Climate Transition Risk: Indices and Textual Analysis Approaches

Ida Colella

Dipartimento di Scienze Politiche
Università degli Studi di Napoli, Federico II
ida.colella@unina.it

December 9, 2025

Outline

Why Climate Risks Matter

- Climate change affects macroeconomic and financial dynamics.
- Transition to a low-carbon economy can deeply reshape asset prices.
- Stranded assets, policy shocks, technological shifts affect firms and markets.
- Today's focus: **transition risk indices**, with emphasis on **textual methods**.

Two Types of Climate Risk (Brief Overview)

- **Physical risk**:
  - Damages from extreme events or gradual climate deterioration.
- **Transition risk**:
  - Arises from climate policies, technological change, and shifts in preferences.
  - Generates re-pricing of brown vs green sectors.

World Risk Index (WRI)

The **WorldRiskIndex** measures disaster risk from extreme natural events and climate change impacts for **193 countries**. It is computed as the **geometric mean** of:

- **Exposure**: earthquakes, tsunamis, floods, cyclones, droughts, sea-level rise.
- **Vulnerability**, composed of:
  - **Susceptibility**: societal conditions increasing damage likelihood.
  - **Coping**: capacities and resources to minimize immediate impacts.
  - **Adaptation**: long-term structural changes to reduce future climate risks.

Environmental Performance Index (EPI)

The **2024 Environmental Performance Index (EPI)** provides a data-driven summary of global sustainability performance. Using **58 indicators across 11 categories**, the EPI ranks **180 countries** on:

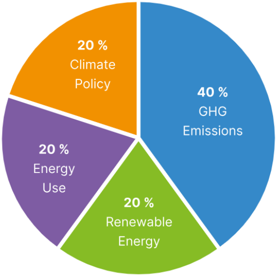
- climate change performance,
- environmental health,
- ecosystem vitality.

EPI scores help identify problems, set policy targets, track trends, and highlight best practices. A granular view of the indicators supports policymakers in understanding the determinants of environmental progress and refining policy choices.

Climate Change Performance Index (CCPI)

The **Climate Change Performance Index (CCPI)** promotes transparency in climate policy. It compares performance across **63 countries + the EU**, representing **over 90% of global GHG emissions**.
The assessment covers four categories:

- **GHG Emissions**
- **Renewable Energy**
- **Energy Use**
- **Climate Policy**



The CCPI provides an independent benchmark of climate ambition and implementation.

CCPI: Methodology and Policy Assessment

The three quantitative categories — **GHG Emissions**, **Renewable Energy**, and **Energy Use** — each include four indicators:

- Current Level,
- Past Trend,
- Well-Below-2°C Compatibility (current),
- Well-Below-2°C Compatibility (2030 target).

The remaining **20%** of the score is based on the **Climate Policy** component:

- National Climate Policy,
- International Climate Policy.

This dimension uses expert surveys to evaluate policy frameworks, capturing developments not yet visible in quantitative indicators.

Transition Risk: Text-Based Indicators

- Recent literature increasingly relies on **text-based indicators** to measure climate-related transition risks, following the metholodogy of Engle et al.(2020), extracting information from:
  - newspapers, newswires,
  - blogs and online media.
- Two widely used measures:
  - **Climate Risk Index** (Bua et al., 2022)
  - **Climate Policy Uncertainty (CPU) Index** (Gavriilidis, 2021)
- Both indices capture **policy-driven climate transition risk**, detecting shifts in the regulatory environment that affect firms and markets.

Text-Based Climate Risk Indices: Bua et al. (2022)

- Using text-based methods and authoritative sources, Bua et al. build **global vocabularies** for **physical** and **transition** climate risk.
- They construct two daily indices: **Physical Risk Index (PRI)** and **Transition Risk Index (TRI)**, based on **Reuters News** from 2005 onwards (updated semi-annually).
- Starting from scientific climate-change texts, they create:
  - a **Physical Risk Document (PRD)**,
  - a **Transition Risk Document (TRD)**,

  which summarize the relevant climate-risk information.
- PRD and TRD are converted into numerical vectors using **tf–idf** (term frequency–inverse document frequency) and fed into text-mining algorithms.

Climate Policy Uncertainty (CPU) Index: Gavriilidis (2021)

- Gavriilidis follows the approach of **Baker, Bloom and Davis** (“Measuring Economic Policy Uncertainty”) to construct the **Climate Policy Uncertainty (CPU) Index**.
- He searches articles in **eight leading U.S. newspapers** containing:
  - **uncertainty terms**: “uncertainty”, “uncertain”, etc.;
  - **climate terms**: “carbon dioxide”, “climate”, “climate risk”, “CO2”, “emissions”, “global warming”, “climate change”, “green/renewable energy”, “environmental”;
  - **policy terms**: “regulation”, “legislation”, “White House”, “Congress”, “EPA”, “law”, “policy”, including variants (“regulatory”, “policies”, etc.).
- The index spans **April 1987 to the present** and tracks changes in **U.S. climate policy**

Pricing of Climate Risks

- Empirical literature analyses:
  - stock returns of carbon-intensive vs low-carbon firms;
  - bond yields and CDS spreads for sovereigns and corporates;
  - real estate prices in high-risk areas.
- Main findings:
  - pricing of **physical risk** is more heterogeneous, often stronger after extreme events.
  - markets price **transition risk**: brown assets tend to carry a premium and underperform when climate policies tighten;

Transition Risk: Evidence from Financial Markets

- Bouri et al. (2023), using the TRI index built by Bua et al. (2022), show that clean energy stock prices have a much stronger response to physical risk shocks than technology stocks.
- Wendai and Bin (2023) show that the CPU index **predicts stock market volatility one month ahead** using an AR model on Chinese sectoral indices. Predictability is strongest for energy, materials, industrials, consumer goods.

CPU effects are:

- **stronger in low-volatility periods**,
- weaker at longer forecast horizons,
- sharply amplified during COVID-19, especially for the financial sector.

Market Responses to Climate Policy Uncertainty

- Tedeschi et al. (2024): **time-varying effects** of CPU on European markets (EURO STOXX 50) and NASDAQ OMX Clean Energy Europe using a TVP-VAR. Clean energy stocks **respond positively to CPU shocks**.
- Bezgin et al. (2025): wavelet coherence analysis of causality between CPU and major developed markets (Finland, Germany, Netherlands, Norway, Sweden, UK).
  - No causal link for Norway (OBX).
  - Short-term causality from CPU $\rightarrow$ Finland (OMXH25) and Sweden (OMXSPI).
  - Short- and long-term causality for the Netherlands (AEX).
- Findings reveal **heterogeneous market responses**, requiring adaptive investment strategies. This study uniquely combines CPU with **CCPI-based country clustering**.

Sectoral and Cross-Country Heterogeneity

- **Sector heterogeneity**:
  - energy, utilities, heavy industry more exposed to transition risk;
  - agriculture, tourism, infrastructure more exposed to physical risk.
- **Country heterogeneity**:
  - emerging and developing economies often more exposed to physical risk;
  - advanced economies may have more tools to manage transition but also larger stranded-asset risk.
- Implications:
  - climate risk is *not* a single factor, but a set of interacting exposures;
  - portfolio construction must account for geography, sector and policy regimes.

Summary

- Climate risks can be broadly divided into **physical** and **transition** risks, with additional legal and reputational dimensions.
- The literature proposes a rich set of indicators:
  - disaster and climate-data based measures;
  - policy and vulnerability indices;
  - text-based measures.
- Financial markets increasingly price climate risks, but:
  - the magnitude and timing of effects remain uncertain;
  - heterogeneity across sectors and countries is substantial.

Open Issues and Next Steps

- Need for **integrated** indicators combining physical and transition risk.
- Better identification of causal effects on asset prices and macro outcomes.
- Incorporation of climate risks into:
  - portfolio construction and risk management;
  - stress testing and prudential frameworks;
  - fiscal and monetary policy analysis.
- Data quality, disclosure and standardisation remain key challenges.

Thanks!

Questions?