

CORPORATE CLIMATE RISKS: MEASUREMENTS AND FINANCIAL RESPONSES

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Abstract: *As climate change increasingly affects the global economy, businesses are facing not only environmental challenges but also mounting climate risks. This paper focuses on analyzing two key categories of climate-related risks, including physical risks and transition risks and their impacts on corporate financial performance. Based on this analysis, the study proposes a set of financial solutions for mitigating and responding to climate risks, including climate insurance, green financial instruments, and the integration of climate risk into corporate financial models. Finally, the paper offers several policy implications aimed at strengthening the resilience and long-term climate risk preparedness of Vietnamese firms.*

• Keywords: *climate risks, firm-level climate exposure, climate risk measurements, financial responses.*

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1. Introduction

Recent studies have identified climate change as one of the most urgent global concerns (World Economic Forum, 2019), with an estimated financial burden of approximately USD 1 trillion on businesses due to climate-related risks (Roston, 2019). Since the 20th century, the average global surface temperature has been rising by approximately 0.2°C per decade (Kozarcenin, Liu, & Andresen, 2019). Research indicates that around 70% of global economic activities are adversely affected by weather-related phenomena (Anton, 2021). By 2050, global GDP could shrink by roughly 4%, translating into economic losses of up to USD 7.9 trillion if timely mitigation measures are not undertaken (Sun et al., 2023). The increasing frequency and intensity of extreme weather events such as droughts, floods, heatwaves, and tropical cyclones pose profound risks to financial stability and business continuity worldwide (IPCC, 2022). Beyond the direct physical consequences, the global transition toward a low-carbon economy introduces complex transition risks, encompassing regulatory shifts, technological disruption, market reconfiguration, and mounting societal pressure.

Business operations are increasingly vulnerable to the financial repercussions of climate change, which affect economic performance through both direct and indirect impacts (Addoum, Ng, & Ortiz-Bobea, 2023; LePoiré, 2013; Sun et al., 2020). Specifically, climate risks encompass both physical impacts and regulatory challenges associated with the implementation of decarbonization or green transition measures. Physical

risks may manifest as gradual and cumulative threats over time such as increasing variability in temperature and precipitation, rising sea levels or as immediate, severe consequences of natural disasters (Woetzel, Pinner, & Samandari, 2020). Climate-related damage to a company's tangible assets can lead to higher production costs per unit, and if selling prices remain unchanged, the firm's financial performance will deteriorate. Indirect impacts such as government policies aimed at reducing greenhouse gas emissions, shifts in decarbonization strategies, changes in consumer preferences toward environmentally friendly products, and potential class-action lawsuits against companies for harming communities may undermine a firm's financial performance through increased costs, asset devaluation, and reputational damage. Transition-related risks, driven by governmental policy implementation, have already had significant economic effects, leading to business bankruptcies and job losses (Albitar, Al-Shaer, & Liu, 2023).

Moreover, transition costs also contribute to financial risks (Wang, Wu, & Zhang, 2022). Operating in a high climate-risk environment elevates financial costs, as lenders tend to impose higher interest rates on companies involved in risk-prone activities. Additionally, demand for a firm's products may decline if a significant portion of consumers experience adverse consequences from climate change, such as job loss and income reduction (Addoum, Ng, & Ortiz-Bobea, 2023; Ambrosio et al., 2020; Karpoff, Lott, & Wehrly, 2005; Pankratz & Schiller, 2021; Sarkis, Gonzalez-Torre, & Adenso-Diaz, 2010; Sun et al., 2020). In

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addition, regulatory risks, such as additional taxes on greenhouse gas emissions or investments in advanced technologies, will impact emission-sensitive sectors. Even sectors less sensitive to emissions may experience indirect consequences of climate legislation through cost pass-through effects, thereby affecting production expenses (Eleftheriadis & Anagnostopoulou, 2015). Furthermore, the impact of global warming on business costs also depends on plant location, suggesting that firms with facilities in hotter regions will face higher production costs (Hugon & Law, 2019).

Therefore, the identification, quantification, and management of climate-related risks have become vital imperatives for businesses, particularly those operating in highly exposed sectors such as energy, finance and banking, real estate, food processing, agriculture, tourism, and logistics, etc. Climate risks have transcended environmental concerns to become measurable financial risks, exerting direct impacts on firms' profitability, market valuation, and capital access (Giglio, Kelly, & Stroebel, 2021). However, businesses especially those in developing economies such as Vietnam still face considerable constraints in terms of technical capacity and appropriate tools to assess and integrate climate risks into internal financial governance frameworks. Access to financial instruments for climate risk mitigation, including climate insurance, green bonds, and green credit, remains limited due to underdeveloped legal frameworks, technical gaps, and funding challenges.

This study aims to: (1) analyze the current landscape of the two principal categories of climate-related risks affecting businesses including physical risks and transition risks; and (2) propose appropriate financial instruments and mechanisms to mitigate and respond to such risks. Based on these analyses, the study presents targeted policy recommendations for government regulators and other relevant stakeholders.

2. Firm level Climate risks and Financial impacts

2.1. The concept of Climate risks

The Intergovernmental Panel on Climate Change (IPCC) defines risk as "the potential for adverse consequences for human or ecological systems resulting from exposure to climate-related hazards" (IPCC, 2022). From a financial and economic standpoint, the Task Force on Climate-related Financial Disclosures (TCFD, 2017) classifies climate-related risks into two broad categories: physical risks and transition risks- each reflecting distinct but significant sources of business exposure.

Physical risks refer to the direct consequences of climate change on tangible assets, workforce safety, and supply chain continuity. These risks can be further

categorized into: (i) Acute physical risks, which encompass short-term, extreme weather events such as hurricanes, floods, droughts, heatwaves, or wildfires; and (ii) Chronic physical risks, representing long-term impacts of climate change, including sea-level rise, elevated average temperatures, and altered rainfall patterns. Such changes can lead to reduced labor productivity, increased maintenance costs, and gradual devaluation of physical assets. According to TCFD (2017), physical risks may disrupt entire industries and regions, particularly those situated in coastal zones or ecologically vulnerable areas.

Transition risks, on the other hand, stem from the systemic shift toward a low-carbon and environmentally sustainable economy. TCFD (2019) identifies four major sources of transition risks: (i) Policy and regulatory changes, including the imposition of stricter greenhouse gas (GHG) emission standards, carbon taxation schemes, and green financing requirements; (ii) Technological evolution, necessitating investment in clean technologies such as renewable energy, electric vehicles, precision agriculture, or sustainable waste management; (iii) Market dynamics, as consumers and investors increasingly demand green products, low-carbon supply chains, and ESG-aligned business models; and (iv) Reputational risks, where firms failing to respond adequately may suffer reputational damage and erosion of market share due to misalignment with stakeholder expectations.

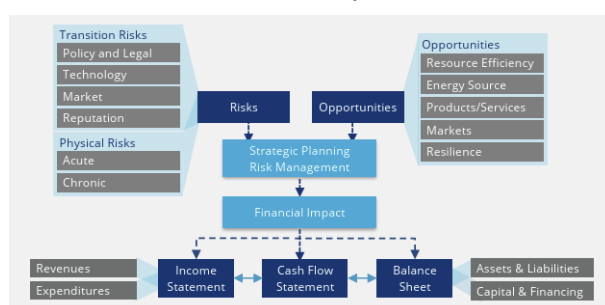
2.2. Climate risks and Financial impacts

Whether derived from physical disruptions or transition pressures, climate risks can significantly influence a firm's financial performance, both directly and indirectly. As can be shown in the Figure 1, these effects are increasingly visible through channels such as operating costs, cash flow volatility, capital structure shifts, creditworthiness, and stakeholder engagement (TCFD, 2021). Acute events can halt production, damage infrastructure, or trigger costly supply chain interruptions. Chronic risks tend to gradually erode asset value, strain operational budgets, and reduce margins. Meanwhile, transition risks may result in elevated compliance costs or necessitate capital expenditures to adopt sustainable technologies. Financial institutions may reassess credit ratings or raise lending premiums for businesses with high climate exposure. Unaddressed, such risks can ultimately lead to a decline in firm valuation and a weakening of investor confidence.

Climate change-related risks affect corporate financial operations through both direct and indirect channels (Sun et al., 2020). Direct impacts include disruptions to production and operations, such as damage to physical assets, raw materials, manufacturing

technologies, and supporting infrastructure. Indirect impacts, on the other hand, stem from changes in the operating and competitive environment such as the introduction of new regulations on greenhouse gas emissions or environmental protection that may alter investment or consumption decisions, or trigger legal disputes related to public health and environmental responsibility. When a company becomes involved in litigation, it often suffers significant reputational damage and faces a series of subsequent financial difficulties (Iftikhar, Bagh, & Khan, 2024). Both of these channels direct and indirect affect corporate financial governance and long-term business success.

Figure 1: Climate-related risks, opportunities, and financial impact



Source: TCFD, 2021

Companies operating in different countries face varying social and regulatory contexts regarding climate change policies and emissions trading systems. Although these mechanisms share common principles, their implementation diverges significantly. As a result, climate-related policies influence firms' strategic planning in distinct ways depending on national circumstances (Kolk & Pinkse, 2004), implying that the impact of climate change on corporate performance is likely to vary by geography and policy environment. Several other studies have also explored the effects of climate change risks on corporate behavior (Bagh, Fuwei, & Khan, 2024b; Berkhout, Hertin, & Gann, 2006; Gasbarro & Pinkse, 2016; Linnenluecke, Griffiths, & Winn, 2013), as well as the nonlinear influence of environmental, social, and governance (ESG) performance on a firm's sustainable growth (Bagh et al., 2024).

More recently, some studies have reported that climate change can influence firm performance, although empirical evidence remains inconclusive (Anton, 2021; He et al., 2019; Huang et al., 2018; Secinaro et al., 2020). While the potential macroeconomic consequences of climate change have been widely discussed, empirical studies examining its specific impact at the firm level remain limited (Cevik & Miryugin, 2023).

Emerging literature has demonstrated that climate change risks negatively affect firms' financial management, including reductions in corporate investment (Painter, 2020), declining stock performance (Choi, Gao, & Jiang, 2020), weaker market returns (Bansal, Ochoa, & Kiku, 2017), and lower firm valuation (Matsumura, Prakash, & Vera-Muñoz, 2014). Additionally, climate risks are associated with higher cost of capital (Balvers, Du, & Zhao, 2017; Huynh, Nguyen, & Truong, 2020; Javadi & Masum, 2021), along with adverse effects on sales, productivity, profitability (Jawid, 2020), and corporate social responsibility (Mbanyele & Muchenje, 2022). According to Chang et al. (2024), in order to manage rising financial risks and maintain flexibility, firms may reduce dividend payouts and increase the use of share repurchases to enhance liquidity buffers and mitigate the effects of potential future cash flow shortages in the face of climate-related shocks.

3. Measuring climate risks at the firm level

Measuring climate risks at the firm level remains a significant challenge due to the lack of standardized data, approaches, and tools. According to Li et al. (2024), there are three primary types of data sources commonly used to assess climate risk exposure at the firm level: (1) voluntary disclosure data, (2) regulatory financial reporting data, and (3) earnings call transcripts.

(1) Voluntary Disclosure

Reid and Toffel (2009) were among the first to use corporate disclosures submitted to the Carbon Disclosure Project (CDP) to evaluate firms' climate risk exposure. Their approach is relatively straightforward and based on a binary indicator: whether or not a company disclosed climate-related information (1 = disclosed, 0 = not disclosed). This measure reflects the firm's level of commitment and transparency, and indirectly serves as a proxy for its climate risk exposure and risk management capacity. Subsequent studies have expanded this method by performing quantitative analyses of the disclosed CDP content, such as Li et al. (2024), Cohen et al. (2023), and Matsumura et al. (2014). However, this approach has limitations, particularly the potential bias from voluntary reporting practices and the risk of "greenwashing," where firms embellish their climate efforts to gain reputational advantages.

(2) Regulatory Disclosure

Since 2010, the U.S. Securities and Exchange Commission (SEC) has required listed companies to disclose climate-related risks in their financial reports (Forms 10-K and 8-K). This approach employs natural language processing (NLP) techniques to scan and extract climate risk-relevant text from corporate filings (Berkman et al., 2024). Based on this methodology,

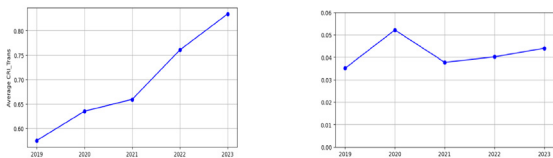
a climate risk keyword dictionary is constructed and iteratively refined to identify climate-related phrases within 10-K filings. Each relevant text segment is then assigned a relevance score, which is aggregated into an annual firm-level climate risk index. The advantages of this method include broad coverage and high reliability, as the disclosures are subject to external auditing. However, one major challenge lies in the inconsistency among firms in interpreting what constitutes “material climate risk,” along with delays in reflecting real-time developments (Matsumura et al., 2024).

(3) Earnings Call Transcripts

A promising and increasingly adopted method involves analyzing quarterly earnings call transcripts to gauge a company’s awareness and response to climate risks. According to Sautner et al. (2023), statements made by executives and investors during earnings calls offer timely, accurate, and substantive reflections of climate risk concerns. Their method employs unsupervised machine learning to identify climate-related bigrams and classify them into three categories: physical risks, transition risks, and opportunities. The frequency of these bigrams in each transcript is then calculated to construct a quarterly climate risk exposure index. More recently, Li Q. et al. (2024) developed a hybrid methodology combining dictionary-based approaches with supervised machine learning and manual validation to improve transparency and precision. The authors distinguish between physical and transition risks, building representative bigram dictionaries from thousands of earnings calls. They then compute the frequency of these bigrams to determine each firm’s quarterly and annual climate risk exposure levels.

4. The current status of climate risk in Vietnam

Figure 2. Trend of average Transition risks over the period of 2019-2023 **Figure 3. Trend of average Physical risk over the period of 2019-2023**



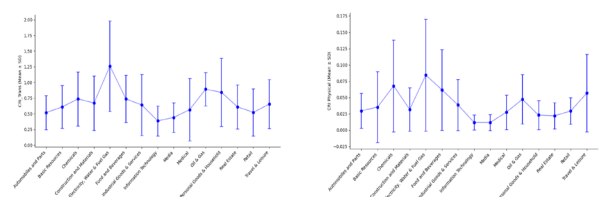
Source: Bui Thu Hien et al., 2025

The Transition Risk Index (CRI_Trans) for Vietnamese companies from 2019 to 2023 indicates a significant upward trend in the frequency of transition-related terminology in corporate reports, as illustrated in Figure 2. Overall, the index has increased sharply over the years, with the exception of 2021, which showed only a modest rise reflecting the economic prioritization during the COVID-19 pandemic over sustainability initiatives. Meanwhile, fluctuations in the Physical Risk Index (CRI_Phy) among publicly listed firms in Vietnam during the same period (shown

in Figure 3) reveal changes in the intensity and frequency of climate events. In 2019, natural disaster-related economic losses exceeded VND 7 trillion, prompting businesses to develop greater awareness of climate risks. In 2020, Typhoon Molave and historic flooding caused damages of nearly VND 40 trillion, resulting in a surge of climate risk references in corporate disclosures. Conversely, 2021 saw a record low economic loss of just over VND 5 trillion, leading to a decline in the CRI_Phy index. However, 2022 marked a resurgence of extreme weather events, with losses amounting to approximately VND 19.5 trillion, pushing the index upward again. This trend continued into 2023, when more than 1,145 climate-related incidents caused damages exceeding VND 8.2 trillion, reinforcing firms’ awareness of physical climate risks and maintaining a high level in the CRI.

As can be seen in Figure 4 & 5, Climate-related risks in Vietnam vary considerably across industries, with notable differences between physical and transition risk exposure. Industries such as Electricity, Water & Fuel Gas, Oil & Gas, Chemicals, and Food & Beverages exhibit the highest physical risk levels due to their vulnerability to extreme weather events and environmental changes. The Electricity and Fuel sector, particularly reliant on hydropower, is severely affected by prolonged droughts and declining water levels caused by El Niño. Thermal power generation also suffers from temperature fluctuations that reduce efficiency. Rising sea levels and storm intensification further jeopardize coastal infrastructure and offshore oil platforms, raising maintenance and investment costs (Vu Sy Cuong et al., 2022). These cumulative threats make the energy sector the most exposed to physical risks. The Chemical industry is similarly impacted due to its reliance on energy and resource-intensive processes. Extreme weather disrupts input supplies like oil, gas, and electricity, increasing operational and supply chain risks. Meanwhile, the Food and Beverages sector, including aquaculture and agriculture, faces soil erosion, flooding, and heat stress that undermine yields and infrastructure. Notably, the degree of risk varies within sectors. For example, in the Food sector, agriculture and fisheries are more exposed than beverage producers. Similarly, different types of power sources (hydro, thermal, gas) face distinct risk profiles.

Figure 4. Transition risks across Industry **Figure 5. Physical risks across Industry**



Source: Bui Thu Hien et al., 2025

Regarding transition risks, which arise from policy shifts, technological change, and market dynamics, energy-related sectors once again top the list. Vietnam's dependence on fossil fuels, particularly coal, and its commitment to phasing out coal-fired power by the 2040s raise concerns about stranded assets and long-term financial viability (World Bank, 2022a; Vu Sy Cuong et al., 2022). Manufacturing sectors, including Industrial Goods and Personal & Household products, are heavily exposed due to high emissions and growing regulatory pressure. New domestic requirements such as GHG inventory mandates under Decision No. 13/2024/QD-TTg combined with external mechanisms like the EU's Carbon Border Adjustment Mechanism (CBAM), challenge export-dependent firms to adopt cleaner technologies (World Bank, 2022b). The Chemicals and Food sectors also face high transition risks due to emissions intensity and water usage, alongside rising demands from international buyers for sustainable production. Although many Food companies highlight "sustainable agriculture" in reports, implementing such practices requires costly upgrades and technical capacity (Choudhary et al., 2023). Construction must reduce 74.3 million tonnes of CO₂ by 2030 (Ministry of Construction, 2022), but faces technological, market, and financing barriers to transition. Similarly, the Healthcare sector, contributing 4.6% of global GHGs, is increasingly targeted for improved waste and emissions management (WHO, 2023). By contrast, sectors like IT, Media, and Retail currently face lower climate transition risks due to minimal direct environmental impacts. However, as Vietnam progresses toward its net-zero target, even low-risk sectors will face rising expectations from regulators and markets alike.

In Vietnam, following the Net Zero by 2050 commitment at COP26, a series of policy measures have been introduced, including the amended Law on Environmental Protection (2020), the National Climate Change Adaptation Plan, and Circular No. 17/2022/TT-NHNN on green credit. However, the implementation of climate risk quantification and financial integration at the enterprise level remains limited. According to a survey by the International Finance Corporation (IFC, 2022), most small and medium-sized enterprises (SMEs) in Vietnam have yet to incorporate climate risks into their financial planning or investment appraisal processes. Many still confuse climate risk with basic environmental compliance, and lack the tools or capacity to quantify such risks in monetary terms.

Moreover, the current legal framework remains largely advisory in nature. Although the 2020 Law on Environmental Protection mandates GHG inventory reporting, it does not require firms to disclose climate-related financial risks. Similarly, Circular No.

17/2022/TT-NHNN from the State Bank of Vietnam only recommends that credit institutions "integrate environmental and social risks" into their lending practices, but lacks an effective supervisory mechanism.

In addition, Vietnam's green finance market remains fragmented. While the government has issued several sovereign green bonds, private enterprises still face significant barriers in accessing green finance due to the absence of standardized evaluation criteria, independent verification mechanisms, and specialized risk assessment tools (World Bank, 2023).

5. Financial responses to corporate climate risks

Climate risks are increasingly turning into real financial threats for both businesses and investors. Therefore, beyond measurement and disclosure, companies must proactively implement financial mechanisms to mitigate, respond to, and adapt to climate change. Based on the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD, 2021), this study proposes several financial solutions applicable to Vietnamese firms as follows:

5.1. Climate insurance and risk transfer

One of the most direct approaches to mitigating financial risks from climate change is through insurance. At present, traditional insurance products such as property insurance, business interruption insurance, and catastrophe insurance are already being used by large corporations to hedge against physical risks. In particular, parametric insurance products, which trigger payouts based on predefined weather indices (e.g., rainfall, wind speed, or extreme temperatures) rather than on the assessment of physical losses, should also be explored and implemented as an innovative solution.

5.2. Green financial instruments and sustainable investment

According to TCFD (2021), one of the most effective financial solutions available to firms is to raise capital for adaptation and emission-reduction activities through green financial instruments. These instruments not only help firms align with sustainability goals but also provide access to emerging markets of environmentally conscious investors. By integrating climate objectives into financial decision-making, firms can simultaneously reduce climate-related risks and enhance long-term financial resilience.

Green bonds are among the most prominent tools in this regard. These are debt securities issued specifically to fund projects that yield positive environmental outcomes. Typical examples of eligible projects include investments in renewable energy, wastewater treatment, sustainable urban transport, and green-certified infrastructure. Green bonds offer dual benefits: they enable firms to diversify their investor base by appealing to ESG-focused institutions and also

demonstrate corporate responsibility in environmental stewardship.

In addition, green credit mechanisms also known as green loans offer another impactful avenue for financing sustainable development. These loans are typically provided at preferential interest rates, conditional upon the borrower meeting certain environmental performance criteria, such as reduced carbon emissions, lower energy consumption, or improved resource efficiency. By linking loan conditions to sustainability outcomes, green credit instruments create strong financial incentives for firms to adopt environmentally responsible business practices.

A third important mechanism is the deployment of sustainable investment funds, including exchange-traded funds (ETFs), pension funds, and actively managed ESG portfolios. These funds incorporate environmental, social, and governance (ESG) criteria into their investment selection frameworks. For firms that meet these ESG standards, inclusion in such portfolios can result in improved access to capital and enhanced market valuation. Moreover, sustainable investment funds are gaining significant traction globally, reflecting a growing investor preference for long-term value creation that accounts for climate and social considerations.

5.3. Integrating climate risks into internal financial systems

According to TCFD (2021), climate risks should not be treated as a standalone or isolated issue, but rather should be fully integrated into a firm's financial governance, enterprise risk management, and long-term strategic planning. Such integration ensures that financial decision-making reflects not only traditional market risks, but also the increasingly complex dynamics of environmental uncertainty.

One critical tool is climate scenario analysis, which enables firms to simulate climate change pathways such as a 1.5°C or 2°C temperature rise and assess the long-term implications for cash flows, fixed assets, and profitability. In addition, companies can implement climate stress tests, similar to those employed by central banks, to evaluate the vulnerability of investment portfolios or financial assets to climate shocks.

Furthermore, climate-adjusted cash flow analysis is essential to revalue long-term investments, taking into account transition costs (e.g., carbon taxes) and recovery expenses following extreme weather events. These tools not only enhance the precision of financial planning but also strengthen firms' decision-making capabilities in an increasingly climate-volatile business environment.

5.4. Implications for other stakeholders

To enhance resilience and minimize losses from climate risks in the context of global integration and

the green transition, national regulators should urgently standardize the legal framework for climate risk disclosure. This includes gradually moving toward mandatory adoption of TCFD recommendations for listed enterprises and financial institutions. Such regulatory mandates will not only promote transparency but also create positive pressure for domestic firms to align with international standards.

Simultaneously, it is necessary to develop and promulgate a national set of green finance evaluation standards, including a green bond rating system, green credit criteria, and independent auditing mechanisms, in order to ensure the credibility and effectiveness of climate finance instruments.

Moreover, to ensure inclusive access, the government should implement targeted policies to support small and medium-sized enterprises (SMEs) in accessing transition finance. These may include the establishment of credit guarantee funds, concessional lending schemes, and technical assistance programs focused on climate risk measurement, disclosure, and governance.

In addition, financial institutions and investors should actively incorporate climate risk considerations into their credit assessment models and investment decisions. Companies with clear transition strategies and transparent climate risk disclosures should be prioritized in loan and investment portfolios. Financial institutions also play a pivotal role in fostering the development of the green finance market by establishing ESG investment funds, creating specialized climate finance products, and engaging in public-private partnerships for sustainable infrastructure projects with transformative impact. These measures are critical for building a climate-resilient financial system that can support an effective and inclusive national green transition.

References:

- Ngân hàng Nhà nước Việt Nam. (2022). *Thông tư 17/2022/TT-NHNN quy định về quản lý rủi ro môi trường và xã hội trong hoạt động cấp tín dụng*.
- Giglio, S., Kelly, B., & Stroebe, J. (2021). Climate finance. *Annual Review of Financial Economics*, 13, 15–36. <https://doi.org/10.1146/annurev-financial-110119-102154>
- IPCC. (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Intergovernmental Panel on Climate Change. <https://www.ipcc.ch/report/ar6/wg2/>
- Li, Q., Shan, H., Tang, Y., & Yao, V. (2024). Corporate climate risk: Measurements and responses. *SSRN*. <https://doi.org/10.2139/ssrn.4372107>
- Matsumura, E. M., Prakash, R., & Vera-Muñoz, S. C. (2014). Firm-value effects of carbon emissions and carbon disclosures. *The Accounting Review*, 89(2), 695–724. <https://doi.org/10.2308/accr-50629>
- Matsumura, E. M., Kim, H., & Trinh, Q. T. (2024). Materiality of climate risk disclosure: Evidence from 10-K filings. *Journal of Accounting and Economics*. <https://doi.org/10.2139/ssrn.4532100>
- World Bank (2022). *Vietnam Climate Risk Country Profile*. <https://climateknowledgeportal.worldbank.org>
- Nordhaus, W. D. (2019). Climate change: The ultimate challenge for economics. *American Economic Review*, 109(6), 1991–2014. <https://doi.org/10.1257/aer.109.6.1991>
- Reid, E. M., & Toffel, M. W. (2009). Responding to public and private politics: Corporate disclosure of climate change strategies. *Strategic Management Journal*, 30(11), 1157–1178. <https://doi.org/10.1002/smj.796>
- Sautner, Z., van Lent, L., Vilkov, G., & Zhang, C. (2023). Firm-level climate change exposure. *Journal of Finance*, 78(1), 245–285. <https://doi.org/10.1111/jofi.13189>
- TCFD. (2017). *Recommendations of the Task Force on Climate-related Financial Disclosures*. <https://www.fsb-tcfd.org>
- TCFD. (2019). *Technical Supplement: The Use of Scenario Analysis in Disclosure of Climate-related Risks and Opportunities*. <https://www.fsb-tcfd.org/publications>
- TCFD. (2021). *Guidance on Metrics, Targets, and Transition Plans*. <https://www.fsb-tcfd.org/publications>