

Corporate Greenness

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

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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?

- **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

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.

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.

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.