

Corporate Greenness

Quantifying Transition Risk Exposure via Guided Topic Modeling and Stock Market Reactions

Klara Pavic

Master Thesis Presentation, MSc. Quantitative Finance
University of Economics and Business Vienna

January 8, 2026

Introduction and Motivation

- The transition to a low-carbon economy constitutes a fundamental structural shift for financial markets.
- Climate transition risk affects firms heterogeneously through regulation, taxation, and changing business models.
- Existing measures of corporate greenness rely on emissions data or ESG scores, which are often backward-looking, infrequent, or subject to reporting bias.
- This thesis proposes a measure of corporate transition risk exposure derived from unstructured news text.
- The measure is validated using stock market reactions to major climate policy events.

Research Question

Main Research Question:

Can firm-level exposure to climate transition risk be quantified using news-based text measures, and does a shock to this risk lead to a significant revaluation of firm value?

Sub-questions:

- Can Guided Topic Modeling be used to construct a continuous, firm-specific transition risk exposure score?
- How does this news-based measure compare across firms and industries?
- Does corporate transition risk exposure lead to a significant shift in log stock prices following the Paris Climate Agreement?

Literature Review and Theoretical Framework

- **NLP-based climate risk measurement:**

- Dangl, Halling, and Salbrechter (2025): physical climate risk measured via Guided Topic Modeling of news.
- Fliegel (2025): conceptual challenges in measuring climate transition risk.

- **Market-based measures of greenness and exposure:**

- Rehbein et al. (2025): abnormal stock returns around climate policy events as a measure of corporate greenness.

- **This thesis:**

- Combines text-based exposure measurement with market-based validation.
- Focuses on *transition* rather than physical climate risk.

- **News Data:**

- Thomson Reuters News Archive (1992–present)
- Firm-level tagging, daily frequency

- **Financial Data:**

- CRSP stock returns and firm characteristics (1992–present)
- Daily data used for valuation and event-study analysis
- Sample construction follows Dangl et al. (2025) to ensure comparability.

Methodology I: Measuring Transition Risk Exposure (NLP approach)

- Train a self-built Word2Vec model on the Reuters corpus.
- Apply Guided Topic Modeling (GTM_{w2v}) to identify transition-risk-related topics
 - e.g. carbon taxation, emission regulation, stranded assets.
- Compute topic loadings for each news article based on weighted word counts.
- Aggregate topic loadings to construct an article-level transition risk score.
- Adjust for:
 - word frequency bias,
 - article length,
 - firm-level media attention.

Methodology I : Constructing a Transition Risk Score

Goal: construct a firm–time transition risk exposure score $TR_{i,t}$ from Reuters news.

Objects:

- $q \in \{1, \dots, Q\}$ transition-risk topics (e.g. carbon tax, regulation, carbon emission fade out)
- j news article, i firm, t day
- \mathcal{W}_q : topic-specific word set with weights $g_{w,q}$

Key output:

$TR_{i,t}$ (firm-specific, daily, media-attention adjusted)

Methodology I: Article–Topic Loadings

For each article j on day t , compute a topic loading for topic q :

$$L_{q,j,t} = \left(\sum_{w \in \mathcal{W}_q \cap j} g_{w,q} \cdot \text{count}_j(w) \right) \times \gamma_{\text{freq},q} \times \gamma_{\text{len},j}$$

- $g_{w,q}$: topic weight for word w (from GTM_{w2v})
- $\gamma_{\text{freq},q}$: correction for common-word / frequency bias
- $\gamma_{\text{len},j}$: normalization for article length

Methodology I : Aggregate Index and Pre-Event Exposure

Aggregate transition-risk news index (market-wide):

$$TR_t^{agg} = \sum_i TR_{i,t}^{raw}$$

Pre-Paris firm exposure score:

$$TR_i^{pre} = \frac{1}{T_0} \sum_{t \in \text{pre-2015}} TR_{i,t} \quad (\text{some rolling mean, not defined yet})$$

- TR_i^{pre} is constructed *before* Paris to ensure predetermined exposure.

Methodology II: Identification Strategy DiD Validation

Goal: Establish a causal link between climate transition risk and firm value using a DiD design.

- **Identification through shock:** The 2015 Paris Agreement is treated as an exogenous regulatory shock to corporate transition risk.
- **Validation objective:** Test whether firms with higher *ex ante* transition-risk exposure experience a differential change in firm value relative to low-exposure firms after the agreement.

Methodology II: Difference-in-Differences Framework

Continuous-treatment DiD specification:

$$\log(P_{i,t}) = \alpha_i + \delta_t + \beta (TR_i^{pre} \times Post_t) + \varepsilon_{i,t}$$

- **Dependent variable** $\log(P_{i,t})$: Log of firm i 's stock price at time t .
- **Fixed effects**:
 - α_i : industry fixed effects capturing time-invariant characteristics.
 - δ_t : time fixed effects absorbing market-wide shocks.
- **Coefficient of interest** β : Measures the differential change in firm value (stock price as proxy) per unit of pre-event transition-risk exposure after the Paris Agreement.

Parallel Trends Assumption and Validation

Parallel trends assumption: Absent the Paris Agreement, firms with different levels of transition-risk exposure would have followed the same valuation trend.

Test 1: Event-time leads and lags

Test 2: Visual inspection

Test 3: Placebo test

Expected Contribution

- Introduces a news-based measure of firm-level climate transition risk.
- Links transition risk exposure to firm valuation in a DiD framework.
- Adds new evidence to the corporate finance literature on climate risk.