

Component 3: Converting Cash Flows to Credit Metrics
Public EDF Model

MOODY'S
Note: All Values are Expository Only
Average Transition-Adjusted EDF Term Structures

Transition Risk: Mean Portfolio Increase in PD by Tenor

Investor Expectations Assumption: Perfect scenario foresight occurs when announced
Relative Risk Varies Widely within each Scenario
Average Transition-Adjusted EDF – High Exposure Sector Portfolio

Investor Expectations Assumption: Perfect scenario foresight occurs when announced.
Results Vary Within Sectors

Increase in Annualized PD By Sectors
Late Policy

Strongly Energy-related Sectors

Oil Refining
Oil and Natural Gas Extraction
Nuclear Fuel Generation
Gas Processing
Flight
Fertilizer
Electricity Production
Delivered Gas
Concrete
Coal to Liquid Refining
Coal Extraction
Cars

variable
1 Year Increase
10 Year Increase

Increase in Annualized PD
Looking Ahead: A Paradigm Shift

**Regulatory Requirements**
- Fast emerging requirements to perform climate stress tests
- Investor (and regulatory) pressure to disclose exposure and management response to climate risk
- Directional but imperfect alignment between regulatory requirements across jurisdictions

**Uncertainty**
- AI, geospatial & satellite imagery, vision learning are revolutionizing how we look at and into corporations
- Cost of meeting climate change targets could be dramatically affected by technology developments
- Policy environment shifting but still fraught with lack of credible commitment

**Climate Change**
- Hard reality of the energy transition and of extreme weather events and chronic climate change on the economy
- Social equity implications of transition (Just Transition) rising on the agenda domestically and internationally
- Investing in adaptation, risk management, resilience: an imperative
Emilie Mazzacurati
Global Head of Climate Solutions
Moody’s ESG Solutions
emilie.mazzacurati@moodys.com