Original Article

Does Climate Risk Perception Drive Corporate Financial Performance? Evidence from Manufacturing Firms in Vietnam

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Abstract: *This study investigates the influence of climate risk perception, including physical risk perception (CRPhy) and transition risk perception (CRTra), on the corporate financial performance (ROA, ROE) of 85 Vietnamese manufacturing firms from 2016 to 2024. Using baseline OLS complemented by FEM, REM, and FGLS estimations, robust and efficient inference is ensured. The findings indicate that physical climate risk perception is negatively associated with corporate financial performance, whereas transition risk perception is positively associated. These results highlight that physical risks signal operational vulnerability, while transition-oriented perceptions reflect adaptive capabilities that enhance firm performance, underscoring the need for stronger climate disclosure and proactive transition strategies in emerging markets.*

I. INTRODUCTION

Climate change is among the most pressing challenges of the 21st century, posing a profound threat to the sustainable development of the global economy [1 - 3]. At the current rate of carbon emissions, global temperatures are projected to rise from the existing 1°C above pre-industrial levels to an average of 1.5°C between 2030 and 2052 [4], leading to an escalation in the frequency and intensity of extreme weather events. The impacts of climate change not only cause asset losses and disrupt supply chains but also reduce productivity and increase firms' operating costs [5, 6]. Vietnam is among the five countries most severely affected by climate change. Owing to its geographical characteristics and limited infrastructure, the country remains particularly vulnerable to climate shocks [7]. The manufacturing sector, which serves as a key driver of economic growth and exports [8], has been increasingly affected by climate change. Thus, achieving financial performance and sustainable enterprise development is an urgent imperative for identifying and responding to climate risks.

Corporate financial performance is one of the critical elements that reflect a company's overall health and competitiveness [9], as it denotes the capacity to generate income, optimize resource utilization, and bring enduring value to stakeholders. Higher financial performance allows firms to invest in growth while providing confidence in profitability for investors and other stakeholders [10-14]. On the other hand, weak financial performance can constrain a firm's capacity to address risk, affect access to capital, and inhibit sustainable growth [15]. Hence, it is important to comprehend the factors influencing financial performance, given that climate-related risks are on the rise, both for corporate strategic planning and for policy development of the green economy.

In recent years, the relationship between climate risk perception and corporate financial performance has gained more attention from international studies. Suppose firms wish to survive in a carbon-constrained economy. In that case, they must regard climate change as a strategic issue [16] and implement their strategy by developing internal mechanisms [17, 18]. Firms with a strong ability to perceive climate risks can proactively respond, mitigate potential losses, and seize opportunities from the green transition, thereby enhancing their long-term financial performance [19]. However, the potential financial effects of climate change are still not well understood by many firms because they lack an in-depth understanding of the scope and magnitude of emerging threats in their business. Thus, companies need to understand the relationship between business operations and the potential threats brought by climate change [20].

Despite increasing global interest in the impact of climate risk perception on company financial performance, this domain has been minimally explored in Vietnam, particularly within the manufacturing sectors. Most domestic research has so far focused on the general impacts of climate change or on environmental, social, and governance (ESG) factors on corporate performance, without specifically examining climate risk perception as an independent factor directly affecting financial outcomes. Therefore, this study aims to investigate the relationship between climate risk perception and corporate financial

performance in manufacturing listed firms in Vietnam, thereby addressing an existing research gap and offering policy-relevant insights for sustainable corporate governance.

II. THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

A) Theoretical framework

Based on the Resource-Based View (RBV), a firm's competitive advantage is determined by resources that are valuable, rare, inimitable, and non-substitutable [21]. Building upon this view, the Dynamic Capabilities Theory (DCT) extends the RBV by emphasizing the firm's ability to adapt, integrate, and reconfigure resources in response to rapidly changing environments [22, 23]. These capabilities are exercised through three core activities: sensing opportunities, seizing opportunities, and reconfiguring assets and competencies [24]. These mechanisms enable firms not only to react to changes in the environment but also to alter the competitive structure actively, thus establishing sustainable advantages in the face of irregular fluctuations [22]. Therefore, organizations must continuously adjust and manage their resource base to create new configurations that sustain their strategic positioning [3, 25, 26]. In this context, climate change represents one of the most critical environmental challenges that compel firms to develop and exercise their dynamic capabilities to adapt and remain competitive.

B) Theoretical framework

Climate change introduces both physical and transition risks that can materially impact firms' financial performance, through balance sheet impairment and influencing investment and the growth of the economy [27]. Physical risk encompasses the immediate effects of weather events or long-term shifts in climate that can harm property and disrupt business operations [28]. These risks may include such things as storms, floods, high temperatures, or droughts, which may damage infrastructures and/or materials and/or production processes that will increase operational costs and reduce operating efficiency [29 - 31]. These impacts go beyond production interruptions, and they can result in long-term economic costs capable of undermining a firm's profitability and financial performance [32]. Thus, for companies whose key activities are strongly determined by specific natural conditions, climate change causes loss of physical assets and higher operational costs, which leads to deteriorating financial performance [33].

Besides physical impacts, firms are also exposed to transition risks that arise from the rapid shift toward a low-carbon economy [34]. Cortés and Strahan [35] argue that such a transition may cause financial instability as firms struggle to adapt to changing environments. Transition risks include policy, legal, technological, market, and reputational risks [28]. Among these, policy, legal, and market risks related to climate change can increase compliance costs, reduce revenues, and alter consumer demand toward environmentally friendly products. Moreover, firms that respond slowly to green transformation trends face reputational risks for failing to meet societal expectations regarding climate-related management [36]. Companies unable to keep pace with sustainable development may suffer reputational damage and a loss of investor confidence, limiting their access to capital [37, 38]. In addition, the transition to a low-carbon economy threatens traditional business models, turning many carbon-intensive assets into stranded assets [39]. Altogether, these factors increase operational costs, weaken competitiveness, and erode market confidence, thereby negatively affecting corporate financial performance.

In this context, climate risk perception (CRP) emerges as a critical strategic capability that determines how firms respond to climate-related challenges. According to DCT, risk perception enables firms to identify emerging threats, reconfigure resource allocation, and strengthen operational resilience [40]. CRP reflects business managers' subjective willingness to respond to climate change, which directly influences the enterprise's ultimate climate risk management behavior [41]. By enhancing their understanding of the multifaceted impacts of climate change on corporate strategy, resource management, supply chains, and social responsibility, firms can better anticipate potential climate risks, build resilience to environmental uncertainties, and create favorable conditions for sustainable growth [42]. Therefore, we propose the following hypotheses for testing the perceptions of climate risks on corporate financial performance:

H1. Physical climate risk perception significantly impacts corporate financial performance.
H2. Transition climate risk perception significantly impacts corporate financial performance.

III. METHODOLOGY

A) Sample

This study is for non-financial firms operating in the Vietnamese manufacturing sector, one of the industries most exposed to both physical and transition climate change risk. The sample consists of 85 firms grouped within Section C - Manufacturing of the Vietnam Standard Industrial Classification (VSIC), being listed on the Ho Chi Minh Stock Exchange (HOSE) and Hanoi Stock Exchange (HNX) during 2016 - 2024. The sample excludes any companies that were under special supervision at the time, or delisted in the period, and firms with missing key financials or audit disclosures. Extreme outliers are dealt with by winsorizing all continuous variables at the 1st and 99th percentiles.

B) Variables measurement

Dependent variable. Corporate financial performance is proxied by two complementary accounting-based indicators that are widely adopted in the literature. First, return on assets (ROA) is defined as the ratio of net income over total assets. ROA captures the firm's ability to generate earnings from its asset base and thus reflects its overall efficiency in utilizing resources, independent of firm size [43 - 45].

Second, return on equity (ROE) is defined as net income divided by total equity, and thus it represents value creation and risk-adjusted performance from an equity-holder standpoint [46 - 48]. Employing both ROA and ROE as alternative dependent variables enables us to test whether the association between climate risk perception and financial performance holds across the two dimensions of profitability.

Independent variable. We construct the Climate Risk Perception (CRP) index based on textual information extracted from firms' annual reports, following recent studies on text-based risk identification [49, 50]. The climate risk-related terms are primarily derived from reports published by the Intergovernmental Panel on Climate Change (IPCC), which have been widely used in prior research to capture and measure information related to climate risks and opportunities [51]. In addition, this study also draws upon and synthesizes content from other key sources, including the Task Force on Climate-related Financial Disclosures (TCFD) report, the Paris Agreement, and policy documents issued by the Government of Vietnam, in order to reflect both global and national contexts of climate risk identification. The list of sources utilized is presented in Appendix 1.

In this study, climate risk is categorized into two dimensions: physical risk (CRPhy) and transition risk (CRTra). Physical risk represents the direct physical effects of climate change, including both acute events (e.g., droughts, floods, extreme precipitation, and wildfires) and chronic impacts (e.g., rising temperatures and the accelerating loss of biodiversity). The transition risk, on the other hand, occurs when companies do not manage either the impact of climate change or their own business with a view to the global move towards sustainable low-carbon business activity. The final set of keywords used for measurement is presented in Appendix 2. The resulting counts of physical and transition risk terms are then used to construct [45]:

$$CRPhy_{i,t} = \frac{1}{W_{i,t}} \sum_{w=0}^{W_{i,t}} 1[w \in C^{Phy}] \times 10^3; CRTra_{i,t} = \frac{1}{W_{i,t}} \sum_{w=0}^{W_{i,t}} 1[w \in C^{Tra}] \times 10^3$$

Where $w = 0, 1,... W_{i,t}$; $W_{i,t}$ is the total number of words/phrases in the selected sections of the annual report of enterprise i in year t, and $1\blacksquare$ is the indicator function. C^{Phy} is the dictionary for physical climate risk perception; C^{Tra} is the dictionary for transition climate risk perception.

Control. To reduce potential omitted-variable bias, we incorporate several firm-level control variables that the prior literature identifies as important determinants of financial performance and risk [13, 52]. The indicators included firm age (Age), financial leverage (Lev), and Liquidity (Liq). Detailed definitions and measurements of the variables are presented in Table 1.

Table 1: Description of variables and data sources

Variables	Variable names	Coding	Measurements	Sources
Dependent variables	Return on assets	ROA	Net income/total assets	[43 - 45; 53]
	Return on equity	ROE	Net income/total equity	[46, 47, 54]
Independent variables	Physical risk perception	CRPhy	$CRPhy_{i,t} = \frac{1}{W_{i,t}} \sum_{w=0}^{W_{i,t}} 1[w \in C^{Phy}] \times 10^3$	[45, 49, 50, 55]
	Transition risk perception	CRTra	$CRTra_{i,t} = \frac{1}{W_{i,t}} \sum_{w=0}^{W_{i,t}} 1[w \in C^{Tra}] \times 10^3$	[45, 49, 50, 55]
Control variables	Firm age	Age	Number of years since establishment	[13, 56]
	Financial leverage	Lev	Total liabilities/total assets	[52, 56]
	Liquidity	Liq	Current assets/current liabilities	[52, 56]

C) Research model

To empirically examine the extent to which climate risk perception influences corporate financial performance, this study employs firm-level panel data models with both firm fixed effects and year fixed effects. The baseline specification estimates the direct impact of climate risk perception (CRP) on corporate financial performance (CFP), measured alternately by return on assets (ROA) and return on equity (ROE).

$$ROA_{i,t} = \alpha_0 + \alpha_1 CRPhy_{i,t} + \alpha_2 CRTra_{i,t} + \alpha_k Controls_{it} + \mu_i + \tau_t + \varepsilon_{it} \quad (1)$$

$$ROE_{i,t} = \alpha_0 + \alpha_1 CRPhy_{i,t} + \alpha_2 CRTra_{i,t} + \alpha_k Controls_{it} + \mu_i + \tau_t + \varepsilon_{it} \qquad (2)$$

$$Controls = \{Firm\ age,\ Leverage,\ Liquidity\};\ \mu\_i = firm\ FE;\ \tau\_t = year\ FE.$$

D) Estimation method

We estimate pooled OLS as an initial benchmark, followed by fixed-effects and random-effects panel models to control for unobserved firm heterogeneity. The Hausman test determines the preferred estimator. Given the characteristics of financial and text-based disclosure data, all regressions employ heteroskedasticity-robust standard errors clustered at the firm level to address heteroskedasticity and within-firm serial correlation.

For robustness, feasible generalized least squares (FGLS) models are also estimated to allow for heteroskedasticity and potential cross-sectional dependence, and results are interpreted as complementary. The implication of combining the ROA and ROE with disaggregated climate-risk indicators (CRPhy and CRTra) would be a demarcation of a rigorous approach with regard to how various dimensions of climate risk are perceived in corporate financial performance.

IV. RESULTS

A) Descriptive statistics

Table 2 indicates substantial variability across firms. Return on assets (ROA) is 0.068 on average but varies from the minimum of -0.364 to the maximum of 0.507, while return on equity (ROE) has even higher dispersion (-3.259 to 5.231), indicating that significant disparities in terms of equity-based performance are generally seen in emerging markets. Average CRPhy for climate-related risks is 5.987, and CRTra is found higher at 7.641, with broad ranges demonstrating heterogeneity in firms' exposure to both physical climate risk and transition risk driven by policy adjustments, technological advances, and carbon emission-based regulations.

Table 2: Descriptive statistics of the research sample

Variable	Obs	Mean	Std. dev.	Min	Max
ROA	765	0.0682431	0.0779534	-0.364	0.507
ROE	765	0.131034	0.2738564	-3.2589	5.231
CRPhy	765	5.986768	4.286788	0.1415942	26.558
CRTra	765	7.64097	5.551056	0.1415942	40.177
Age	765	36.90588	21.56019	5	149
Lev	765	0.275451	0.1851954	0	0.74
Liq	765	2.154275	4.12131	0.15	52.26

Source: Compiled by the authors using STATA 19.0. See Table 1 for variable definitions.

Great variation can also be observed for the control variables. A firm's age has an average of 36.91 years, but the sample ranges from five to 149 years, suggesting that long-established corporations coexist with younger firms in our data. This indicates a wide variety of capital structure choices; for example, financial leverage (Lev) varies from 0 to 0.740. Unsurprisingly, Liq (Liquidity) has a mean of 2.154 with a highly variable spread (0.15-52.26), underlining huge variances among firms' short-term asset holding and financial padding capabilities.

B) Regression results

Table 3 reports the correlation matrix for the variables used in the regression analysis. The correlations provide initial insights into potential relationships among profitability measures, climate-risk indicators, and firm characteristics. ROA is positively correlated with physical risk ($r = 0.1793$, $p < 0.01$) and firm age ($r = 0.3493$, $p < 0.01$) but is negatively associated with leverage ($r = -0.6108$, $p < 0.01$), consistent with the expectation that higher indebtedness may depress operating returns. ROE, in contrast, shows only modest correlations with the explanatory variables, though it is positively associated with liquidity ($r = 0.0921$, $p < 0.05$) and leverage ($r = 0.1134$, $p < 0.01$), indicating that equity-based profitability reacts differently to capital structure adjustments.

Table 3: Correlations of variables

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ROA	1.0000						
ROE	-0.0963**	1.0000					
CRPhy	0.1793***	-0.0304	1.0000				
CRTra	0.0735**	0.0856**	0.5823***	1.0000			
Age	0.3493***	-0.0938**	0.2688***	0.1410***	1.0000		
Lev	-0.6108***	0.1134***	-0.2980***	-0.0943**	-0.4754***	1.0000	
Liq	0.0453	0.0921**	0.1983***	0.1585***	0.0118	-0.0599*	1.0000

Source: Compiled by the authors using STATA 19.0. See Table 1 for variable definitions.
Note(s): *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$; N = 765*

The two climate-risk indicators CRPhy and CRTra are strongly correlated (r = 0.5823, p < 0.01), reflecting their conceptual proximity and shared underlying risk sources. Both indicators also show positive but moderate associations with liquidity and age. Importantly, none of the absolute correlation coefficients are above the commonly used multicollinearity threshold of 0.80. Ensuring that the explanatory variables are not too correlated is helpful and alleviates fears of multicollinearity, thus ensuring our regression estimations below should be reliable. Several diagnostic tests were carried out for both profitability specifications to ensure that the empirical findings are reliable. Model (1) defines financial performance as ROA, while Model (2) uses ROE as the dependent variable. Both models were initially estimated using the Pooled OLS approach, followed by diagnostic checks for heteroskedasticity, serial correlation, and multicollinearity. Table 4 summarises the results of these diagnostic tests.

Table 4: Diagnostic Tests

Test type	Model 1	Model 2	Outcome
White test	60.78 (p=0.0000)	5.61 (p=0.2993)	ROA: heteroskedasticity; ROE: homoskedastic
Wooldridge test	3.105 (p=0.0962)	4.635 (p=0.0342)	ROA: No AR(1); ROE: AR(1) present
Mean VIF	3.01	3.01	No multicollinearity

Source: Compiled by the authors using STATA 19.0. See Table 1 for variable definitions.

The diagnostic evidence also shows distinct misspecification patterns for the two models. For Model (1): ROA, the null hypothesis of homoskedasticity is strongly rejected by the White test (p = 0.0000): there is severe heteroskedasticity in residuals. In contrast, first-order autocorrelation is not rejected (p = 0.0962), which indicates AR(1) serial correlation is not present in Model (1) at the 5% significance level. For model (2): ROE, the White test does not reject homoskedasticity (p = 0.2993), suggesting that the variance of the residuals is constant. However, the Wooldridge test for autocorrelation shows substantial AR(1) serial correlation, suggesting that Model (2) violates the independence assumption of errors.

In addition, since all variance inflation factors are lower than the standard 5 threshold, the concern of multicollinearity is not relevant in both models: maximum VIF = 4.65 and average VIF=3.01. Thus, in light of these diagnostic results, the Fixed Effects estimator was rejected because it discards relevant time-invariant regressors. As such, the Random Effects specification is estimated but remains heteroskedastic (ROA) or serially correlated (ROE). In order to address the aforementioned specification conditions and identify efficient and appropriate estimates, the Feasible Generalized Least Squares (FGLS) estimator was employed in both models. The FGLS method corrects both heteroskedasticity and autocorrelation at the same time, and its outputs for ROA and ROE are shown in Table 5.

Table 5. FGLS estimation results for ROA and ROE

Variables	ROA	ROE
CRPhy	-0.0058023** (-2.16)	-0.0014976** (-1.97)
CRTra	0.0054065*** (3.85)	0.0055619*** (5.60)
Age	0.000257** (2.22)	-0.0006507*** (-3.48)
Lev	-0.2575843*** (-17.98)	0.1114787*** (4.95)
Liq	0.0002028 (0.37)	0.0114488*** (7.71)
Constant	0.1305949*** (15.58)	0.078001*** (6.03)

Source: Compiled by the authors using STATA 19.0. See Table 1 for variable definitions.
*Note(s): *p < 0.1, **p < 0.05, ***p < 0.01; N = 765*

V. DISCUSSION

Physical climate risk perception (CRPhy): The coefficient of CRPhy is negative and statistically significant for both ROA (-0.0058, p < 0.05) and ROE (-0.0015, p < 0.05). Given the standard deviation of CRPhy ($\approx$ 4.29), a one standard deviation increase in physical climate risk perception is associated with a decline of approximately 0.025 points in ROA and a decline of about 0.006 points in ROE. These are economically meaningful reductions, indicating that when firms emphasize physical climate risks such as storms, floods, droughts, and extreme weather in their disclosures, this tends to coincide with a marked deterioration in operating performance.

This result is consistent with recent empirical evidence showing that physical climate risks are closely associated with reduced operational efficiency and diminished firm value, particularly in regions with high climate-hazard exposure. Findings in climate-vulnerable economies also show that higher physical climate-risk scores are linked with lower profitability, more volatile cash flows, asset-repair costs, supply-chain disruptions, and elevated operational risks [57]. In the Vietnamese context, where many manufacturing firms operate in flood-prone and storm-affected locations, CRPhy effectively functions as a signal of vulnerability: the more a firm must report on physical climate hazards, the more its short-term financial performance is

eroded. Hence, H1 is supported.

Transition climate risk perception (CRTra): In contrast, the coefficient of CRTra is positive and highly significant for both ROA (0.0054, $p < 0.01$) and ROE (0.0056, $p < 0.01$). With a standard deviation of 5.55, a one-standard-deviation increase in CRTra corresponds to an improvement of approximately 0.030 points in ROA and 0.031 points in ROE. These magnitudes indicate that heightened managerial attention to transition-related issues, Net-Zero commitments, emission reduction, CBAM readiness, renewable-energy adoption, and circular-economy practices is strongly associated with enhanced profitability.

This finding aligns with textual-analysis studies showing that firms emphasizing climate transition issues tend to pursue green innovation, adopt energy-efficient technologies, and secure competitive advantages in emerging low-carbon markets [8, 55]. Transition-ready firms often benefit from improved investor sentiment, stronger stakeholder trust, and lower financing costs [55, 58]. The positive coefficients, therefore, support the interpretation that transition risk perception reflects dynamic capabilities; specifically, firms' ability to sense, seize, and reconfigure resources during the low-carbon transformation [24]. Unlike physical risks, transition-related awareness offers substantial upside potential when firms leverage green investments, regulatory alignment, and market opportunities. Consequently, H2 is supported.

Firm age (Age): Firm age exhibits a positive and significant effect on ROA but a negative and significant impact on ROE. A one standard deviation increase in Age (approximately 21.6 years) raises ROA by about 0.0055, while reducing ROE. This pattern suggests that older firms tend to use their assets more efficiently but do not necessarily generate greater shareholder value. The result aligns with evidence showing that mature firms accumulate relational capital, experience, and established routines that stabilize asset-based profitability, yet they also face organizational rigidity and limited growth opportunities, making it more difficult to sustain high equity returns [59].

In the climate-risk context, combined with the CRPhy and CRTra results, the findings imply that older firms possess sufficiently large asset bases and operational networks to absorb physical climate risks more effectively, reflected in higher ROA, while not always being agile enough to restructure equity positions or reposition their strategies under transition pressures. Consequently, their return on equity responds more weakly, or becomes diluted, due to more conservative growth strategies.

Financial leverage (Lev): Leverage presents a clear two-sided pattern: it has a strong and significant negative effect on ROA (-0.258, $p < 0.01$) but a positive and significant effect on ROE (0.111, $p < 0.01$). A one standard deviation increase in leverage (approximately 0.19) reduces ROA by nearly 0.048 points, reflecting the extent to which interest expenses and heightened financial risk erode asset-use efficiency [53]. At the same time, the same increase in leverage raises ROE, illustrating the classic leverage effect whereby debt magnifies returns to shareholders when firms remain profitable [60].

Liquidity (Liq): The regression results indicate that liquidity does not significantly affect ROA but has a strong positive impact on ROE, consistent with the view that liquidity functions primarily as "financial slack" rather than a direct driver of asset efficiency. A one standard deviation increase in Liq raises ROE by about 0.047 points, suggesting that the market values liquidity as a buffer that enhances firms' resilience to shocks. This interpretation aligns closely with Huang et al. [56], who show that firms in high climate risk regions deliberately increase cash holdings and reduce short-term debt to strengthen their capacity to absorb climate-related disruptions, and with Zhang et al. [20], who find that firms facing greater climate uncertainty hold more liquid resources to offset earnings and cash-flow volatility. Accordingly, higher liquidity improves firms' financing stability and reduces refinancing risk, thereby raising returns to equity even when it does not immediately translate into higher returns on assets.

VI. CONCLUSION

A. Theoretical contribution

This study advances theory by showing that climate risk perception is inherently multidimensional. By distinguishing between physical and transition risks, the analysis demonstrates that firms process climate threats through distinct cognitive channels that activate different strategic behaviours. This refined view strengthens the application of Dynamic Capabilities Theory, highlighting that managerial interpretation, rather than the risk itself, determines how firms sense environmental shifts and reconfigure resources to maintain competitiveness.

Beyond this, the study extends the Resource-Based View by conceptualising climate risk perception as a strategic intangible capability. Perceiving physical risks often drives defensive, cost-absorbing responses, whereas transition-oriented perception is linked to anticipatory resource reallocation and opportunity-driven adaptation. A key methodological contribution is the development of a rigorous, context-specific climate-risk keyword dictionary built from IPCC, TCFD, the Paris Agreement, and domestic regulatory texts. This tool offers a replicable foundation for measuring climate perception in emerging markets where disclosure standards are fragmented, and it establishes a framework for future textual analysis of climate strategy and transition readiness.

B. Practical contribution

These findings have some Implications For firms and policymakers as Vietnam actualizes its climate policy framework, which includes a range of policies, such as the national strategy on climate change to 2050; Net Zero pledge. For corporate managers, the difference between CRPhy and CRTra reveals that framing of climate risks matters. A disclosure profile dominated by physical risks suggests exposure to operational disruptions, asset damage, and higher adaptation costs, as well as weaker short-term performance. In contrast, firms that have internalized transition risks, stricter environmental regulation, decarbonization of export markets, and emerging carbon-pricing mechanisms as strategic signals are able to: better anticipate policy shifts; align investment decisions with future constraints; and seize new market and financing opportunities.

The evidence on liquidity highlights liquidity as financial slack that increases climate resilience. Sufficient liquidity and diversified funding sources can allow manufacturing firms to endure the immediate impacts of extreme weather events and policy changes, while still making necessary investments in adaptation and transition. Clear and predictable climate regulations, concerning emissions targets, for example, or energy transition regulations, or disclosure requirements, can also help bolster the positive linkage between perceptions of transition risk and firm performance from a policy perspective. Promoting climate-related financial disclosure to TCFD recommendations and creating a stable roadmap for instruments like a domestic carbon market would enable firms to better embed climate considerations into their core strategy rather than treat them as an issue of transient compliance.

C. Limitations and directions for future research

This study has some limitations that pave the way for future promising research. (1) Climate risk perception is then quantified using a dictionary-based text-mining procedure, built in Python 3.9. Although this approach is transparent and replicable, it primarily accounts for the abundance of predetermined keywords used in managerial narratives and does not address more sophisticated concerns, as well as implicit tones. Future work could utilize improved language models with a newer generation of natural language processing approaches, including large language models (LLMs) or contextual word embeddings, to categorize climate-related disclosures in more dimensions (e.g., tone; forward-looking nature; strategic orientation), thus allowing for a richer and more multifaceted view into firms' perceptions of climate risk.

The second limitation concerns the empirical scope. The sample is limited to the listed manufacturing enterprises in Vietnam, a carbon-intensive, climate-exposed sector that provides valuable but narrow perspectives. As such, the generalizability of the findings might be restricted across firm sizes, ownership structures, and sectors where climate pressures take different forms. As Vietnam progresses toward more standardized climate disclosure frameworks aligned with TCFD principles and emerging sustainability reporting standards, future studies could broaden the dataset to include SMEs, non-listed firms, and sectors such as energy, transport, or agriculture. Comparative analyses across ASEAN economies or cross-industry settings would also help determine whether the asymmetric effects of physical and transition risk perception persist in varying institutional and regulatory environments.

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Appendix 1. List of Documents and Reports Analyzed

No.	Name of Documents	Year	Source
1	Renewable Energy Sources and Climate Change Mitigation	2011	IPCC
2	Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation	2012	IPCC
3	Paris Agreement	2015	UNFCCC
4	Global Warming of 1.5°C	2018	IPCC
5	Climate Change and Land	2019	IPCC
6	National Climate Change Adaptation Plan for the period 2021 - 2030, with a vision to 2050	2020	Government of Viet Nam
7	Climate Change 2022: Mitigation of Climate Change	2022	IPCC
8	Decision Approving the National Strategy for Climate Change until 2050	2022	Government of Viet Nam
9	AR6 Synthesis Report: Climate Change 2023	2023	IPCC
10	Task Force on Climate-related Financial Disclosures (Updated Guidance)	2023	TCFD
11	National Climate Change Adaptation Plan 2021-2030, Vision 2050 (Updated)	2024	Government of Viet Nam

Appendix 2. Detailed keywords of each type of climate risk

Physical Risk (CRPhy)	Natural disasters, Storms, Floods, Inundation, Erosion, Drought, Saltwater intrusion, Climate change, Extreme weather, Heatwaves, Landslides, Rainfall, Global warming, Earthquakes, El Niño
Transition Risk (CRTra)	Greenhouse gas (GHG) emissions, Emission reduction, Net Zero emissions, Carbon credits, Carbon emissions, Carbon market, Carbon neutrality, Carbon footprint, Carbon Border Adjustment Mechanism (CBAM), Carbon labeling, Environmental protection tax, Emission circulation, Green energy, Clean energy, Renewable energy, Energy transition, Solar energy, Energy security, Circular economy, Green production, Green products, Green materials, Green processes, Green technologies, Green initiatives, Green certification

Interest Conflicts
The author(s) declare(s) that there is no conflict of interest concerning the publishing of this paper.