Twin Threats: The Compound Effect of Transition and Physical Risks on Firms' Credit Rating

Executive Summary

Authors: Marcin Borsuk, Gireesh Shrimali

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Abstract

We investigate how climate change—through both physical and transition risks—affects firms' credit ratings. Our findings show that climate-related risks reinforce each other, with transition risk having a more pronounced negative effect on the credit ratings of firms exposed to physical threats. Exploiting the Trump administration's withdrawal from the Paris Agreement as a quasi-exogenous shock, we find that high-emitting U.S. firms experienced a ratings improvement, with the effect stronger for those facing high physical risk. Finally, we show that while strong financial positions, proactive environmental strategies, and net-zero alignment help mitigate transition risk, they do not offset the financial consequences of physical climate hazards. These findings enhance the understanding of climate risk interactions and how rating agencies incorporate them into their assessments.

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Executive summary

Introduction

Climate change presents profound challenges for firms, introducing risks that directly affect their financial health and operational stability. Physical risks—ranging from acute events like hurricanes and floods to chronic shifts such as rising sea levels and temperature changes—can disrupt production, inflate insurance costs, and devalue assets. Transition risks stemming from regulatory changes, technological advancements, and evolving market preferences impose additional pressures, particularly on high-emission firms, by increasing compliance costs and exposure to penalties as environmental standards tighten.

In principle, higher physical and transition risks should be associated with elevated funding costs for riskier firms and heighten firms' credit risk, especially when intertwined with other financial vulnerabilities**.** This conjecture aligns with recent studies documenting their adverse effects on productivity, profitability, supply chain resilience, and earnings and cash flows volatility. Moreover, climate-related risks tend to extend beyond firm-level outcomes and are increasingly reflected in asset valuations, affecting equity prices, bond spreads, and real estate values This suggests that climate change is already impacting firms' operations and causing economic harm, with investors increasingly pricing climate-related risks, indicating a shift in market dynamics.

Credit rating agencies (CRAs) have responded by incorporating Environmental, Social, and Governance (ESG) factors—including climate risks—into their credit assessments. For example, S&P Global Ratings integrates ESG credit factors into its analysis across all sectors when these factors are deemed material and relevant to creditworthiness. However, strong ESG credentials do not necessarily imply robust creditworthiness nor always reflect a firm's actual environmental impact, especially given that environmental disclosures remain insufficient or inconsistent among peers. Moreover, given the relatively elastic approach to incorporating climate risk drivers, the methodologies employed by CRAs remain opaque, and little is known about how these risks interact with and are integrated into traditional financial metrics. The magnitude of the impact of material climate change risk on credit ratings is rarely disclosed, precluding a definitive conclusion regarding what credit ratings would be in the absence of climate change risk.

This study

This study fills a gap by examining the interplay between physical and transition risks and their combined impact on corporate credit ratings. While existing research often treats these risks as separate dimensions—examining, for instance, the effect of carbon intensity on credit ratings or the financial repercussions of climate hazards—we integrate these perspectives, hypothesizing that

transition and physical risk amplify each other, exacerbating financial instability. Yet, the extent to which CRAs account for such compounded effects remains unclear.

We construct a firm-level dataset that integrates corporate credit ratings, climate risk metrics, and firms' fundamental financial characteristics to test these hypotheses**.** Our empirical strategy is built on a panel regression model that relates the S&P domestic long-term issuer credit rating to measures of transition and physical risks. S&P ratings contain 22 levels, ranging from AAA (the highest) to D (the lowest), with a higher rating indicating a lower probability of default. We measure transition risk through company-specific carbon footprints, specifically Scope 1 and 2 GHG-emission intensity (log transformed). We assess physical risk using firm-specific forward-looking physical risk scores, which capture exposure to acute and chronic climate hazards based on the geographic distribution of assets and projected climate scenarios. The physical risk score ranges from 1 (lowest exposure) to 100 (highest exposure). Our dataset encompasses 2,292 firms across 67 countries from 2005 to 2022.

Key findings

Both transition and physical risk exhibit negative associations with corporate credit ratings. We also find evidence of a compounding effect arising from the interaction of climate risk drivers (Table 1).

Table 1. The impact of transition and physical risk on long-term corporate credit rating

	Coefficient	Economic significance
Transition risk	-0.087***	-0.2 rating points
Physical risk	-0.013***	-0.1 rating points
Transition risk × Physical risk	-0.007**	-0.1 rating points

Note: ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

1. A one-standard-deviation increase in a firm's carbon-emissions intensity (i.e., 1.7 tons/$) is associated with a 0.2-notch decline in its credit rating. This represents 4.8% of the rating's standard deviation.
2. A one-standard-deviation rise in physical risk score (i.e., 5.5 units) reduces the rating by 0.1 notches. These represents 2.3% of the rating's standard deviation.
3. Among firms with a high physical risk score (one standard deviation above the mean), a one-standard-deviation increase in GHG emissions leads to an additional 0.1-notch decline in their credit rating (compared to firms with an average physical risk score).

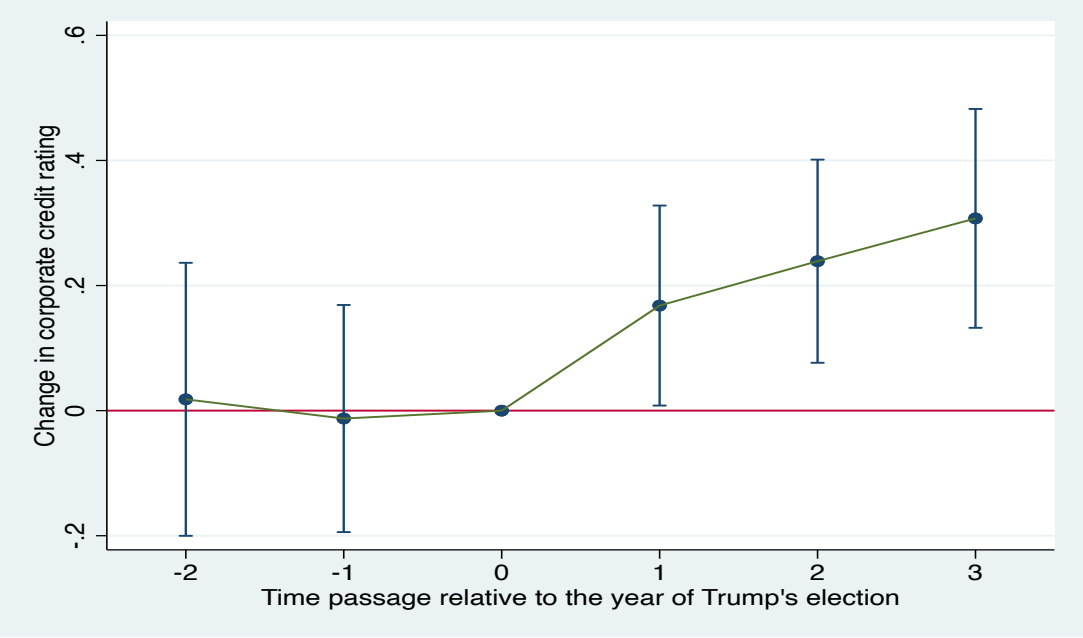
These findings suggest that CRAs view greater emissions intensity as an indication of elevated transition risk, likely driven by regulatory penalties, compliance costs, and reputational challenges

associated with a carbon-intensive profile. Looking ahead, as climate change intensifies, firms operating in regions exposed to acute and chronic climate-related hazards may face an increased risk of rating downgrades due to heightened default risk.

Both transition and physical risk also exhibit negative causality with corporate credit ratings. To establish causality in a robust manner, we leverage the Trump administration's withdrawal from the Paris Agreement in 2017 as a quasi-natural experiment. This regulatory shock enables us to differentiate between firms affected by the policy change and those less impacted. We find that:

1. U.S. firms exposed to transition risk experienced 0.25-notch improvement in credit rating following the withdrawal, reflecting a reduction in short-term regulatory costs associated with the Paris Agreement (Figure 1).
2. This effect is twice as pronounced for firms with higher physical risk (i.e., ones with above median risk), corroborating our previous findings that CRAs price in transition risk more aggressively when firms face high potential climate-related damage costs.
3. Examining states that opposed the withdrawal by suing the Trump administration and committing to the Paris Agreement's goals, high-emitting firms in these states experienced a 0.3-notch decline in credit ratings relative to firms in non-challenger states.

Figure 1. Event study: U.S. high-carbon emitters vs. non-U.S. high-carbon emitters.



Firms with strong financial health, effective environmental management, and alignment with climate targets are better positioned to manage climate-related risks. Our cross-sectional analysis identifies three key mechanisms through which climate risks affect corporate credit ratings. We find that:

1. Firms with stronger financial positions—characterized by higher profitability and lower leverage—are less vulnerable to both transition and physical risks, whereas financially constrained firms incur harsher credit penalties.
2. Firms with robust ESG performance receive relatively higher credit ratings despite high emissions; furthermore, firms that align with net-zero targets are rewarded with higher ratings, while those that are misaligned face additional downgrades, underscoring the importance of forward-looking environmental commitments.
3. Technological innovation—as measured by green patent activity—partially offsets the negative financial effects of high carbon emissions, reducing the transition risk premium.

Collectively, these findings suggest that firms with strong financial health, effective environmental management, and alignment with climate targets are better positioned to manage climate-related risks, leading CRAs to assign them more favorable credit ratings.

Conclusion

Our research has important implications, particularly for investors and policymakers, as climate change represents a material financial risk. This is especially relevant given the ongoing debate on how climate risk factors should be integrated into credit rating, and whether enhanced disclosures are likely to be useful.

CRAs should explicitly incorporate climate risk considerations into their evaluations. While our study does not determine whether CRAs account for climate risks through traditional risk channels or as standalone factors, we provide evidence that firms with greater exposure to climate risks tend to receive lower credit ratings. This suggests that CRAs explicitly incorporate climate risk considerations into their evaluations, addressing concerns that they may repeat past mistakes—such as those observed during the 2008 financial crisis, where miscalculations of risk led to systemic failures.

Regulators should provide enhanced disclosure guidelines on climate risk. At the same time, transparency in how climate factors are factored into credit ratings remains critical. Clarifying these methodologies helps investors, regulators, and other stakeholders understand and respond to evolving climate-related threats. Ultimately, enhanced disclosure and clearer guidelines on integrating physical and transition risks can strengthen market confidence, support efficient capital allocation, and mitigate the threat of underpriced climate exposures that could destabilize the financial system.

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