



**IMPACTS OF CLIMATE CHANGE ON FINANCIAL
PERFORMANCE OF AGRICULTURAL, FOOD,
AND BEVERAGE COMPANIES LISTED
ON THE STOCK EXCHANGE
OF THAILAND**

**BY
KRITSADA LEELIANG**

**A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR
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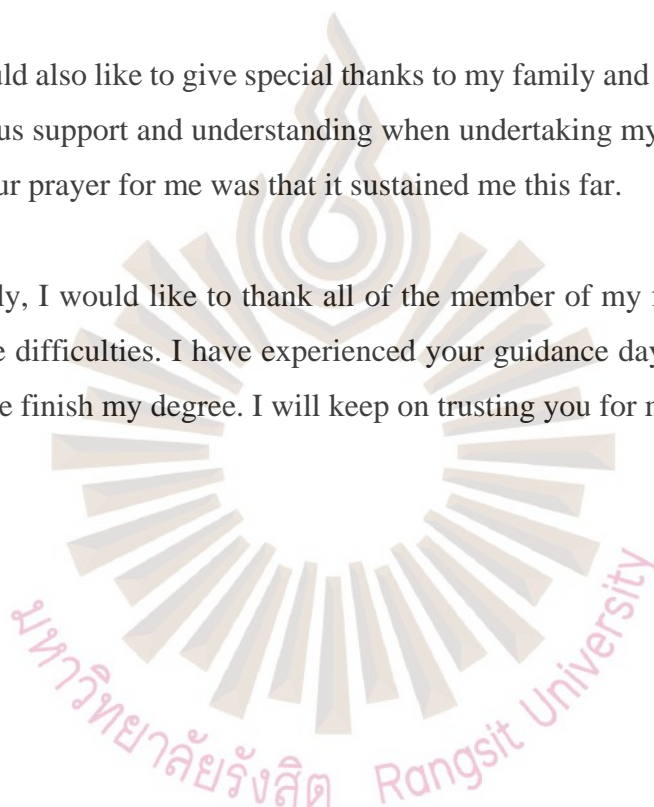
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Abstract

The objectives of this thesis was to study the impacts of climate change on the financial performance of agriculture listed on the Stock Exchange of Thailand. This research uses secondary data consisting of return on assets and return on equity, as reported in financial reports of approximately 31 companies. This study employed data for ten years, from 2013 to 2022. The meteorological data were acquired from the Thai Meteorological Department. The panel data of the independent climate change variables and dependent financial performance variables were collected. The control variables are capital structure (Debt-to-equity ratio), operating cash flow to total assets ratio, company size, and GDP growth. According to the statistical analysis, multiple regression both fixed and random effect models were conducted to test the relationship between the dependent and independent variables. The results present the impact of climate change on the financial performance on the agricultural, food, and beverage companies. It is found that Return on Assets ratio is positively influenced by the rainfall index and operating cashflow to total assets ratio. On the other side, the average temperature and capital structure negatively impact to Return on Assets. Additionally, the average temperature and the humidity index illustrate a negative impact on Return on Equity. While the operating cashflow to total assets ratio and company size show a positive impact, the capital structure negatively impacts on the Return on Equity.

(Total 98 pages)

Keywords: Average Temperature, Rainfall Index, Humidity Index, Debt-to-Equity Ratio, Operating Cash Flow to Assets Ratio, Size, Return on Assets, Return on Equity


Student's SignatureThesis Advisor's Signature

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The image contains a large, semi-transparent watermark of the Rangsit University logo. The logo is circular, featuring a central emblem with a flame-like or sunburst design. Below the emblem, the university's name is written in Thai script 'มหาวิทยาลัยรังสิต' and English 'Rangsit University'.

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CHAPTER 1

INTRODUCTION

1.1 STATEMENTS AND SIGNIFICANCE OF THE PROBLEMS

In the current era, human activities face climate phenomena including greenhouse gas emissions and weather instabilities. Climate change is a significant global issue affecting many human activities. In this concern, the United Nations published a framework convention for climate change. The conference of the Parties, at its 21st session, adopted the Paris Agreement on 12 December 2015. The Paris Agreement offers a robust framework for guiding the global endeavor towards the establishment of a world with net-zero emissions. This agreement encompasses the pledges made by all nations to decrease their emissions and collaborate in adapting to the consequences of climate change. Additionally, it urges countries to progressively strengthen their commitments. The agreement also outlines a pathway for developed nations to support developing nations in their efforts to mitigate and adapt to climate change while establishing a framework for transparent monitoring and reporting of each country's climate objectives (Ginglinger & Moreau, 2023). It enhances corporate sustainable development and reduces information asymmetries between stakeholders and top management (Suttipun & Dechthanabodin, 2022). While, studies have shown that extreme weather events and rising temperatures can have negative effects on economic growth and financial performance (Dell, Jones, & Olken, 2009; Musah, Gyamfi, Kwakwa, & Agozie, 2023; U-Din, Nazir, & Shahzad, 2023). Climate change is a significant global issue that has implications for various sectors including finance, accounting, and business models. Research has shown that climate change can impact international stock markets, with climatological and biological disasters having the most extreme reactions on global stock market indexes (Albouy, Graf, Kellogg, & Wolff, 2016). In addition, more research studies have shown that climate change risks directly impact companies' financial performance. For example, in the power sector,

climate change risks such as extreme weather events can lead to regional breakdowns in the power system, affecting the financial performance of listed electric power companies (Sun, Zou, Jiang, & Yang, 2023). Therefore, firms in industries less vulnerable to extreme weather face less climate-related risk (U-Din et al., 2023). Similarly, in the manufacturing industry, climate change risks, particularly humidity, can negatively correlate with companies' financial performance (Sakhel, 2017).

The achievement of corporate triumph is heavily influenced by a multitude of factors, one of which is the evaluation of financial performance. Financial performance is a comprehensive assessment of a company's financial outcomes and welfare. The process involves the analysis of various financial metrics and indicators to determine the efficiency with which a firm manages its resources, generates earnings, and delivers value to its stakeholders. This serves to improve the long-term viability of the company and minimize disparities in information between stakeholders and senior management (Dell et al., 2009; Suttipun & Dechthanabodin, 2022).

Climate change disclosure (CCD) also plays a significant role in the domain of financial performance, as CCD within large corporations enhances the return on assets (ROA) and sales growth in the long term (Musah et al., 2023). The deteriorating weather conditions and climate-related risks can harm financial performance, leading to reduced and more unpredictable earnings and cash flows. It has been observed that climate transition risk has a limiting effect on the performance of commercial banks in China, although this effect diminishes as the bank's size increases (Shrestha, Gunawardana, Piman, & Babel, 2020). These findings emphasize the need for businesses to incorporate climate change risks into their risk management frameworks and develop strategies to mitigate the adverse effects on financial performance.

The lack of extensive research on the effects of climate change to the financial performance of Thailand is a matter of great concern. Following the disastrous floods that occurred in Thailand in 2011, a significant number of Japanese-affiliated companies experienced negative consequences. In the contemporary era, it is crucial to consider the implications of climate change for all stakeholders involved in business

operations. As a result, the ultimate goal of maximizing shareholder wealth heavily relies on achieving favorable financial performance.

1.2 RESEARCH OBJECTIVES

1.2.1 Investigate the relationship between climate change and the financial performance of listed agricultural, food, and beverage firms in the Stock Exchange of Thailand.

1.2.2 To examine the impact of climate change and financial performance of agricultural, food, and beverage listed firms in the Stock Exchange of Thailand.

1.3 EXPECTED BENEFITS OF A RESEARCH PROJECT

1.3.1 Stakeholders are likely to contemplate the potential correlation between climate change and the financial performance of agricultural, food, and beverage companies listed on the Stock Exchange of Thailand.

1.3.2 Stakeholders possess valuable data to facilitate the assessment of the consequences of climate change and the economic viability of agricultural, food, and beverage corporations that are publicly traded on the Stock Exchange of Thailand.

1.3.3 The information pertinent to the investigation of Voluntary Disclosure Theory, Legitimacy Theory, and Stakeholder Theory. Overall, these theories suggest that climate change can have significant implications for firms' financial performance, with specific effects depending on various factors such as industry and geographical location.

1.4 SCOPE OF RESEARCH

The research consortium consisted of agricultural, food, and beverage enterprises that were publicly traded on the Stock Exchange of Thailand between 2012 and 2022. The information used in this study consists of ten 10-year-information and encompasses 31 companies consisting of agricultural 7, and food and beverage 24 listed companies. The main goal involved evaluating the financial outcomes of these publicly traded companies. Additionally, meteorological data obtained from the Thai Meteorological Department for the timeframe ranging from 2012 to 2022 was incorporated for analytical purposes. The consortium for research was composed of publicly traded agricultural, food, and beverage enterprises on the Stock Exchange of Thailand from 2012 to 2022. The study's data spanned ten (10) years and involved 31 companies. The main aim was to evaluate the financial outcomes of these listed corporations. Furthermore, meteorological information obtained from the Thai Meteorological Department for the period of 2012 to 2022 was incorporated for analysis.

1.5 CONCEPTUAL FRAMEWORK

Based on an exhaustive analysis of prior academic literature, it was ascertained that a collective sum of a variable subject to dependency existed, three autonomous variables, and four variables that served as controls. This conceptual framework is represented in Figure 1.1

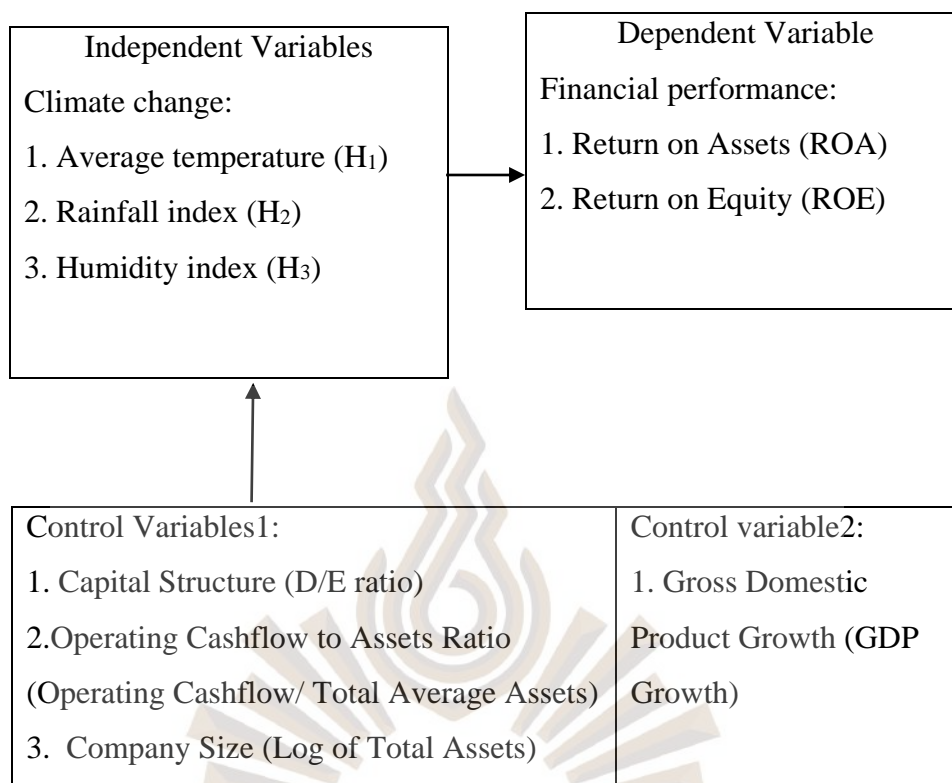


Figure 1.1 Conceptual framework

1.6 HYPOTHESES DEVELOPMENT

Climate change can have an impact on the financial performance of companies. Climate change risk affects the financial performance of companies by increasing their operating cost ratio (Dalal & Thaker, 2019). Studies have shown that climate change risks, such as temperature and rainfall, can affect the financial performance of agriculture-listed firms in Vietnam (Thai et al., 2023). Additionally, climate change can indirectly impact financial performance through market opportunities and corporate reputation (Giang et al., 2021). For example, consumers are increasingly interested in buying environmentally friendly products, which can create market opportunities for companies that align with sustainability goals (Thai et al., 2023). Furthermore, companies that actively implement environmental governance and protection measures can achieve a win-win situation between the environment and finance (Sun et al., 2020). However, it is important to note that the specific effects of climate change on financial

performance may vary depending on factors such as industry, location, and specific climate-related risks faced by the company.

1.6.1 Average Temperature:

Climate change can affect average temperature. As temperatures rise due to climate change, it can have negative impacts on economic activities and outputs, leading to a reduction in average global income by about 23% by 2100 if not mitigated. Additionally, climate change can also affect the viability of production activities and increase campaign costs in the manufacturing industry (Huang, Kerstein, & Wang, 2018). The Intergovernmental Panel on Climate Change (IPCC) assessment reports highlight that climate change is accelerating, with a documented increase in average temperature (Ginglinger & Moreau, 2023). These effects of climate change on temperature can have significant consequences, including physical and transition risks for investors and the pricing of stocks, bonds, and real estate (Giang et al., 2021). Overall, climate change has the potential to disrupt economic activities, impact global income, and introduce risks in various sectors due to changes in average temperature.

In this research paper, the hypothesis is as follows;

H1: Climate change (Average Temperature) is negatively influenced the profitability (measured by ROA and ROE)

1.6.2 Rainfall Index:

The rainfall index is an important factor that can have a negative impact on production activities and enterprises. High rainfall can cause flooding, which has been shown to affect production activities negatively (Giang et al., 2021). Additionally, previous studies have also highlighted the negative effects of rainfall. Therefore, it is crucial to consider the rainfall index when assessing the potential impact on production activities.

In this research paper, the hypothesis is as follows;

H2: Climate change (Rainfall Index) is negatively influenced the profitability (measured by ROA and ROE)

1.6.3 Humidity Index:

The humidity index is an important variable when considering climate change in Vietnam and regions with tropical monsoon climates. Previous research by (Andrew & Cortese, 2011; Thai et al., 2023) has shown the negative impact of humidity on human health in Asian countries. High humidity levels can have detrimental effects on human health and can contribute to various health issues (Giang et al., 2021).

In this research paper, the hypothesis are as follows;

H3: Climate change (Humidity Index) is negatively influenced the profitability (measured by ROA and ROE)

1.6.4 Control Variables:

Studies have shown that leverage (capital structure) has a negative relationship with financial performance, indicating that higher levels of debt can negatively impact a firm's performance (Chen, Song & Gao, 2023; Thai et al., 2023). On the other hand, firm growth and firm size have a positive impact on financial performance, suggesting that larger and growing firms tend to have better financial performance (Huang et al., 2018; Thai et al., 2023). These findings are consistent with previous research that has examined the relationship between these control variables and financial performance (Sun et al., 2020). Therefore, it can be concluded that these control variables play a significant role in determining a firm's financial performance.

In this research paper, the hypothesis is as follows;

H4: Control variables (measured by capital structure, cash return on asset ratio and size) are statistically significant to the financial performance (measured by ROA and ROE)

1.7 TERMINOLOGY

Average Temperature varies depending on the context. In the field of solar chromosphere models, different types of average temperatures are assessed, including mean, median, and ionization temperatures. The ionization temperature, which is related to the hydrogen ionization degree, is always higher than the mean and median temperatures, except in the photosphere (Rammacher & Cuntz, 2005). In thermodynamics, a physically correct definition of mean temperature is proposed based on equilibration processes and the role of energy and entropy. This definition is unique and applicable to ideal and non-ideal gases with temperature-independent heat capacity (Pagnottoni, Spelta, Flori, & Pammolli, 2022). Another method involves determining the average temperature of a measuring line by evaluating the delay time of a temperature-dependent dielectric medium (Puspita & Dewi, 2019). Additionally, temperature can be defined as the "right" integrating factor of exchanged heat in statistical thermodynamics, leading to the determination of the correct expression for entropy (Carati, 2006).

The Rainfall Index is a measure used to assess and quantify rainfall behavior and its variability. It can be used to analyze temporal patterns, intensity, and duration of rainfall events. The n-index is one such rainfall index that measures the temporal variability of rainfall behavior within an event (Li et al., 2019). Another rainfall index is the R' index, which takes into account the effect of preceding rainfall on the occurrence probability of sediment-related disasters during heavy rainfall (Albouy, Graf, Kellogg, & Wolff, 2016). In the context of India, a hydrological flood/drought index has been developed to identify years with excessive or deficient rainfall in different parts of the country (Singh, Kumar, & Kripalani, 1990). Additionally, a rainfall index insurance product called the Rainfall Index (RI) insurance has been developed for hay and pasture producers, which assesses expected payoffs based on rainfall shortage

probabilities (Nakai, Sasaki, Kaibori, & Moriwakiet, 2006). Overall, rainfall indexes provide valuable information for understanding and managing the impact of rainfall events in various contexts.

The humidity Index is a measurement that describes the level of humidity in a given area. It is often used to assess the comfort or discomfort of the atmospheric conditions for human beings. The index takes into account factors such as specific humidity, temperature, and relative humidity to provide a comprehensive understanding of the moisture content in the air. The humidity index can be calculated using various formulas and thresholds, depending on the specific purpose or application. For example, one study proposed a humidity index (HI) based on specific humidity thresholds to capture the leading mode of summer rainfall in China (Zeng & Zhang, 2019). Another study presented a simplified scale of apparent temperature, known as the temperature-humidity index (THI), which considers only dry-bulb temperature and humidity (Cuza, 2011). The use of a humidity index allows for a more accurate assessment of the atmospheric conditions and their impact on human comfort and well-being.

Capital structure refers to the composition of a company's long-term funding sources, including equity share capital, reserves and surplus, preference share capital, loans, and debentures. It is a crucial concept in finance as it determines the proportion of equity and debt in a company's liabilities, which significantly impacts its financial performance (Taddesse, 2021). The decision on capital structure involves selecting sources of funds from both internal and external sources, such as debt financing, to support company activities (Surachmad, Agustina, Ortega, & Khaddafi, 2023). Managing capital structure is important for organizations to improve quality and maintain a balance between current liabilities and ownership of capital (Maji & Kalita, 2022). Factors such as profitability, business risk, and interest rates also influence capital structure decisions (Dalal & Thaker, 2019). Overall, capital structure plays a vital role in determining a company's financial position and is a key consideration in financing assets and increasing business capital.

Operating Cashflow to Assets Ratio is a financial metric used to measure the profitability of a company. It calculates the amount of cash generated by a company's assets. The ratio is calculated by dividing the cash flow from operating activities by the average total assets of the company. The operating cashflow to assets ratio is an important indicator of a company's ability to generate cash from its investments. It is commonly used by investors and analysts to assess the financial performance and efficiency of a company (Bansal & Ochoa, 2011).

Company size refers to the scale or magnitude of a company, typically measured by the number of employees or other indicators such as annual revenue or volume of business. Different studies have used various definitions and scales of measurement to study the effects of company size on different aspects of business performance. For example, one study found that smaller companies tend to have higher injury frequency rates and higher rates of absenteeism, while larger companies generally have higher occupational health and safety standards (Jendra, 2018). In terms of financial performance, research has shown mixed results, with some studies suggesting a positive relationship between company size and financial results, while others find no significant influence or even a negative impact (Nordlöf, 2014; Rosique, 2010). The optimal company size can also be influenced by factors such as ownership structure, management objectives, and collaboration efficiency (Gulluscio, Puntillo, Luciani, & Huisin, 2020). Overall, the definition and measurement of company size can vary depending on the specific research context and objectives.

CHAPTER 2

LITERATURE REVIEW

The purpose of this literature review is to provide a general overview of how-to climate change is related to the financial performance of listed companies in the Stock Exchange of Thailand. This information serves this thesis before setting hypothesis testing and evaluating under the following theories (2.1 – 2.3) including the risk management concept (2.4) and the conclusion of the literature review in relation to the research objectives of this study.

2.1 Voluntary Disclosure Theory

2.2 Legitimacy Theory

2.3 Stakeholder Theory

2.4 Risk Management Concept

2.1 VOLUNTARY DISCLOSURE THEORY

Voluntary Disclosure Theory, which applies to accounting and corporate finance, implies that companies are inclined to voluntarily disclose specific information, exceeding the legal requirements. According to this hypothesis, companies may opt to furnish supplementary details to investors and stakeholders, including investors, customers, employees, and regulators to reduce information asymmetry that possesses superior information regarding their operations, financial condition, and prospects compared to external investors, offering more comprehensive and transparent information to promote trust, bolster their reputation, and companies can potentially decrease the perceived risk for investors ultimately decrease their cost of capital. Voluntary disclosure theory suggests that companies choose to disclose information voluntarily, and the transparency of these disclosures can have different effects on market and nonmarket outcomes. The completeness, clarity, and accuracy of voluntary nonfinancial disclosures are found to affect both market valuation and reputation risk

(Khalifa, Zouaoui, Othman, & Hussainey, 2023). Motivations for adopting integrated reporting, a form of voluntary disclosure, can differ from motivations for broader social and environmental sustainability reporting. Companies may shift to integrated reporting to refine or reveal their voluntary reporting philosophy, and the timing and duration of this shift can be influenced by social and environmental performance (Sharma, Gunawardana, Piman, & Babel, 2020). There is also a theory of asymmetries between voluntary and mandatory disclosure, where efficiently designed mandatory disclosure policies can substitute excessive voluntary disclosures. Mandatory disclosures are asymmetric, featuring conservative reporting of bad news (Leitold, Garschagen, Tran, & Diezet, 2021). Firms may tacitly collude by disclosing information when market demand is low, indicating a relationship between voluntary disclosure and production decisions (Iriyadi & Antonio, 2021).

Voluntary disclosure theory posits that organizations possess the capacity to opt for the revelation of specific data, such as carbon emissions, on a voluntary basis. The outcomes stemming from the examination demonstrate that organizations exhibiting higher ratings in terms of their environmentally proactive initiatives are more inclined to disclose their carbon emissions, while those with higher ratings in relation to environmentally detrimental actions are less inclined to do so. The likelihood of disclosure is also observed to augment as more organizations within the sector engage in disclosure. Counter to expectations, organizations with greater leverage are discovered to be less prone to disclosing their carbon emissions. Moreover, it is worth noting that organizations that divulged their emissions in the preceding year exhibit a significantly higher likelihood of revealing them in the current year, thereby denoting the persistence of the disclosure decision. These discoveries offer valuable insights into the elements that exert influence on organizations' choice to voluntarily disclose their carbon emissions (Matsumura, Prakash, & Vera-Muñoz, 2014).

Voluntary disclosure surpasses legal requirements, it can assist companies in staying abreast of regulatory changes and demonstrating compliance with evolving standards. This proactive approach may help mitigate legal risks and regulatory scrutiny (Khalifa et al., 2023). Many listed companies in the stock exchange were mandated by

rules and regulations Stock Exchange Commission to disclose sustainable information related to stakeholders. In this section communicate with stakeholders because many industries are affected by the weather causes climate change. In the part of consideration about information asymmetry many stakeholders considering business activities were affected the financial performance. Suppose, regulatory agencies like the government intervene setting tax regulations to reduce pollution from activities (Iriyadi & Antonio, 2021; Sharma et al., 2023). Moreover, the creditors consider the cost of business and how to drive effectively based on the cost of capital. Investors use information tools to measure financial performance. In the customer part, by attracting environmentally conscious customers, recruiting top talent, and differentiating themselves from competitors. While the listed companies disclose sustainable information, it reduces the financial risk of how to use financial instruments to drive business. The agriculture, food, and beverage listed companies were affected by uncertain weather information, especially climate change. So, how to plan the strategy to drive business reach to maximize stakeholders' participation with the different goals (Matsumura et al., 2014).

The relationship between voluntary disclosure theory and climate change revolves around the role of corporations in disclosing information related to their environmental impact and actions taken to mitigate climate change. Expanded disclosure can contribute to the efficiency of the market by providing investors with more accurate and timely information for valuing securities. As a result, this may lead to more precise pricing and a reduced likelihood of market inefficiencies. Voluntary disclosure theory suggests that companies have an incentive to disclose information beyond what is required by regulation or law, driven by factors such as reputation management, stakeholder interests, and potential economic benefits. The entities may disclose information about their efforts to address climate change to enhance their reputation as responsible corporate citizens. Positive perceptions among stakeholders like customers, investors, and other stakeholders can lead to increased trust and loyalty. In addition, climate change poses various risks to businesses, including regulatory changes, physical impacts (such as extreme weather events), and reputational risks. By voluntarily disclosing their environmental practices and climate-related risks,

companies can demonstrate proactive management of these risks to investors and stakeholders.

2.2 LEGITIMACY THEORY

Legitimacy Theory is an alien conspiracy theory that is applied within the realm of corporate social responsibility (CSR) and sustainability reporting. It posits that businesses operate within a social contract and strive to maintain their legitimacy by aligning their actions and behaviors with societal expectations and norms. In more basic terms, organizations strive to appear credible in the eyes of their stakeholders, including investors, customers, employees, regulators, and the broader community.

According to the Legitimacy Theory, organizations are viewed as entities operating within a broader framework, tasked with fulfilling societal responsibilities that extend beyond mere profit maximization. This social contract involves meeting expectations regarding ethics, environmental sustainability, social equity, and community engagement through actions perceived as socially responsible and in alignment with prevailing societal norms. The notion of legitimacy plays a pivotal role in ensuring the continual existence and prosperity of organizations, which may encompass the embrace of sustainable practices, backing for philanthropic initiatives, advocacy for diversity and inclusivity, and adherence to ethical standards (Wiesner, Philipp, & Harfst, 2022). Additionally, the understanding and management of the diverse expectations of stakeholders play a crucial role in Legitimacy Theory, involving a wide range of actors such as shareholders, employees, customers, suppliers, communities, and regulatory bodies (Pratiwi & Giovanni, 2022). By addressing the concerns and priorities of these stakeholders, organizations can bolster their legitimacy and cultivate trust. The implementation of Legitimacy Theory holds significant relevance in the sphere of sustainability reporting, as companies are progressively issuing reports that elaborate on their environmental, social, and governance (ESG) performance to evidence their commitment to sustainability and social responsibility. These reports serve as a tool for engaging with stakeholders and assist organizations in upholding their legitimacy in the eyes of society. Noncompliance with ethical standards,

participation in irresponsible practices, or divergence from societal expectations can imperil an organization's legitimacy, resulting in reputational harm and erosion of trust (Dalal & Thaker, 2019). Therefore, organizations must proactively monitor and adjust to evolving societal standards to prevent legitimacy crises (Galeone, Onorato, Shini, & Dell'Atti, 2023).

Legitimacy theory is a concept that is central to political sociology and political processes. It is a dynamic concept that encompasses the social networks and processes of legitimization. Legitimacy claims are influenced by changing power relations and expanding networks, leading to a greater variety of claims and counterclaims. The concept of legitimacy has been the subject of academic controversy, with debates between normative-theoretical and empirical approaches. However, a proposal has been made to reconcile these approaches and develop a unified conceptualization of legitimacy. This proposal aims to integrate normative-theoretical and empirical camps in legitimacy research. The construct of legitimacy has also been extended to include three novel legitimacy states between legitimacy and illegitimacy, and a model has been developed to analyze the dynamics of legitimacy state change. This framework bridges the research streams on legitimacy judgment formation and legitimation strategies. (Galeone et al., 2023; Wiesner et al., 2022; Pratiwi & Giovanni, 2022).

Legitimacy theory is a concept that is discussed in the field of accounting and organizations. It refers to the idea that organizations strive to maintain a positive image and reputation in order to gain legitimacy in the eyes of their stakeholders. This theory suggests that organizations engage in certain activities, such as disclosing their carbon emissions or implementing sustainable practices, in order to be seen as legitimate and socially responsible. These papers investigate the interconnectedness between the carbon behavior, reputation, and performance of organizations, as well as the potential influence of customers' responses to carbon performance on financial performance. Through the examination of these connections, these papers enhance comprehension of how organizations manage the intricate dynamics of legitimacy and sustainability (Iriyadi & Antonio, 2021).

Legitimacy theory proposes that organizations aim to preserve their legitimacy among stakeholders by aligning their actions and communications with societal expectations and norms. Industries with notable environmental footprints, such as energy, manufacturing, or transportation, depend on a social license to operate, which denotes the recognition and endorsement from stakeholders like communities, NGOs, governments, and the broader public (Iriyadi & Antonio, 2021). Engaging in discussions with communities, environmental groups, investors, and authorities to grasp concerns, request input, and exhibit receptiveness to stakeholder anticipations concerning climate change is vital (Dalal & Thaker, 2019). Moreover, climate change emerges as a significant apprehension for numerous stakeholders, prompting firms to utilize legitimacy approaches to showcase their dedication to tackling this matter and safeguarding their social license to operate. Firms may embrace legitimacy methods to proactively validate adherence to prevailing regulations and forecast forthcoming regulatory prerequisites linked to climate change mitigation and adjustment. Through the adoption of legitimacy techniques, like voluntary divulgence of environmental performance, execution of sustainability projects, or involvement in climate-focused endeavors, companies strive to boost their standing and cultivate trust with stakeholders attentive to climate change concerns. Furthermore, a dedication to enduring sustainability and adaptability can augment their legitimacy as conscientious corporate entities (Pratiwi & Giovanni, 2022).

2.3 STAKEHOLDER THEORY

The concept of stakeholder theory, within the framework of business management and ethics, argues that a corporation should consider the concerns of all stakeholders rather than solely focusing on maximizing shareholder value. Stakeholders, being individuals or groups who possess a vested interest in or are affected by a company's actions, encompass not only shareholders but also employees, customers, suppliers, communities, and other entities (Baumgartner, Hatami, & De Uster, 2016; Javadi & Masum, 2021). Stakeholder theory recognizes that companies' impact and are impacted by a multitude of groups, each with their own distinct interests and concerns. Stakeholder theory balances the interests of stakeholders that companies

should strive to find a middle ground between the needs of all stakeholders in order to achieve long-term sustainability and success (Jekwam & Hermuningsih, 2018). In the interests of all stakeholders, companies can establish trust, enhance their reputation, and generate value over the long haul, even if it may not always result in immediate financial gains (Milne & Grubnic 2011).

Stakeholder theory is a framework used to understand the impact of climate change on economic performance. Companies can fulfill stakeholders' demands by engaging in activities such as corporate social responsibility (CSR) and disclosing information related to climate change issues (Baumgartner et al., 2016; Capasso, Gianfrate, & Spinelli, 2020; Javadi & Masum, 2021; Jekwam & Hermuningsih, 2018). Research has shown that social performance consistently leads to improved economic performance, while the effect of environmental performance is smaller but still positive. Stakeholders increasingly demand transparency and accountability from companies, and financial disclosure can improve both CSR performance and investment returns. Companies that pay attention to climate change factors and adopt responsible reporting practices can enhance their reputation, mitigate risks, and strengthen their innovation capacity (Baumgartner et al., 2016; Capasso et al., 2020; Javadi & Masum, 2021; Jekwam & Hermuningsih, 2018). However, there is weak evidence for a significant relationship between governance and economic performance. This understanding of the importance of each dimension of CSR on economic performance can help managers make informed decisions and develop strategies that align with stakeholder expectations (Milne & Grubnic, 2011; Sila & Cek, 2017)

Stakeholder theory stresses the significance of considering the concerns and viewpoints of all stakeholders impacted by the decisions of a corporation, not just shareholders. In the context of climate change, the association between stakeholder theory and corporate behavior is of negligible importance as it fails to prompt companies to acknowledge and prioritize stakeholders impacted by climate change, encompassing not only shareholders but also employees, customers, suppliers, communities, governments, and future generations (Sila & Cek, 2017). Grasping their concerns, viewpoints, and anticipations concerning climate change is crucial. This interaction aids

companies in formulating more efficient climate strategies, establishing trust, and fostering cooperative approaches to confronting challenges associated with climate change (Milne & Grubnic, 2011). Each category of stakeholders might possess diverse outlooks, interests, and anticipations regarding climate change and corporate reactions to it. Stakeholder theory engages in continual discussions with stakeholders to comprehend their concerns, viewpoints, and anticipations linked to climate change. This interaction supports companies in devising more efficient climate strategies, fostering trust, and promoting collaborative methods to tackle challenges related to climate. Moreover, it advocates for transparency and answerability in corporate decision-making procedures, particularly those tied to climate change. Companies are anticipated to reveal pertinent details about their ecological performance, climate-related hazards and opportunities, and measures taken to alleviate and adjust to climate change. Open communication nurtures trust and empowers stakeholders to hold companies accountable for their commitments and activities related to climate change. Evaluating the potential repercussions of their activities, goods, and services on various stakeholders, including those associated with climate change, is essential. This encompasses contemplating both direct consequences like greenhouse gas emissions and resource exhaustion, as well as indirect repercussions such as alterations in weather patterns, disruptions in the supply chain, and community susceptibilities to climate-linked incidents (Jekwam & Hermuningsih, 2018). Stakeholder theory actively incorporates stakeholder input into their strategies for climate and decision-making procedures. This might entail assimilating stakeholder viewpoints into corporate governance frameworks, sustainability reporting models, risk management methodologies, and endeavors for innovation in products/services concerning mitigation and adaptation to climate change. By doing so, all stakeholders, as well as companies, can more effectively recognize and alleviate risks related to climate within their activities, supply chains, and reputations. Proactively dealing with stakeholder worries regarding climate change can strengthen corporate resilience and diminish the probability of adverse impacts on stakeholders and the broader society (Baumgartner et al., 2016; Capasso et al., 2020; Javadi & Masum, 2021; Jekwam & Hermuningsih, 2018).

2.4 RISK MANAGEMENT CONCEPT

Risk management is an essential concept applied in diverse industries and sectors for the purpose of identifying, assessing, ranking, and mitigating risks that possess the capacity to influence an organization's goals or undertakings. The fundamental objective of risk management lies in the minimization of unfavorable outcomes resulting from uncertainties, while concurrently maximizing potential opportunities (Galeone et al., 2023). Identification and documentation of potential risks that could potentially impede the organization's goals are crucial. Risks may potentially originate from various origins, encompassing internal procedures, external variables, project interdependencies, or alterations in the regulatory framework. Evaluation is conducted based on the likelihood of occurrence and the probable impact, facilitating the prioritization of risks and the efficient allocation of resources. Risk evaluation frequently entails quantitative evaluation (assigning numerical values to probability and impact) or qualitative analysis (subjective assessment grounded on expert opinion). Risk management formulates tactics to alleviate or reduce their repercussions. Moreover, a continuous surveillance of identified risks and the efficacy of mitigation tactics is imperative. This approach empowers organizations to adjust to evolving circumstances and emerging risks that may manifest over time. Strategies for mitigation may encompass the implementation of controls, risk transfer through insurance or contracts, avoidance of specific activities, or the acceptance of risks with contingency measures in place (Burstein & Zuckerman, 2023). Dissemination of risk management information is aimed at aiding stakeholders in comprehending potential hazards and their ramifications. Effective communication also fosters cooperation and decision-making processes, as alterations in the risk environment are critical for stakeholders to remain informed and make well-informed decisions. The frequency and level of detail in reports may be contingent on the specific requirements of the organization (Sakhel, 2017).

Risk management is the process of identifying, assessing, and managing risks to reduce their negative impact on an organization's goals. It involves evaluating different types of risks, such as financial, operational, strategic, and reputational risks, and implementing controls to mitigate them (Surachmad et al., 2023). Risk management

is crucial for businesses in various sectors, including banking, where it equips risk managers with tools to detect, analyze, and resolve risks (Galeone et al., 2023). Additionally, risk management is becoming increasingly important in supply chains due to the complexity of relationships between components and the occurrence of disruptions like climate change and geopolitical scenarios (Liu, Zhou, Yang, Hoepner, & Kakabadse, 2023). To address this, a machine learning approach using factor analysis and artificial neural networks has been proposed to achieve a more objective risk evaluation (Burstein & Zuckerman, 2023).

Risk management is a crucial aspect for companies in the context of climate change. Climate risks, such as floods, droughts, and extreme temperature events, can have significant impacts on various sectors, including power transmission and transformation systems. These risks can lead to power loss, damage to infrastructure, and financial losses for electric power companies in China (Sun et al., 2023). Previous studies have focused on identifying and understanding climate-related risks, but there is a need for a comprehensive overview of risk perception and responses across different categories and sectors (Sakhel, 2017). Effective risk management requires the development of financial regulations, better reporting requirements, and common policy frameworks to support investment decision-making and foster green science, technology, and innovation (Barbier & Burgess, 2017). Active risk management policies have real consequences and can have an impact on debt capacity and investment decisions (Pérez-González & Yun, 2013).

In conclusion, the previous research has presented the relationship between climate change and its impact on the financial performance of companies. Part of climate change has been widely acknowledged as one of the major sources of risk by the global community. The risks climate change poses are not confined strictly to the environment and direct physical impacts of global temperature rise but they also involve social, economic, and financial impacts (Pérez-González & Yun, 2013).. The probable consequence of this phenomenon is that it will bring about swift alterations to existing climatic patterns, thereby directly impacting economic sectors including tourism, transportation, agriculture, healthcare, insurance, and real estate. Numerous countries

and industries, including power generation companies in China, have extensively investigated this correlation (Eleftheriadis, Anagnostopoulou, Diavastis, & Konstantinos, 2012; Zhang, Deschenes, Meng, & Zhang, 2018). The impacts of climate change risks on financial performance from listed manufacturing firm Vietnam were investigated and found that Return on Asset (ROA), Return on Equity (ROE) and Earnings per share (EPS) have negative impacts on financial performance (Giang et al., 2021). In addition, higher levels of greenhouse gas emissions and energy consumption have a negative impact on firm value (Noh, 2017). The carbon emission is negatively associated with organizational performance (Liu et al., 2023). Thai et al (2023) showed that both rain and temperature have a significant and positive impact on financial performance measured by ROA when measuring climate change at the firm's factory location. However, the finding from other researchers may contra to the previous finding. For example, the study by U-Din et al. (2023) founded that the impacts of weather conditions on performance of banks is not significant in relation to catastrophes (U-Din et al., 2023). While other papers found some key climate change variables significant to the company performance. The financial performance of mining companies was found to be influenced by both advantageous and detrimental consequences stemming from climate change risk (Sun et al., 2020).

The link between risk management and climate change is elaborate and varied because of the considerable risks that climate change brings to businesses, economies, and societies, requiring the identification, evaluation, and prioritization of risks that might affect an organization's goals. The initiation of climate change brings about a wide array of risks, encompassing physical hazards (e.g., severe weather events, rising sea levels, changes in temperature patterns), transitional hazards (e.g., policy and regulation shifts, market changes, technological advancements), and liability hazards (e.g., legal proceedings, harm to reputation) (Eleftheriadis et al., 2012; Zhang et al., 2018). Risk management frameworks must include these climate-related risks for a thorough risk appraisal. Furthermore, climate change has the potential to worsen existing vulnerabilities within organizations and throughout supply chains, strategic planning procedures, financial risks, and regulatory and reporting mandates (Giang et al., 2021). Risk management procedures should assess how climate-related threats might

impact infrastructure, operations, supply chains, and stakeholders. Understanding vulnerabilities allows organizations to devise strategies to bolster resilience and adaptability to climate-related risks. The strategic processes of an organization must evaluate how climate-related risks and opportunities harmonize with their long-term objectives, business structures, and competitive tactics (U-Din et al., 2023). By integrating climate risk evaluations into strategic decision-making, organizations can more accurately foresee and handle emerging challenges and opportunities tied to climate change. Business uncertainties arising from climate change and the adequacy of risk management strategies may be insufficient (Sun et al., 2020). Techniques like scenario analysis and stress testing can aid organizations in exploring various potential climate scenarios and evaluating their resilience under different climate-related circumstances. Through scenario analysis, organizations can pinpoint possible "tipping points," systemic risks, and cascading consequences linked to climate change (Galeone et al., 2023). Within the financial sector, financial risk management encompasses aspects such as property loss, disruptions in supply chains, heightened insurance costs, and expenses related to litigation. Risk management tactics should incorporate financial tools like insurance, hedging, and diversification to alleviate climate-related financial risks. Additionally, financial entities and investors are progressively factoring climate-related risks into investment choices and portfolio management strategies. Climate-related regulations and reporting standards are swiftly evolving as governments, regulators, and stakeholders strive to tackle climate change. Effective risk management necessitates keeping abreast of regulatory advancements and ensuring adherence to climate-related disclosure mandates, such as those delineated by the Task Force on Climate-related Financial Disclosures (TCFD). By proactively addressing regulatory risks, organizations can reduce compliance expenses and reputational hazards linked to non-compliance. Moreover, climate change affects a wide range of parties, such as staff, clients, investors, communities, and authorities. Effective risk management involves actively engaging with stakeholders to grasp their worries, expectations, and preferences concerning climate change. Transparent communication regarding climate-related risks and mitigation endeavors can heighten stakeholder confidence and bolster support for organizational resilience strategies (Sun et al., 2023).

CHAPTER 3

RESEARCH METHODOLOGY

In this thesis studies the impacts of climate change risks on the financial performance from listed property and construction companies on the Stock Exchange of Thailand in the following:

- 3.1 Research population and samples
- 3.2 Data Collection
- 3.3 Research Methodology
- 3.4 List of Variables and Measurements

3.1 RESEARCH POPULATION AND SAMPLES

The research consortium consisted of agricultural, food, and beverage enterprises that were publicly traded on the Stock Exchange of Thailand between 2012 and 2022, encompassing 31 companies. These 31 companies are the population and the samples of the study.

3.2 DATA COLLECTION

This research uses secondary data from agricultural, food, and beverage-listed companies in the Stock Exchange of Thailand related to financial performance consisting of return on assets, represented in financial reports (form 56-1) encompassing approximately 31 companies. On the other hand, this study started from 2012 to 2022. The meteorological data acquired from the Thai Meteorological Department for the period spanning from 2012 to 2022 was integrated for analysis.

3.3 RESEARCH METHODOLOGY

The data of this study is a panel data. Multiple regression fixed/random effect analysis was employed to test the relationship between the dependent variables and independent variables. This study aims to determine the impact of climate change risks on financial performance. The study scope was agriculture, food, and beverage enterprises that were publicly traded on the Stock Exchange of Thailand between 2012 and 2022. This research formally investigates the impact of climate risk on a company's financial performance by estimating the following regression models:

$$ROA_{it} = \beta_0 + \beta_1 \text{Temp}_{it} + \beta_2 \text{Rain}_{it} + \beta_3 \text{Humid}_{it} + \beta_4 \text{Debt}_{it} + \beta_5 \text{OCFTA}_{it} + \beta_6 \text{Size}_{it} + \beta_7 \text{GDPGrowth}_{it} + \epsilon_{it} \quad (1)$$

$$ROE_{it} = \beta_0 + \beta_1 \text{Temp}_{it} + \beta_2 \text{Rain}_{it} + \beta_3 \text{Humid}_{it} + \beta_4 \text{Debt}_{it} + \beta_5 \text{OCFTA}_{it} + \beta_6 \text{Size}_{it} + \beta_7 \text{GDPGrowth}_{it} + \epsilon_{it} \quad (2)$$

Explanation:

3.3.1 Average Temperature

The impact of average temperature on financial performance varies across different industries. Various ways exist through which average temperature levels can influence financial outcomes, particularly affecting heating and cooling needs. In regions characterized by colder climates, both businesses and households might witness heightened energy consumption and increased utility bills during colder months (Ginglinger & Moreau, 2023). Conversely, in hotter zones, increased temperatures can generate a rise in the necessity for air conditioning and cooling technology (Huang, Kerstein, & Wang, 2018). Research indicates a negative correlation between economic output and rising average temperatures. It has been suggested that uncontrolled heating may potentially lessen global revenue by roughly 23% by the year 2100 (Huang et al., 2018). Furthermore, climate change exerts an influence on the valuation of stocks,

bonds, and real estate, underscoring its impact on financial assets and economic operations (Ginglinger & Moreau, 2023). The manufacturing sector also experiences the effects of climate change, with temperature fluctuations affecting exploration, extraction, production, and transportation, thereby possibly leading to increased expenses and disruptions in production processes (Giang et al., 2021). These research findings underscore the substantial impact of climate change on average temperature and its subsequent repercussions on various segments of the economy. Fluctuations in energy consumption driven by changes in average temperature can significantly impact the financial performance of energy companies. The consequences of average temperature changes are far-reaching across numerous industries. Primarily, within the agricultural sector, the average temperature plays a pivotal role in the growth, development, and yield of crops. Different crops have distinct temperature requirements for optimal growth. While warmer temperatures can expedite plant growth in certain cases, extreme heat can stress crops, reduce yields, and affect agricultural productivity. On the other hand, cooler temperatures may postpone planting and harvesting activities and influence crop quality. The financial performance of farmers, agricultural producers, and related sectors is intricately linked to temperature conditions throughout the growing season. Secondly, average temperature impacts travel patterns and tourism demand in the tourism and hospitality industries. Warmer temperatures often attract tourists to destinations offering outdoor recreational activities, beaches, and natural attractions. Seasonal fluctuations in tourism revenue may arise based on temperature preferences and weather conditions. Hospitality establishments such as hotels, restaurants, and tour operators may experience financial performance fluctuations due to temperature-driven shifts in visitor numbers and expenditures. Thirdly, temperature fluctuations influence consumer behavior and purchasing patterns in the retail and consumer goods sector. Seasonal changes in temperature affect the demand for seasonal clothing, outdoor gear, and seasonal goods. For instance, higher temperatures could boost sales of summer attire, outdoor furniture, and recreational items, while lower temperatures may increase sales of winter clothing, heating devices, and comfort foods. Retailers adapt their inventory, marketing approaches, and promotions based on temperature forecasts to leverage seasonal demand variations. Lastly, warmer temperatures can impact construction activity and property development by extending

the construction season and enabling outdoor work, thereby boosting building activity and project completions. Conversely, extreme heat or cold weather conditions may disrupt construction schedules and postpone projects, affecting revenues and profitability for construction companies and property developers. Fifth, the mean temperature has an impact on the frequency and severity of weather-related risks that are encompassed by insurance policies. Providers of property and casualty insurance might observe variations in claims linked to temperature-induced occurrences like wildfires, winter storms, heatwaves, and floods (Huang et al., 2018). Alterations in temperature trends have the potential to influence insurance underwriting, pricing strategies, and reserves, thus exerting an influence on the financial performance of insurers. Moreover, the average temperature within the realm of the healthcare sector can play a role in shaping public health outcomes and patterns of healthcare utilization. Instances of extreme temperatures have the ability to elevate the prevalence of heat-related ailments, respiratory disorders, and diseases transmitted by vectors. Consequently, healthcare professionals could witness fluctuations in the number of patients seeking treatment and in the corresponding medical costs attributed to temperature-related health implications, ultimately impacting financial performance (Giang et al., 2021).

3.3.2 Rainfall Index

The influence of precipitation on financial outcomes may exhibit notable diversity contingent upon the sector and specific contexts under consideration. Various mechanisms exist through which precipitation can impact financial performance. Excessive rainfall has the potential to trigger flooding, resulting in adverse effects on the operational activities of businesses (Thai et al., 2023). Moreover, humidity, which correlates closely with climate change, can detrimentally affect public health in Asian nations (Giang et al., 2021). These elements, encompassing high precipitation levels and humidity, possess the capacity to influence the economic landscape, employee motivation, work efficiency, and productivity levels within organizations. Therefore, it can be deduced that climate variability, particularly concerning precipitation levels and humidity, holds substantial ramifications for different facets of the economy and human

welfare. Initially, within the agricultural domain encompassing activities like farming and livestock management, precipitation assumes a critical role in dictating crop yields and overall output levels. Inadequate precipitation can result in drought conditions, crop failures, diminished harvests, and reduced profits for farmers. Conversely, excessive precipitation may lead to flooding, soil degradation, and harm to crops, infrastructure, and equipment, thereby adversely affecting financial performance. Secondly, precipitation levels can impact hydroelectric power generation, especially in regions where hydroelectric dams serve as a key energy source (Giang et al., 2021). Elevated precipitation can elevate water levels in reservoirs, consequently enhancing power generation and potentially bolstering the financial standing of energy firms reliant on hydroelectric power. Thirdly, precipitation patterns can shape consumer behavior and purchasing tendencies. For instance, prolonged spells of rainy weather might dissuade individuals from engaging in outdoor pursuits and shopping, resulting in reduced footfall in retail establishments and decreased sales of seasonal goods such as outdoor gear, attire, and recreational items. Conversely, specific retail segments like umbrella sales or rain gear could witness heightened demand during rainy spells. Fourthly, precipitation can exert an impact on the tourism and hospitality sectors, particularly in locales heavily dependent on outdoor activities and attractions. Persistent rainfall might deter tourists from visiting, leading to diminished occupancy rates in hotels, reduced earnings for tour operators, and decreased revenue for local enterprises like eateries, stores, and entertainment venues (Huang et al., 2018). Fifthly, insurance providers offering weather-linked insurance products, such as precipitation-based insurance, may encounter fluctuations in premiums, claims, and overall financial performance predicated on variations in precipitation patterns and associated hazards. Heightened claims disbursements during adverse weather phases could impinge on profitability, whereas periods of favorable weather might translate into reduced claims and enhanced financial outcomes (Giang et al., 2021).

3.3.3 Humidity Index

Humidity, akin to precipitation, can exert influence on financial outcomes, albeit in varied manners contingent upon the sector and specific conditions. The

humidity index plays a crucial role when examining climate shifts in Vietnam and areas characterized by tropical monsoon climates. Prior investigations by (Haiyan et al., 2020; (Lovell, 2011) have demonstrated the adverse effects of humidity on public health in Asian nations. This suggests a plausible correlation between climate change and the humidity index (Giang et al., 2021). Herein lie several ways in which humidity levels can impact financial performance, as elevated humidity levels may escalate the need for air conditioning and cooling systems, particularly in regions with warm and humid climates. Consequently, this surge in demand can lead to augmented energy consumption and utility expenses for enterprises, notably those within the hospitality, retail, manufacturing, and commercial real estate sectors. Pertaining to agricultural activities, fluctuations in humidity levels can influence crop vitality and development, particularly within greenhouse settings or regions susceptible to fungal infections. Elevated humidity levels can foster environments conducive to pests and diseases, potentially resulting in diminished crop yields and quality, thereby affecting the financial standing of agricultural enterprises, encompassing farms, plant nurseries, and horticultural facilities (Thai et al., 2023). Concerning the tourism sector, heightened humidity levels can render outdoor pursuits uncomfortable, culminating in reduced engagement in events such as outdoor sports, festivals, and sightseeing excursions. Such circumstances can impinge on revenues for tourism-related establishments, including hotels, eateries, tour agencies, and tourist attractions. Furthermore, increased humidity levels can facilitate the proliferation of contagious illnesses and exacerbate certain health conditions like respiratory disorders and allergies. Elevated healthcare demand and medical expenses may ensue from heightened occurrences of humidity-related health complications, thereby influencing the financial performance of healthcare providers, insurers, and pharmaceutical enterprises. Within the realm of construction and real estate management, humidity levels can influence construction ventures and building upkeep. Elevated humidity can precipitate issues related to moisture such as mold formation, corrosion, and structural deterioration, necessitating remedial actions and refurbishments that can heighten expenses for construction enterprises and property proprietors. Additionally, the manufacturing and production sectors can be impacted by humidity levels, influencing manufacturing procedures and product caliber, particularly within industries sensitive to moisture levels like electronics, pharmaceuticals, and food

processing. Elevated humidity levels can result in production setbacks, equipment malfunctions, and product deficiencies, thus impacting operational efficacy and financial performance (Andrew & Cortese, 2011). In the insurance domain, scenarios like water damage stemming from indoor humidity or mold proliferation may fall under the purview of insurance policies. Insurers providing property and casualty insurance may encounter fluctuations in claims and premiums based on variations in humidity levels and associated hazards (Giang et al., 2021).

3.3.4 The Capital Structures

The configuration of a firm's capital makeup entails the combination of debt and equity funding utilized to support its activities and ventures. The structure of a company's capital can significantly influence its financial performance and overall worth. Initially, debt capital costs typically involve fixed interest payments, whereas equity entails the sharing of ownership and profits with shareholders (Chen et al., 2023; Thai et al., 2023). Due to the tax deductibility of interest payments, debt financing often carries lower expenses compared to equity financing. Yet, an excessive dependence on debt can heighten financial risk and escalate the expense of debt financing, particularly if the company's creditworthiness weakens (Sun et al., 2020). Furthermore, the capital arrangement impacts the risk-return profile of the company. Debt financing increases financial leverage, enhancing returns for equity shareholders during favorable company performance. However, it also intensifies the downside risk, as interest payments must be fulfilled irrespective of business performance (Thai et al., 2023). On the other hand, equity financing, though less risky in terms of insolvency, diminishes ownership and earnings per share. Achieving the appropriate ratio between debt and equity is key to optimizing shareholder value and financial performance, as well as the company's financial adaptability and ability to pursue expansion opportunities. An overabundance of debt can restrict the company's ability to obtain additional funds or embark on new projects, as creditors may hesitate to extend credit to heavily leveraged entities. Conversely, an excessively cautious capital structure with an abundance of equity may underutilize leverage and restrict growth possibilities. Achieving an ideal capital structure necessitates the equilibrium of financial steadiness with the capacity to

leverage growth prospects and considering the company's liquidity and financial soundness (Thai et al., 2023). Elevated debt levels can strain liquidity, particularly if interest payments deplete a substantial portion of cash inflows. During economic downturns or financial challenges, substantial debt levels may imperil the company's financial stability and ability to fulfill its financial commitments. Upholding a cautious capital structure with sufficient liquidity reserves is imperative for fortifying financial stability and resilience. Investors and analysts evaluate a company's capital structure as part of assessing its financial well-being and investment potential. A well-matched capital structure that optimizes the blend of debt and equity signifies prudent financial administration and could bolster the company's valuation and appeal to investors (Sun et al., 2020). Conversely, an unbalanced or heavily leveraged capital structure may prompt apprehensions regarding financial risk and diminish investor trust, resulting in decreased stock prices and heightened borrowing expenses (Huang et al., 2018; Thai et al., 2023).

3.3.5 Operating Cashflow to Assets Ratio

The Operating Cashflow to Assets Ratio (OCFTA) serves as a financial metric utilized to assess the efficiency of cash generation by a company in relation to its total assets. The calculation involves dividing the company's operating cash flow by its average total assets. This financial indicator offers insights into the effectiveness of a company in utilizing its assets to produce cash. A higher OCFTA signifies that the company is adept at generating cash from its assets, showcasing proficient asset management and operational efficacy. Conversely, a lower OCFTA implies that the company might struggle in converting its assets into cash. The focus of Operating Cashflow to Assets Ratio (OCFTA) is specifically on cash generation rather than profitability. Unlike profitability metrics such as Return on Assets (ROA) that involve net income encompassing non-cash elements like depreciation and amortization, OCFTA directly assesses cash flow. Consequently, OCFTA is particularly valuable for evaluating a company's capacity to produce cash for supporting its operations, investments, and debt commitments. A positive Operating Cashflow to Assets Ratio (OCFTA) implies that the company is capable of generating sufficient cash flow from

its assets to cover operational expenses and investment needs, thereby enhancing its financial stability and resilience by ensuring liquidity for meeting short-term obligations and pursuing growth opportunities. However, a persistently negative OCFTA could indicate financial distress and liquidity issues, necessitating a more thorough examination by investors and creditors. These financial indicators facilitate cross-company and cross-industry comparisons, delivering insights into relative efficiency and performance. Companies with higher OCFTA ratios typically excel in generating cash from their assets compared to those with lower ratios. Comparative scrutiny of OCFTA aids in pinpointing strengths, weaknesses, and avenues for enhancement within a company or industry. A robust OCFTA ratio in financial assessment can bolster investor trust and perception of a company's financial standing and managerial prowess. Companies with elevated OCFTA ratios might garner more positive investor reception due to their capacity to produce cash flow and prudently leverage assets. Conversely, diminishing or negative OCFTA ratios could raise investor apprehensions regarding the financial stability and operational effectiveness of the company (Bansal & Ochoa, 2011).

3.3.6 Company Size

The scale of a corporation may have a substantial influence on its financial performance, impacting various aspects of its operations, growth opportunities, risk management, and market competitiveness. Businesses often reap the benefits of economies of scale, enabling them to distribute fixed costs over a larger production or customer base (Jendra, 2018). This can lead to decreased average costs per unit of production, resulting in increased profit margins and enhanced financial performance. Economies of scale can also encompass purchasing power, marketing efficiency, and distribution networks, further improving competitiveness and profitability. Many large corporations frequently experience heightened market dominance and brand recognition, which can translate into competitive advantages, pricing power, and customer loyalty. Robust brand equity and market leadership positions can drive higher sales volumes, revenue growth, and profitability, contributing to superior financial performance when compared to smaller competitors. Larger firms typically enjoy easier

access to capital markets and financing options in contrast to smaller entities (Nordlöf, 2014; Rosique, 2010). They possess a greater capacity to raise funds through equity offerings, debt issuance, or bank loans, enabling them to finance investments, expansion initiatives, and strategic acquisitions. Access to capital can facilitate growth opportunities and bolster long-term financial performance for larger corporations. Numerous companies may boast more diversified business operations, product portfolios, and geographic presence, diminishing reliance on any single market or revenue stream. Diversification can fortify resilience against economic fluctuations, industry disruptions, and market risks, ultimately mitigating downside risk and stabilizing financial performance over time (Gulluscio et al., 2020). Furthermore, companies often possess ample resources and capabilities to invest in innovation, research and development, and technological advancements. They can allocate substantial budgets towards developing new products, enhancing processes, and outpacing competitors in rapidly evolving industries. Growth strategies driven by innovation can propel revenue expansion, market differentiation, and the creation of long-term value for large corporations. Conversely, larger companies typically confront heightened regulatory scrutiny and compliance demands due to their scale, complexity, and market significance. While regulatory compliance may entail additional costs and administrative burdens, it also fosters transparency, accountability, and sound governance practices (Rosique, 2010). Effective risk management and regulatory compliance endeavors can safeguard the company's reputation, mitigate legal liabilities, and underpin sustainable financial performance. The size of a company can influence investor confidence, stock valuations, and access to capital markets. Larger corporations may be perceived as more steady, resilient, and trustworthy, thereby attracting institutional investors and favorable analyst coverage. Positive market sentiment and investor perceptions can uplift stock prices, diminish the cost of capital, and augment financial performance for large-cap companies (Gulluscio et al., 2020).

3.3.7 GDP Growth

Gross Domestic Product (GDP) expansion can profoundly impact the financial outcomes of enterprises, with GDP growth often associated with heightened consumer

assurance and expenditure. During periods of economic growth, individuals typically experience increased earnings and greater buying power, resulting in heightened demand for products and services. This surge can elevate revenues and profitability for businesses spanning different industries, including retail, hospitality, and consumer goods. Economic expansion generates prospects for investment as enterprises broaden their activities, initiate capital undertakings, and embark on fresh endeavors. Elevated GDP growth rates might entice investment funding, foster entrepreneurial activities, and stimulate business investments in research and development, technology, and infrastructure. Consequently, this scenario can precipitate heightened business dealings, job generation, and revenue amplification, which favor firms in domains like construction, manufacturing, and technology. Robust GDP growth has the potential to enhance credit accessibility and diminish borrowing expenditures for enterprises (Sun et al., 2020). Financial establishments are inclined to extend credit to businesses within burgeoning economies, thereby facilitating capital accessibility for expansion, investment, and operational capital requisites. Reduced interest rates have the capacity to curtail borrowing outlays, ameliorate cash flow, and refine financial outcomes for firms reliant on debt financing (Chen et al., 2023). The determination of import and export dynamics is intertwined with GDP growth, as export-driven sectors like manufacturing, agriculture, and technology may reap benefits from augmented international sales and market openings. Elevated export proceeds can amplify profitability and contribute to the overall financial performance of enterprises participating in global commerce. Swift GDP growth can instigate inflationary pressures, including escalating wages, input expenses, and inflation anticipations. Businesses could confront escalated production costs, supply chain disruptions, and margin constraints as a consequence. Effectively managing inflationary hazards and expenditure pressures becomes pivotal for preserving profitability and financial outcomes within a burgeoning economy. Governmental strategies and regulations wield a pivotal influence on shaping the business milieu and impacting financial outcomes. Economic expansion could be bolstered by advantageous policies like tax breaks, deregulation, infrastructure outlays, and pro-enterprise reforms (Huang et al., 2018). Conversely, uncertainties in policies, alterations in regulations, and geopolitical tensions could pose challenges to businesses and impact financial performance. Deliberation

concerning investor portfolios, GDP growth impacts market sentiment and investor conviction, thereby influencing stock values, assessments, and investment determinations. Robust economic expansion signifies a robust business ambiance, fostering optimism among investors and buttressing stock market performance. Favorable market sentiments have the potential to draw capital inflows, curtail capital costs, and enhance financial outcomes for firms engaging in public markets (Thai et al., 2023).

3.4 LIST OF VARIABLES AND MEASUREMENTS

Table 3.1 Variables Measurement

VARIABLE DEFINITION				
VARIABLE TYPE	Variable Name	Variable Code	Variable Description	Unit
DEPENDENT VARIABLE	Financial Performance	ROA	Return on Assets: synthesize data from financial statements (Net Income/Assets)	Times
		ROE	Return on Equity: synthesize data from financial statements (Net Income/Equity)	Times
INDEPENDENT VARIABLE	Average Temperature	Temp	Annual Average Temperature from Thai Meteorological Department for the period spanning from 2012 to 2022 data	Celsius
	Rainfall Index	Rain	Average total Rainfall at some monitoring stations from 2012 to 2022 following Thai Meteorological Department data	Milimeters
	Humidity Index	Humid	Average total Humidity at some monitoring stations from 2012 to 2022 following Thai	Percentage

Table 3.1 Variables Measurement (cont.)

VARIABLE DEFINITION				
			Meteorological Department data	
CONTROL VARIABLE – COMPANY FACTOR	Capital Structure	DA	Asset-liability ratio was calculated the formula as $\text{Total Liabilities} / \text{Total Assets}$	Times
	Operating Cashflow to Assets ratio	OCFTA	Operating Cashflow/ Total Assets	Times
	Company Size	Size	Natural Logarithm of Total Assets (unit in million Baht) at the end of the year	-
CONTROL VARIABLE – ECONOMIC FACTOR	Gross Domestic Product Growth	GDP	The GDP Growth Rate compares the year-over-year change in country's economic output to measure how fast an economy is growing.	Percentage

Source: Researcher

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 DESCRIPTIVE SUMMARY

The statistical data summarizing the independent and dependent variables is displayed in Table 4.1, encompassing the entire sample of 31 agricultural, food, and beverage enterprises that were publicly traded on the Stock Exchange of Thailand from 2012 to 2022. The data available for analysis spans the period from 2012 to 2022. This research examines these summary statistics over a decade to assess the influence of climate change on businesses listed under the agricultural, food, and beverage sectors on the Stock Exchange of Thailand (SET). The statistical data illustrates the economic viability of the corporations during the designated research period, as evidenced by the average return on assets (ROA) and return on equity (ROE) rates of 8.57 and 8.75 respectively significance positive sign with the previous result (Giang et al., 2021). Notably, the maximum values for return on assets (ROA) and return on equity (ROE) are 34.58 and 79.90 respectively. One of the financial performance indicators exhibits standard deviations that exceed the average representing a return on equity (20.94). On the other hand, the standard deviation of return on assets is below the mean value (8.38). This signifies a notable disparity in the financial performance of publicly traded agricultural, food, and beverage companies on the Stock Exchange of Thailand. Consequently, this result observes a rise in the average ROA and ROE.

Table 4.1 Summary Statistics

Variable	Obs	Mean	Std. Dev	Min	Max
TEMP	341	28.05	0.40	26.80	28.18
RF	341	144.14	16.72	118.59	169.42
HMD	341	75.98	0.01	75.97	76.00
DE	341	1.06	1.72	0.03	24.99
OCFTA	341	9.24	9.26	-26.03	45.05

Table 4.1 Summary Statistics (Cont.)

Variable	Obs	Mean	Std. Dev	Min	Max
logTA	341	6.81	0.63	5.85	8.97
GDP	341	0.02	0.03	-0.06	0.07
ROA	341	8.57	8.39	-29.29	34.58
ROE	341	8.75	20.94	-216.73	79.90

The weather information factors to determine climate change with the average temperature, rainfall index, rainfall index and humidity index (28.05, 144.14, 75.98) respectively. The maximum value the average temperature, rainfall index, and humidity index (28.18, 169.41, 76.00) and minimum value of each weather factors (26.80, 118.59, 75.97) respectively. Moreover, the standard deviation of the average temperature, rainfall index and humidity index (0.40, 16.72, 0.01) respectively, weather information factors evident that this particular variable exhibits a substantial standard deviation, which suggests that the quantity of weather variables in the designated area varies significantly. In terms of the control variables of economic factors, the debt-to-equity ratio (DE) possesses an average value of 1.06 alongside a standard deviation of 1.72. Moreover, it is noteworthy that the operating cashflow to assets ratio (OCFTA) represent an average value 9.24. The other statistic value considerable standard deviation of 9.26. This finding indicates a significant variation in the operating cashflow to assets ratio within the agricultural, food, and beverage enterprises that were publicly traded on the Stock Exchange of Thailand. With the macroeconomic variable, the GDP growth rate has an average of 0.02 thousand million baht, the lowest is -0.06 thousand million baht, the highest is 0.07 thousand million baht, and the standard deviation is 0.03 thousand million baht, showing no difference through which does not impact the financial performance of the company.

4.2 CORRELATION RESULT

Table 4.2 Correlation Matrix of Variables

	TEMP	RF	HMD	DE	OCFTA	Log TA	GDP	ROA	ROE
TEMP	1.00								
RF	0.19	1.00							
HMD	0.53	0.52	1.00						
DE	0.02	0.03	0.06	1.00					
OCFTA	-0.01	-0.06	-0.07	-0.18	1.00				
Log TA	0.06	0.06	0.11	0.14	-0.05	1.00			
GDP	-0.49	-0.14	-0.43	-0.12	0.00	-0.04	1.00		
ROA	-0.17	0.02	-0.11	-0.34	0.63	-0.01	0.10	1.00	
ROE	-0.13	-0.06	-0.16	-0.69	0.43	0.09	0.14	0.71	1.00

Table 4.2 displays the correlation matrix among variables. To perform regression modeling on variables with the same units, most variables are expressed as percentages. However, the size variable is computed as the natural logarithm of total assets. The highest correlation was presented between the return on assets and return on equity significantly with a correlation result (0.71). The next correlation variable is the average temperature and humidity index result (0.53). The lowest correlation presented between the operating cashflow to assets ratio and GDP growth rate with (0.00). The correlation coefficients indicate the direct and indirect relationships between return on asset and return on equity with other independent variables, as signified by the positive or negative signs. The previous study's multicollinearity between return on assets and return on equity showed with positive sign (Giang et al., 2021). In addition, the relationship between weather factors and financial performance. Firstly, the average temperature, rainfall index, humidity index and return on assets with -0.17, 0.02, and -0.11 respectively. Secondly, the average temperature, rainfall index, humidity index to return on equity -0.13, -0.06, and -0.16 respectively. Therefore, almost correlation of each variable show negative sign. Thirdly, the relationship between weather information

and control variable including with average temperature, rainfall index, humidity index and capital structure (debt-to-equity ratio) 0.02, 0.03, and 0.06 respectively. Fourthly, the relationship between weather information and control variable including with average temperature, rainfall index, humidity index and operating cashflow to assets ratio (OCFTA) -0.01, -0.06, and -0.07 respectively. Finally, the coefficient between weather informations consist of the average temperature, rainfall index, humidity index and company size (logTA) represent positive sign with 0.06, 0.06, 0.11 respectively.

4.3 MAIN RESULTS

Table 4.3 Simple regression OLS Model of Return on Asset

Source	SS	df	MS	Number of obs	=	341
Model	11778.444	7	1682.635	F (7, 333)	=	46.11
				Prob > F	=	0.000
Residual	12150.538	333	36.488	R-squared	=	0.492
Total	23928.982	340	70.379	Adj R—squared	=	0.487
				Root MSE	=	6.040
ROA	Coef.	Std. Err.	t	P > t	[95% Conf. Interval]	
TEMP	-3.628	1.043	-3.48	0.001	-5.680	-1.576
RF	.056	.023	2.40	0.017	.010	.102
HMD	-26.353	42.773	-0.62	0.538	-110.493	57.788
DE	-1.156	.197	-5.88	0.000	-1.543	-.770
OCFTA	.540	.0360	14.98	0.000	.470	.611
logTA	.800	.530	1.51	0.132	-.242	1.842
GDP	-1.567	12.583	-0.12	0.901	-26.319	23.185
_cons	2095.490	3237	0.65	0.518	-4272.056	8463.036

In the simple regression modeling of ROA, the result shows that R-squared is .492 in this model. The independent variable affects the ROA 49.22%. The residual percentage depended on other factors that reflect the financial performance. The value of the t-test shows that the average temperature 95% confidential interval the average

temperature shows a significant .001 and the rainfall 95% confidential interval the rainfall index is .017 consecutively. Moreover, The value of the t-test shows that the shows that rainfall index a significant .005.

The interpretation of the average temperature of simple regression is that when the temperature drops a unit, ROA is decreased 3.638. In contrast, the rainfall index of simple regression shows a positive sign, when the rainfall increases a unit, ROA is increased .056. While determined about control variables both of capital structure and operating cashflow to assets ratio 95% coefficient shows a significant .001. In this testing, capital structure (D/E Ratio) shows a negative sign when the increased cost of capital one unit, ROA is decreased. On the other hand, the Operating cashflow to assets ratio 95% coefficient shows a significant .001 shows a positive sign. When the operating cashflow to assets ratio increases one unit, ROA is increased by .540.

Table 4.4 Mean VIF of ROA

Variable	VIF	1/VIF
HMD	2.00	0.499
TEMP	1.60	0.627
GDP	1.43	0.699
RF	1.41	0.711
DE	1.07	0.935
OCFTA	1.04	0.963
logTA	1.03	0.969
Mean VIF	1.37	

The variance inflation factor (VIF) is the statistic that measures the degree of collinearity of ith predictor with the others. The independent variables including the humidity index, the average temperature, and the rainfall index show less than 4. Moreover, the control variables consist of capital structure, operating cashflow to assets ratio, company size, and GDP growth rate also less than 4. So, each variable is not collinear.

Table 4.5 Fixed-effect (within) regression model of ROA

Fixed-effects (within) regression		Number of obs		=	341	
Group variable :	year	Number of groups		=	11	
R-sq:		R-squared				
Within	= 0.485	min		=	31	
Between	= 0.010	avg		=	31.0	
Overall	= 0.455	max		=	31	
Corr (u _i , Xb)	= -0.0531	F (3, 327)		=	102.83	
		Prob > F		=	0.0000	
ROA	Coef.	Std. Err.	t	P > t	[95% Conf. Interval]	
TEMP	0	(omitted)				
RF	0	(omitted)				
HMD	0	(omitted)				
DE	-1.173	.196	-5.99	0.000	-1.559	-.788
OCFTA	.548	.0360	15.24	0.000	.478	.619
logTA	.810	.527	1.54	0.125	-.226	1.847
GDP	0	(omitted)				
_cons	-.772	3.606	-0.21	0.831	-7.866	6.322
sigma_u	2.001					
sigma_e	6.007					
rho	.099	(fraction of variance due to u _i)				
F test that all u _i =0: F(10, 327) = 3.43					Prob > F = 0.0003	

Table 4.5 represents the impact of climate change on ROA based on the Fixed-effect (within) regression model and finds that the average temperature, rainfall index, humidity index, GDP growth rate were omitted. In addition, R squares show the range within .485, between .010, and overall.455. The significant 95% confidential interval with a significant .001 represents capital structure (debt-to-equity ratio) when debt is increasing one unit, the ROA also decreases by 1.173. On the other hand, the significant 95% confidential interval with a significant .001 into operating cashflow to assets ratio is increasing by one unit, the ROA increases by .548.

Table 4.6 Random-effects (GLS) regression model of ROA

Random-effects GLS regression		Number of obs	=	341		
Group variable :	year	Number of groups	=	11		
R-sq:		Obs per group:				
Within	= 0.485	min	=	31		
Between	= 0.678	avg	=	31.0		
Overall	= 0.492	max	=	31		
		Wald chi2 (7)	=	322.80		
Corr (u_i, X)	= 0 (assumed)	Prob > chi2	=	0.0000		
ROA	Coef.	Std. Err.	t	P > t	[95% Conf. Interval]	
TEMP	-3.628	1.043	-3.48	0.001	-5.673	-1.583
RF	.056	.023	2.40	0.016	.010	.101
HMD	-26.353	42.774	-0.62	0.538	-110.188	57.482
DE	-1.156	.197	-5.88	0.000	-1.542	-.771
OCFTA	.540	.036	14.98	0.000	.469	.611
logTA	.800	.530	1.51	0.131	-.238	1.838
GDP	-1.567	12.583	-0.12	0.901	-26.229	23.095
_cons	2095.493	3237.002	0.65	0.517	-4248.914	8439.901
sigma_u	0					
sigma_e	6.007					
rho	0	(fraction of variance due to u_i)				

Table 4.6 represents the impact of climate change on ROA based on the Random-effect (within) regression model and finds that the average temperature and rainfall index are significant 95% confidence interval. In addition, R squares show the range within .485, between .678, and overall .492. The interpretation shows the average temperature decreased by one unit, ROA decreased by 3.628. In addition, the rainfall index increased by one unit, ROA increased by .059. On the other side, the weather information (The Humidity index) does not have a significant 95% confidence interval. The control variables including capital structure and operating cashflow to assets ratio are significant 99% confidence intervals. The interpretation of capital structure is also

negative when the capital structure (debt) increases by one unit, ROA decreases by 1.156.

Table 4.7 Hausman Test of ROA

---- Coefficients ----				
	(b)	(B)	(b-B)	Sqrt(diag(V-b – B))
	M3	M4	Difference	S.E.
DE	1.173	-1.156	-.017	.
OCFTA	.548	.540	.008	.
logTA	.8104	.800	.010	.

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

$$\text{Chi2 (3)} = (b-B)'[(V_b - V_B)^{-1}](b-B)$$

$$= -19.01$$

chi2<0 ==> model fitted on these data fails to meet the asymptotic assumptions of the

Hausman test; see suest for a generalized test

The Hausman test is a statistical test used in econometrics to determine whether the estimates of parameters from two different regression models are significantly different from each other. It is often employed in cases where there are concerns about endogeneity or model specification. Table 4.7 The Hausman test of the impact of climate change and ROA represents an absolute 19.01. The Chi-square is greater than 0. The Random-effects GLS regression is more suitable than the Fixed-effect (within) regression.

Table 4.8 Simple regression OLS Model of ROE

	SS	df	MS	Number of obs	=	341
				F (7, 333)	=	78.84
Model	92976.680	7	13282.383	Prob > F	=	0.00000
Residual	56097.894	333	168.462	R-squared	=	0.624
				Adj R—squared	=	0.616
Total	149074.573	340	438.455	Root MSE	=	12.979
ROA	Coef.	Std. Err.	t	P > t	[95% Conf. Interval]	
TEMP	-4.217	2.241	-1.88	0.061	-8.626	.192
RF	.041	.0499	0.82	0.412	-.057	.139
HMD	-198.323	91.908	-2.16	0.032	-379.115	-17.529
DE	-7.949	.422	-18.81	0.000	-8.780	-7.119
OCFTA	.711	.076	9.17	0.000	.558	.863
logTA	7.026	1.138	6.17	0.000	4.787	9.264
GDP	-7.084	27.036	-0.26	0.793	-60.267	46.100
_cons	15144.55	6955.337	2.18	0.030	1462.613	28826.49

Table 4.8, the simple regression modeling of ROE, the result shows that R-squared is .624 in this model. The independent variable affects the ROE 62.40%. The residual percentage depended on other factors that reflect the financial performance. The value of the t-test shows that the average temperature 95% confidential interval the average temperature shows a significant .100 and the humidity index 95% confidential interval based on a significant .032 consecutively. Moreover, The value of the t-test shows that the rainfall index is not significant .005.

The interpretation of the average temperature of simple regression is that when the average temperature drops a unit, ROE is decreased 4.217. Moreover, the humidity index of simple regression shows a negative sign, when the humidity dropped a unit, ROE is decreased 198.322.

While determined about control variables consist of capital structure, operating cashflow to assets ratio, and company size 95% confident interval shows a significant .001. In this testing, capital structure (D/E Ratio) shows a negative sign when the increased cost of capital one unit, ROE is decreased 7.949. On the other hand, the operating cashflow to assets ratio 95% confident interval shows a significant .001 shows a positive sign. When the operating cashflow to assets ratio increases one unit, ROE is increased by .711. The company size 95% confident interval shows a significant .001 shows a positive sign. When the company size increase one unit, ROE is increased by 7.026

Table 4.9 Fixed-Effect (within) Regression Model of ROE

Fixed-effects (within) regression		Number of obs	=	341	
Group variable :	year	Number of groups	=	11	
R-sq:		Obs per group:			
Within	= 0.613	min	=	31	
Between	= 0.329	avg	=	31.0	
Overall	= 0.603	max	=	31	
Corr (u _i , Xb)	= 0.003	F (3, 327)	=	172.74	
		Prob > F	=	0.0000	
ROA	Coef.	Std. Err.	t	P > t	[95% Conf. Interval]
TEMP	0	(omitted)			
RF	0	(omitted)			
HMD	0	(omitted)			
DE	-7.963	.426	-18.71	0.000	-8.800 -7.126
OCFTA	.718	.078	9.19	0.000	.564 .872

Table 4.9 Fixed-Effect (within) Regression Model of ROE (Cont.)

Fixed-effects (within) regression			Number of obs			=	341
logTA	7.035	1.144	6.15	0.000	4.784		9.285
GDP	0 (omitted)						
_cons	-37.353	7.833	-4.77	0.000	-52.762		-21.945
sigma_u	3.366						
sigma_e	13.046						
rho	.062 (fraction of variance due to u_i)						
F test that all u_i=0: F(10, 327) = 2.05							Prob > F = 0.0284

Table 4.9 represents the impact of climate change on ROE based on the Fixed-effect (within) regression model and finds that the average temperature, rainfall index, humidity index, and GDP growth rate were omitted. In addition, R squares show the range within .613, between .329, and overall .603. The significant 95% confidential interval with a significant .001 represents capital structure (debt-to-equity ratio) when debt is increasing one unit, the ROE also decreases by 7.963. On the other hand, The significant 95% confidential interval with a significant .001 into operating cashflow to assets ratio is increasing by one unit, the ROE increases by .718. The company size based on a significant 95% confidential interval with a significant .001 into company size is increasing by one unit, the ROE increases by 7.035.

Table 4.10 Random-effects (GLS) regression model of ROE

Random-effects GLS regression			Number of obs			=	341
Group							
variable :	year	Number of groups				=	11
R-sq:	Obs per group:						
Within	=	0.613	min		=	31	
Between	=	0.919	avg		=	31.0	

Table 4.10 Random-effects (GLS) regression model of ROE (Cont.)

Random-effects GLS regression		Number of obs		=		341	
Overall	=	0.624		max	=	31	
Corr (u _i , X)	=	0 (assumed)		Wald chi2 (7)	=	551.91	
				Prob > F	=	0.0000	
ROA		Coef.	Std. Err.	t	P > t	[95% Conf. Interval]	
TEMP		-4.217	2.241	-1.88	0.060	-8.610	.1763718
RF		.041	.050	0.82	0.412	-.057	.139
HMD		-198.322	91.908	-2.16	0.031	-378.458	-18.186
DE		-7.949	.422	-18.81	0.000	-8.777	-7.121
OCFTA		.711	.076	9.17	0.000	.559	.863
logTA		7.026	1.138	6.17	0.000	4.796	9.256
GDP		-7.084	27.036	-0.26	0.793	-60.074	45.906
_cons		15144.57	6955.342	2.18	0.029	1512.351	28776.79
sigma_u		0					
sigma_e		13.048					
rho		0 (fraction of variance due to u _i)					

Table 4.10 represents the impact of climate change on ROE based on the Random-effect (within) regression model and finds that the average temperature and humidity index are significant 95% confidence interval but the rainfall index is not significant. In addition, R squares show the range within .613, between .919, and overall .624. The interpretation shows the average temperature decreased by one unit, ROE decreased by 4.217. In addition, the humidity index decreased by one unit, ROE decreased by 198.322. On the other side, the weather information (rainfall index) does not have a significant 95% confidence interval. The control variables including capital structure, operating cashflow to assets ratio, and company size are significant 99% confidence intervals. The interpretation of capital structure is also negative when the capital structure (debt) increases by one unit, and ROE decreases by 7.949. In contrast, the operating cashflow to assets ratio increased by one unit, and ROE increased by .711 and the company size increased by one unit, and ROE increased 7.026.

Table 4.11 Hausman Test of ROE

---- Coefficients ----				
	(b)	(B)	(b-B)	Sqrt(diag(V-b - _B))
	M3	M4	Difference	S.E.
DE	-7.963	-7.949	-.014	.052
OCFTA	.718	.711	.007	.010
logTA	7.035	7.026	.009	.117

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

$$\begin{aligned} \text{Chi2 (3)} &= (\mathbf{b} - \mathbf{B})' [(\mathbf{V}_b - \mathbf{V}_B)^{-1}](\mathbf{b} - \mathbf{B}) \\ &= 0.63 \end{aligned}$$

$$\text{Prob>chi2} = 0.8889$$

The hausman test is a statistical test used in econometrics to determine whether the estimates of parameters from two different regression models are significantly different from each other. It is often employed in cases where there are concerns about endogeneity or model specification. Table 4.11 The hausman test of the impact of climate change and ROE represents 0.889. The probability is greater than the chi-square. The random-effects GLS regression is more suitable than the fixed-effect (within) regression.

The first main results of this study (main results 1) are presented in Table 4.12. As such, Table 4.12 contains the estimations of simple, fixed-effect (within), and random-effect GLS regression modeling applied to panel dataset. The data covers 31 agricultural, food, and beverage enterprises that were publicly traded on the Stock Exchange of Thailand from various activity domains, analyzed over the 2012–2022 period, to capture the effect of climate change on their business development. The dependent variables are the ROA indicators (models (1)–(3)) and ROE indicators (models (4)–(6)) respectively.

Model (1) the effect of the average temperature on the return on assets (ROA) of companies is a negative correlation. As a result, when the average temperature dropped by one unit, their ROA ratios were reduced by 3.628 (Giang et al., 2021; U-Din et al., 2023) also represent negative results of return on assets (ROA). In contrast, previous paper show a positive correlation between the average temperature on the return on assets (ROA) (Eleftheriadis et al., 2012; Noh, 2017). While the effect of rainfall on the return on assets (ROA) of companies has a positive correlation. Thus, when the rainfall index increases by one unit, their ROA ratios increase on average by .055. According to the previous paper result, the correlation of the rainfall index and return on assets show a positive correlation (Giang et al., 2021). In contrast, past research papers show a negative correlation between rainfall index and return on assets (ROA) (Thai et al., 2023). This study is not significant because of the humidity index and return on asset (ROA) compared with previous papers that show a negative correlation (Thai et al., 2023). Moreover, In the financial ratio analysis, the estimates of the effect of the debt-to-equity ratio on the ROA of companies is a negative correlation. When the debt-to-equity ratios of companies increase by one unit, their ROA ratios are reduced on average by 1.156. Supporting with previous paper the represent negative correlation capital structure-debt-to-equity ratio (Chen et al., 2023; Thai et al., 2023). When the cash returns on assets ratio of companies increased by one unit, their ROA ratios increased on average by .540. Only the previous paper disclosed a financial performance (Thai et al., 2023). The other control variable is the company size measure as a LogTA shows insignificant results. In contrast, the previous paper shows a positive correlation between company size and return on assets (ROA) (Huang et al., 2023). Thai et al, 2023 use the gross domestic product growth rate (GDP growth) as a control factor determination, the result shows that factors are not correlated to financial performance-return on assets. The statistical from random-effect (within) regression show R^2 within, between, and overall 0.49, 0.68, and 0.49 respectively with adjusted $R^2 = 0.48$. Both of independent and control variables show the factors influenced to return on assets (ROA) 48%. The other residual depends on other factors that effect the regression equation. Comparing with previous paper shows that the amount of variance in the return on assets (ROA) explained by both independent and control variables is $R^2 = .49$. The more

companies finance their activities through debt, the less their performance for return on shareholders' equity.

Model (2) the effect of the average temperature on the return on equity (ROE) of companies has a negative correlation. As a result, when the average temperature dropped by one unit, their return on equity (ROE) ratios were reduced by 4.127. Moreover, the previous paper shows a negative correlation between the average temperature and return on equity associated with this correlation statistical (Noh, 2017; U-Din et al., 2023). On the other hand, this model of statistics of the rainfall index and return on equity (ROE) is not significant. However, previous research shows a negative relation between the rainfall index and return on equity (ROE)(Giange al.,2021; Thai et al., 2023). On the other hand, the effect of the humidity index on the return on equity (ROE) of the industry has a negative correlation. Thus, when the high humidity decreases by one unit, their ROE ratios decrease on average by -198.327. Associated with the previous paper, the correlation between humidity and return on equity also shows a negative correlation (Thai et al., 2023). In the financial ratios analysis as control variables, the estimates of the effect of the debt-to-equity ratio on the return on equity (ROE) of companies have a negative correlation. This indebtedness indicator has the highest explanatory power its correlation coefficient is -.685. In addition, form previous paper show a negative correlation between the debt-to-equity ratio and return on equity (ROE)(Thai et al., 2023). When the debt-to-equity ratios of companies increase by one unit, their return on equity (ROE) ratios are reduced on average by 7.949. However, When the cash returns on assets ratio of companies increased by one unit, their return on equity (ROE) ratios increased on average by .711. The previous paper is not represent the correlation between cash returns on assets ratio and return on equity (ROE). However, The effect of the operating cashflow to assets ratio on the return on equity (ROE) of companies has a positive correlation but discloses the financial performance (Thai et al., 2023). Moreover, the effect of company size on the return on equity (ROE) of companies has a positive correlation. When the company size of companies increases by one unit, their return on equity (ROE) ratios increase on average by 7.026. No previous paper shows that company size correlated to return on equity (ROE) but only show positive sign for return on assets (ROA) (Huang et al., 2023). The amount of

variance in the return on equity (ROE) explained by both the climate change and financial ratio variables are within $R^2 = .613$, between $R^2 = 0.919$, and $R^2 = .624$. The more companies finance their activities through debt, the less their performance for return on shareholders' equity.

The main alternatives to the baseline OLS estimation method from model (1) are the fixed effects model (FEM; model (2)) and the random effect model (REM; model (3)). As expected, all the previously validated independent variables from models (1)–(3) keep their signs and significances (except for humidity index, company size, and Gross Domestic Product growth in the model (3)), with approximately the same estimated impact through their coefficients. The Hausman test indicates the REM model is optimal. The amount of variance in the ROA of the REM model explained by both independent and control variables is represented within $R^2 = .485$, between $R^2 = .678$, and overall $R^2 = .492$.

Moreover, the main alternatives to the baseline OLS estimation method from model (2) are the fixed effects model (FEM; model (5)) and the random effect model (REM; model (6)). As expected, all the previously validated independent variables from models (4)–(6) keep their signs and significances (except for rainfall index, and Gross Domestic Product growth in the model (6)), with approximately the same estimated impact through their coefficients. The Hausman test indicates the REM model is optimal. The amount of variance in the ROE of the REM model explained by both independent and control variables is represented within $R^2 = .613$, between $R^2 = .919$, and overall $R^2 = .624$.

The outcome of Model (3), wherein the independent variables comprise weather measurement-average temperature and capital structure-debt-to-equity ratio, indicates a negative correlation. Consequently, the financial performance of agricultural, food, and beverage enterprises that were publicly traded on the Stock Exchange of Thailand demonstrated low economic performance.

In contrast, the rainfall index, when considered as an independent variable, exhibits a positive correlation with the financial indicator of cash returns on assets. Hence, businesses operating in the agriculture, food, and beverage sectors showcase positive business performance.

The result of Model (6) reveals a negative correlation between the independent variables, which include weather measurements such as average temperature, rainfall index, humidity index, and capital structure-debt-to-equity ratio. As a result, the financial performance of agricultural, food, and beverage enterprises that were publicly traded on the Stock Exchange of Thailand demonstrated low economic performance.

On the other hand, financial indicators such as the operating cashflow to assets ratio and company size display a positive correlation. Consequently, businesses operating in the agriculture, food, and beverage sectors exhibit positive business performance.

Table 4.12 Model Summary Result

Performance	ROA			ROE		
	Simple regression OLS (Model 1)	Fixed-effect (within) regression (Model 2)	Random-effects GLS regression (Model 3)	Simple regression OLS (Model 4)	Fixed-effect (within) regression (Model 5)	Random-effects GLS regression (Model 6)
Constant	2095.490	-0.772	2095.493	15144.550	-37.353	15144.570
D_Temp	-3.628**	0.00	-3.628**	-4.217*	0.00	-4.217*
D_Rain	.055**	0.00	.056**	0.04	0.00	0.04
D_Humid	-26.35	0.00	-26.35	-198.327**	0.00	-198.322**
D_Debtas	-1.156***	-1.17	-1.156***	-7.949***	-7.96	-7.949***
D_OCFTA	.540***	0.55	.540***	.711***	0.72	.711***

Table 4.12 Model Summary Result (Cont.)

	ROA			ROE		
	Simple regression OLS (Model 1)	Fixed-effect (within) regression (Model 2)	Random-effects GLS regression (Model 3)	Simple regression OLS (Model 4)	Fixed-effect (within) regression (Model 5)	Random-effects GLS regression (Model 6)
Performance						
D_Size	0.80	0.81	0.80	7.026***	7.03	7.026***
D_GDPGrowth	-1.57	0.00	1.57	-7.08	0.00	-7.08
R ²	0.497	0.010	0.678	0.624	0.329	0.919
Adjusted R ²	0.482			0.616		
Hausman Test		-19.01			0.63	
		Prob >Chi ² ; Random effect is favored.			Prob >Chi ² = 0.8889 ; Random effect is favored.	
Number of observation	341	341	341	341	341	341

Note ***designates the 1% significant coefficients, **designates the 5% significant coefficients and *designates the 10% significant coefficients.

Table 4.13 Summary of Findings

Independent Variable	SIGN	
	ROA	ROE
Average Temperature	Negative **	Negative *
Rainfall Index	Positive **	Not Significant
Humidity Index	Not Significant	Negative **
Capital Structure	Negative ***	Negative ***
Operating Cashflow to Assets Ratio	Positive ***	Positive ***
Company Size	Not Significant	Positive ***
GDP Growth	Not Significant	Not Significant

Note ***designates the 1% significant coefficients, **designates the 5% significant coefficients and *designates the 10% significant coefficients.

Source: Author's processing

Table 4.13 shows the results impact of climate change on the financial performance of agricultural, food, and beverage companies listed on the Stock Exchange of Thailand. Return on Assets effect positive sign with rainfall index and operating cashflow to assets ratio. On the other side, the average temperature and capital structure show negative signs that decreased financial measures. The humidity index, company size, and GDP growth are not significant in the return on assets ratio.

The weather information about the average temperature and the humidity index represents a negative sign that decreased return on equity. Dependent variables include operating cashflow to assets ratio and company size shows a positive sign that increased financial performance. However, the capital structure represents a negative sign that the resulting return on equity is decreased. The rainfall index and GDP growth are not significant in the return on equity ratio.

CHAPTER 5

CONCLUSION

5.1 RESEARCH DISCUSSION

This study examines the significant modifications in the operational efficacy of corporations within the agricultural, food, and beverage industries, as observed in publicly traded entities listed on the Stock Exchange of Thailand (SET). The objective is to assess the extent to which business performance has been influenced by the impacts of climate change. Following the inclusion of various control variables, this research has devised an impact model. Therefore, this research uses a multivariate panel data analysis on 31 agricultural, food, and beverage enterprises that were publicly traded on the Stock Exchange of Thailand and belong to the agricultural, food, and beverage sectors for the period 2012 – 2022. The results indicate that climate change risks affect a company's financial performance through negative channels.

Based on the research objective to investigate the relationship between climate change and the financial performance of listed agricultural, food, and beverage firms in the Stock Exchange of Thailand. Serving with voluntary disclosure theory that information should be disclosed. The completeness, clarity, and accuracy of voluntary nonfinancial disclosures are found to affect both market valuation and reputation risk (Khalifa et al., 2023). Voluntary disclosure theory posits that organizations possess the capacity to opt for the revelation of specific data, such as carbon emissions, on a voluntary basis. The outcomes stemming from the examination demonstrate that organizations exhibiting higher ratings in terms of their environmentally proactive initiatives are more inclined to disclose their carbon emissions, while those with higher ratings in relation to environmentally detrimental actions are less inclined to do so. These discoveries offer valuable insights into the elements that exert influence on organizations' choice to voluntarily disclose their carbon emissions (Matsumura et al.,

2014). Moreover, Legitimacy theory refers to the idea that organizations strive to maintain a positive image and reputation to gain legitimacy in the eyes of their stakeholders to fulfill information with financial performance. According to other theories, stakeholder theory applied to the impact of climate change stakeholders' demands by engaging in activities such as corporate social responsibility (CSR) and disclosing information related to climate change issues (Baumgartner et al., 2016; Capasso et al., 2020; Javadi & Masum, 2021; Jekwam & Hermuningsih, 2018). Climate change factors and adopting responsible reporting practices can enhance their reputation, mitigate risks, and strengthen their innovation capacity (Baumgartner et al., 2016; Capasso et al., 2020; Javadi & Masum, 2021; Jekwam & Hermuningsih, 2018). Stakeholder concerned the evaluation of financial performance. The findings demonstrate that the enhancement of equity financing, volatile liquidity management, and the scale of the organization contribute to the consolidation of the economic performance of entities concerning their return on assets and return on equity. The financial performance of agricultural, food, and beverage companies listed on the Stock Exchange of Thailand is influenced by the repercussions of climate change. The relationship between the return on assets and the rainfall index as well as the operating cashflow to assets ratio is characterized by a positive sign. Conversely, the average temperature and capital structure exhibit negative signs, resulting in a decrease in financial measures. The influence of the humidity index, company size, and GDP growth on the return on assets ratio is perceived to be of no significance.

The negative impact on return on equity can be attributed to the weather information concerning the average temperature and the humidity index. The positive sign of the operating cashflow to assets ratio and company size indicates an increase in financial performance. However, the affirmative mark of the capital structure results in an increase in return on equity. The rainfall index and GDP growth do not have a significant effect on the return on equity ratio.

5.2 SUGGESTIONS

While examining the impact of climate change and the financial performance of agricultural, food, and beverage listed firms in the Stock Exchange of Thailand. It is observed that a decline in the average temperature leads to a decrease in the return on assets. Furthermore, an augmentation in debt financing also results in a decline in the return on assets.

On the other, when the average temperature drops and high humidity results the return on equity is decreased. In financial indicators (debt financing) the return on equity also increased. Therefore, debt management is effective in balancing the capital structure. The company size shows a positive correlation, and the resulting return on equity also increases.

The impact of climate change on financial performance varies geographically. Factors such as regional climate vulnerabilities, regulatory frameworks, and market dynamics can influence the relationship between climate change and financial performance in different regions.

The findings have significant implications for a range of internal and external stakeholders, enabling them to make well-informed decisions about their managerial and investment activities. First, policymakers participate in international negotiations and agreements, such as the Paris Agreement, to set collective goals for reducing greenhouse gas emissions and limiting global warming. The regulations and policies are aimed at reducing greenhouse gas emissions, promoting renewable energy sources, and encouraging sustainable practices in industries. Moreover, offers incentives, such as tax credits or subsidies, to encourage businesses to adopt environmentally friendly practices and allocate funding for research and development in renewable energy, climate adaptation technologies, and carbon capture and storage. Second, the management team engages with various stakeholders, including investors, customers, employees, and communities, to communicate the company's efforts to address climate change and solicit feedback. Moreover, responsible for assessing and managing the risks associated

with climate change, such as extreme weather events, regulatory changes, supply chain disruptions, and reputational risks. As a result, by integrating climate risk management into strategic decision-making processes, management can minimize potential financial losses and protect the company's long-term viability. Management develops and implements sustainability strategies that aim to reduce the company's environmental footprint, increase resource efficiency, and mitigate greenhouse gas emissions by investing in research and development of clean technologies, exploring new business models that align with sustainability goals, and incorporating climate resilience into infrastructure and operations planning. Accurately disclosing climate-related risks, opportunities, and performance metrics in financial reports and disclosures. Business strategies may involve setting emission reduction targets, adopting renewable energy sources, optimizing production processes, and implementing sustainable supply chain practices, all of which can contribute to cost savings and operational efficiency improvements. Financial reporting transparency enables investors and other stakeholders to evaluate the company's exposure to climate risks, assess its resilience and adaptation strategies, and make informed investment decisions, ultimately impacting financial performance and valuation. In the rules and regulations, the management team ensures compliance with environmental regulations and standards related to climate change, such as emissions reporting requirements, renewable energy mandates, and carbon pricing mechanisms. Proactive compliance efforts can help avoid regulatory penalties, reputational damage, and operational disruptions, thus safeguarding financial performance. Third, investors incorporate environmental, social, and governance (ESG) factors, including climate change considerations, into their investment decisions. This involves assessing companies based on their environmental impact, carbon footprint, climate resilience, and sustainability practices. By favoring investments in companies that demonstrate strong climate change mitigation and adaptation strategies, investors can contribute to driving capital towards more sustainable and resilient businesses. Engagement with companies through dialogue, shareholder resolutions, and proxy voting to encourage them to improve their climate-related disclosures, set emission reduction targets, and adopt sustainable business practices. Active engagement can influence companies' behavior, promote transparency, and drive positive change toward aligning business strategies with climate-related goals.

Evaluate climate-related risks and opportunities in their investment portfolios to assess potential financial impacts. This includes analyzing exposure to physical risks (e.g., extreme weather events, sea-level rise) and transition risks (e.g., policy changes, technological disruptions) associated with climate change. Investors determine the financial implications of climate change for companies across various sectors. They consider factors such as regulatory compliance costs, market demand for sustainable products and services, resource efficiency, and resilience to climate-related disruptions when evaluating the financial performance and valuation of companies. Moreover, investors allocate capital towards climate-friendly investments, such as renewable energy projects, clean technology companies, and green infrastructure developments. This capital deployment supports the transition to a low-carbon economy, fosters innovation, and creates economic growth opportunities while potentially delivering attractive financial returns for investors. Furthermore, pertinent weather information is sourced from the esteemed Thai Meteorological Department, Ministry of Digital Economy, and Society. Consequently, it becomes imperative for the government to comprehend how companies respond to the phenomena of climate change, given its undeniable impact on the primary source of financial support within key economic sectors such as agriculture, food, and beverage industries, as evidenced in publicly traded entities listed on the Stock Exchange of Thailand (SET). Companies are integrating climate-related risks and opportunities into their risk management strategies and decision-making processes. The climate change policy complies with different risk management approaches (e.g., adaptation measures, mitigation efforts, disclosure practices) in mitigating financial risks and enhancing resilience to climate change. Consequently, there is a pressing need for diligent monitoring and strategic planning in response to climate change. Additionally, it is worth noting that climate change exerts a substantial influence on the overall wealth of the nation. In this regard, the government must acknowledge the critical instability of weather patterns, which often results in missed opportunities.

5.3 LIMITATIONS

Research on the correlation between climate change and financial performance encounters several constraints that researchers must recognize and tackle to ensure the credibility and dependability of their results. The availability of accurate and comprehensive data on climate-related elements and financial performance indicators may be restricted, particularly for past periods or specific sectors. Variations in data, gaps, and measurement inaccuracies can impact the precision and strength of the examination. Climate change and its consequences unfold over extended periods, posing difficulties in establishing causal links between climate-related factors and financial performance results. Short-term investigations might not fully grasp the complete range of climate-related hazards and opportunities or neglect delayed impacts on financial performance. The association between climate change and financial performance might be influenced by endogeneity and reverse causality concerns. For instance, organizations with superior financial performance may possess the means to invest in climate mitigation strategies, resulting in a misleading correlation between climate actions and financial results. Given that climate change affects industries, regions, and firms diversely based on variables like vulnerability to climate-related hazards, adaptability, and market dynamics. Drawing broad conclusions from one scenario to another might oversimplify the intricate connections between climate change and financial performance. Various approaches, measures, and units of examination could produce inconsistent outcomes and complicate comparisons across studies. Furthermore, Climate change intersects with a range of economic, social, and technological factors that could obscure the link with financial performance. Neglecting to adequately consider these influencing variables could lead to prejudiced or deceptive deductions regarding the influence of climate change on financial performance. Research investigations might exhibit sample selection bias if they concentrate on entities that willingly reveal climate-related data or display superior financial performance, potentially resulting in an exaggeration or underestimation of the correlation between climate change and financial performance. Inappropriate model specifications, like excluding pertinent variables or utilizing incorrect functional forms, can skew estimates and weaken the credibility of outcomes. Conducting sensitivity

analyses and robustness assessments is crucial to evaluate the reliability of results under alternative model specifications.

Addressing these limitations requires careful research design, methodological rigor, and transparent reporting practices. Researchers should use robust analytical techniques, incorporate sensitivity analyses, and acknowledge the uncertainties and caveats inherent in their findings. Collaborative efforts between researchers, practitioners, policymakers, and other stakeholders can help overcome these limitations and advance knowledge about the complex relationship between climate change and financial performance.

Although this research paper has yielded certain significant findings, the research must highlight several constraints within the article to enhance future research endeavors and ultimately attain superior outcomes.

Firstly, the procedure of gathering weather data by the Thai Meteorological Department is based on the average readings of all the regions, which could potentially impact the precision of the data. The control variables, although not fully comprehensive, might still exert an influence on the financial performance of the company as there could be other ratios that are more appropriate for assessing financial performance.

Secondly, the present study solely concentrated on the agricultural, food, and beverage sectors, as evidenced by the publicly traded entities listed on the Stock Exchange of Thailand (SET), which underwent testing with a total of 341 samples. These samples were representative of 31 companies operating within the industry. Moving forward, the authors plan to increase the sample size, explore additional industries, or include all Thai firms to expand the scope of the research.

Finally, solely the econometric regression model was employed in this study. In subsequent investigations, the other research aspires to explore alternative models to facilitate more targeted evaluations.

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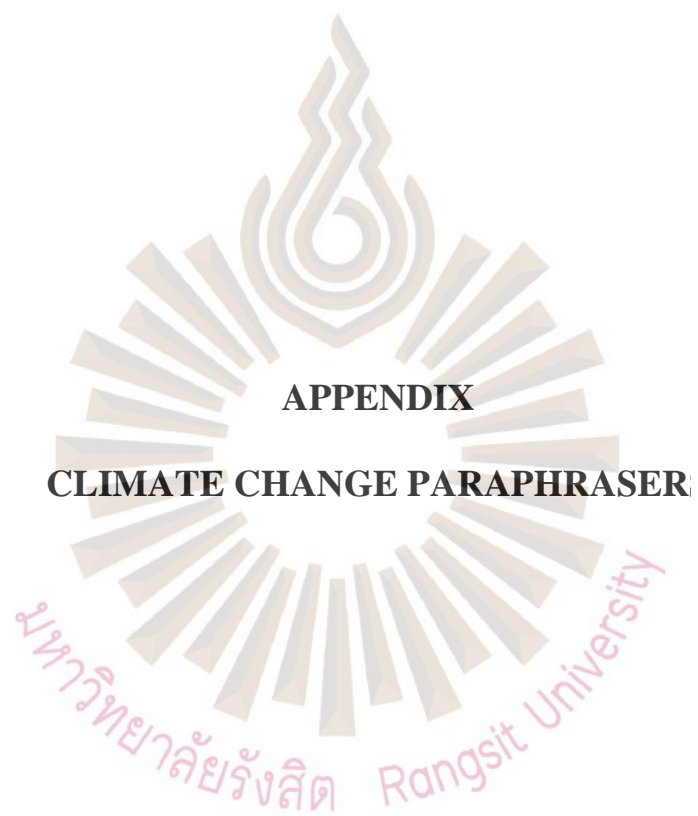
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Paper	Topic	Summarized Abstract	Summarized Introduction	Theory	Literature Survey	Method Used	Independent Variable	Practical Implication	Results	Contribution
1	The Impacts of Climate Change Risks on Financial Performance: Evidence from Listed Manufacturing Firms in Vietnam	Examines climate change risks on financial performance of manufacturing firms in Vietnam. Uses econometric regression model to analyze relationship between climate change and performance. Data from 144 listed companies between 2015-2019 shows negative impact.	Examines climate change risks on financial performance of manufacturing firms in Vietnam. Uses econometric regression model to analyze relationship between climate change and performance.	Agency theory emphasizes capital structure as a disciplinary mechanism. Debt financing mitigates agency costs and enhances firm performance. Capital structure choice influences financial performance of firms.	Climate change impacts nature, human activities, and economic sectors. Global temperatures rising affect economic activities and industries. Climate change risks affect manufacturing activities directly or indirectly. Climate change affects various industries, including mining, agriculture, and construction.	Quantitative and qualitative methods applied, including econometric regression model. Panel data model used for 144 companies over 5 years.	Average temperature, rainfall, sunshine hours, and humidity.	Awareness of climate change impact on firm performance. Need for action plans to cope with climate change risks.	Climate change negatively impacts financial performance of manufacturing companies. Humidity risk significantly correlates with financial performance. Humidity risk significantly correlates with financial performance. Limited impact from temperature, sunshine hours, and rainfall on financial performance. Data collection process limitations include manual extraction and incomplete control variables.	Climate change negatively impacts financial performance of manufacturing companies. Humidity risk significantly correlates with financial performance of companies. Temperature, sunshine hours, and rainfall have negligible performance on financial performance. Data collection process and limited climate change data are study limitations.

	Climate Change and Global Warming Discourses and Disclosures in the Corporate Annual Reports: A Study on the Malaysian Companies	Analysis of climate change disclosures in Malaysian company reports. Disclosure at introductory stage, not mandatory but increasing.	Paper focuses on climate change and global warming discourses. Analyzes corporate reporting of Malaysian companies on these issues.	N/A	Climate change and global warming influenced climate science and policies. Companies are under pressure to address climate change issues.	Content analysis of annual reports. Discourse analysis of climate change and global warming issues.	N/A	Malaysian companies are voluntarily reporting on climate change. Disclosure is at an introductory stage.	Some Malaysian companies are voluntarily reporting on climate change and global warming issues. Disclosure on these issues is still at an introductory stage.	Companies disclosing views and activities on global warming. Introduction of new terms, jargons, and discourses.
3	Temperature effects on productivity and factor reallocation : Evidence from a half million chinese manufacturing plants	Temperature affects firm-level productivity and output in China. Climate change could reduce Chinese manufacturing output by 12% annually.	Paper examines temperature effects on firm-level productivity and output. Finds an inverted U-shaped relationship between temperature and productivity.	N/A	Temperature as a new cause of productivity dispersion. Effects of temperature on labor supply (Heal and Park, 2013).	Olley-Pakes estimator (primary approach). Index number approach (robustness check).	Temperature	Climate change will reduce Chinese manufacturing output by 12%. Chinese manufacturing sector produces 32% of national GDP and supplies 12% of global exports.	Inverted U-shaped relationship between temperature and TFP. Climate change will reduce Chinese manufacturing output by 12% annually	First joint empirical analysis of temperature effects on TFP, factor inputs, and output using firm-level data. Examines temperature effects on manufacturing activity globally.

4	Carbon Emissions and Firm Value	Investigates relationship between carbon emissions and firm value. Negative association between carbon emissions and firm value.	Investigates relationship between carbon emissions and firm value. Negative association between carbon emissions and firm value.	Voluntary disclosure theory signals proactive strategy towards environmental concerns. Legitimacy theory argues for extensive disclosures to create favorable perceptions.	Motivation and hypothesis on association between carbon emissions and firm value. Discussion of market-based climate change regulation and institutional context.	Sensitivity analyses conducted to assess robustness. Use of the GRI's sustainability reporting framework.	TEMIT t (emissions in thousands of metric tons) TEMDUM t (indicator variable for carbon emissions data availability)	Negative association between carbon emissions and firm value. Markets anticipate firms will be required to pay for their emissions.	Negative association between carbon emissions and firm value. Contingent upon firms voluntarily disclosing their carbon emissions.	Investigate relationship between carbon emissions and firm value. Use hand-collected carbon emissions data for analysis.
5	Firm-Value Effects of Carbon Emissions and Carbon Disclosures	Examines firm value effects of carbon emissions and disclosures. Firm value decreases by \$212,000 for every additional thousand metric tons of carbon emissions.	Interest in climate-change risk has grown 18-fold. Little research on association between carbon emissions and firm value.	Voluntary disclosure theory (Verrecchia 1983; Healy and Palepu 2001). Economic theory predicts firms reveal credible private information (Akerlof 1970; Milgrom 1981).	N/A	N/A	N/A	Capital markets integrate carbon emissions and voluntary disclosure into firm valuations. Non-disclosure of carbon emissions may reduce firm value.	For every additional thousand metric tons of carbon emissions, firm value decreases by 212,000 2.3 billion higher than that of comparable non-disclosing firms.	Little research on association between carbon emissions, disclosures, and firm value. () Benefits of carbon disclosures include increased revenues and positive perceptions. ()

6	ORGANIZATIONAL ADAPTATION AND RESILIENCE TO EXTREME WEATHER EVENTS.	Review of existing theories on organizational adaptation and resilience. Development of a conceptual framework for extreme weather events.	Organizational adaptation and resilience to extreme weather events. Limited conceptual foundation for studying organizational adaptation and resilience.	Organizational adaptation as a gradual, incremental change process. Resilience as the capacity to recover from extreme weather events.	Fragmented conceptual foundations in existing literature. Focus on adaptation to climate change and extreme weather events.	Combines strategic choice sensemaking and evolutionary perspectives. Builds on existing management and organization theories.	First-order responses to extreme weather events. Long-term adaptation and resilience to extreme weather events	Organizations dependent on large-scale infrastructure are more exposed to extreme weather events. Organizational adaptation is influenced by various pressures, including climate change and extreme weather events.	N/A	Develops a conceptual model of organizational adaptation and resilience. Highlights the paper's contribution to organizational theory and management.
7	TEMPERATURE AND INCOME: RECONCILING NEW CROSS-SECTIONAL AND PANEL ESTIMATES	Temperature and income relationship in cross-sectional and panel estimates. Importance of adaptation in reconciling data.	Paper examines temperature's effect on income. Considers short-run and long-run effects. Considers adaptation as a factor.	Theory emphasizes adaptation and convergence forces. Price adaptation mechanism offsets temperature effects within countries.	N/A	OLS estimation with clustering observations by state. Corrections for spatial correlation using Conley 1999.	Temperature	New evidence on relationship between temperature and income. Short-term effects of temperature can be offset in the long run through adaptation.	Cross-sectional relationship between climate variables and income. Estimation of mean temperature and precipitation levels.	Examines the implications of convergence alone. Considers the effects of temperature differences within and across countries.

8	The Impact of Climate Change Information : New Evidence from the Stock Market	Non-profit organization released ratings on companies' greenhouse gas emissions. Information had significant impact on capital market returns.	Examines impact of climate change information on stock market. Ratings had significant impact on market returns.	N/A	N/A	N/A	Climate Counts' scores. Interaction between scores and advertising expenditures.	Climate ratings had a significant impact on capital market returns. Poorly rated firms experienced decreased expected returns.	Mean R-squared from security-specific regressions was 0.3. Market model results showed average rated stock closed up/down 0.89% when market closed up/down 1%.	Measures effect of climate change information on capital market performance. Provides early evidence on relationship between financial performance and climate-related environmental behavior.
9	TEMPERATURE, AGGREGATE RISK, AND EXPECTED RETURNS	N/A	Temperature is a source of economic risk in global equity markets. Temperature raises expected equity returns and increases borrowing costs.	Temperature does not affect the model implications. Aggregate growth does not impact temperature.	N/A	N/A	Lagged global temperature. Temperature shocks (residual from autoregressive model).	Temperature is a source of aggregate economic risk. Countries closer to the equator carry a higher temperature risk premium.	N/A	Temperature raises expected equity returns. GDP growth is negatively related to global temperature.
10	CLIMATE AMENITIES, CLIMATE CHANGE, AND AMERICAN QUALITY OF LIFE	QOL index measures willingness-to-pay for households. Geographic control variables affect quality of life.	Paper examines impact of climate change on quality of life. Uses OLS regression to estimate effects on QOL.	WTP declines less steeply over extreme temperatures. WTP departs non-linearly away from 65oF.	Standard practice in QOL literature (Blomquist et al., 1988; Chen and Rosenthal, 2008). Previous literature provides a benchmark for comparison.	Standard practice in QOL literature. Local linear regression with temperature spline basis functions.	Monthly average surface temperature, relative humidity, surface pressure, convective precipitation rate, and large-scale precipitation rate	Recover willingness to pay for non-market goods. Estimate households' valuation of climate amenities.	Strong preference for sunshine. Mild preference for precipitation.	Standard practice in QOL literature. Enforcing preference homogeneity over nontemperature variables.

							(TS, RELHUM, PS, PRECC, and PRECL)			
11	The Impact of Climate Risk on Firm Performance and Financing Choices : An International Comparison	Climate risk affects firm performance and financing choices Firms in countries with severe weather hold more cash, have less short-term debt, and are less likely to distribute cash dividends.	Climate impact on economic performance recognized and documented. Few studies on climate risk and firm financing choices.	Path analysis used to examine dependencies. Financing policies affected by resilience and earnings volatility.	N/A	Estimation of climate risk on financial performance. Control for firm characteristics and fixed effects.	Climate Risk (CRI scores published by Germanwatch)	Managers consider climate risk when making financing choices. Firms in countries with severe climate risk hold more cash and rely less on short-term borrowing.	Likelihood of loss from extreme weather events associated with lower and more volatile earnings and cash flows. Firms in countries with severe weather hold more cash, have less short-term debt, more long-term debt, and are less likely to distribute cash dividends.	Examines effect of climate risk on firms. Uses Global Climate Risk Index (CRI) data.
12	Predicting corporate carbon footprints for climate finance risk analyses: A machine learning approach	Machine learning used to predict corporate carbon emissions. Improved accuracy by up to 30% compared to existing models.	Paper uses machine learning to predict corporate carbon footprints. Limited disclosure of corporate carbon footprints motivates the need for prediction models.	No unifying theory for predicting carbon footprints. Carbon emissions treated as a function of scale, technology, business models, and energy inputs/outputs.	Corporate emission-related information attracts growing interests among stakeholders. Investment portfolios require broad coverage of firm-level emissions.	Machine learning for carbon emission prediction. Comprehensive modelling strategy for data processing and evaluation.	Various data points from Thomson Reuters ESG database. Additional predictors (energy production/consumption data) and firm disclosures	Machine learning improves prediction accuracy for carbon emissions. Different models and predictors can be used for decision-making.	Prediction of Scope 1, Scope 2, and Total Emissions achieve substantial accuracy gains. Inclusion of energy consumption reduces average MAE by 30.	Uses machine learning to predict corporate carbon footprints. Addresses the limited reporting and reliability of self-reported emissions.

13	The Impact of Environmental, Social and Governance Dimensions of Corporate Social Responsibility on Economic Performance: Australian Evidence	Analyzing the impact of CSR on economic performance. Environmental performance positively related to economic performance.	Global financial crisis raised concerns over companies' performance. CSR includes economic, legal, ethical, and philanthropic components.	The research uses instrumental stakeholder theory as a framework. Stakeholder theory supports the hypothesis that CSR performance has a positive impact on economic performance.	No universally accepted definition of CSR. CSR includes social, environmental, and governance aspects. Stakeholder perspective to CSR and positive financial performance. Inconclusive findings on the relationship between CSR and financial performance. Increasing interest in studies utilizing ESG data. Limited empirical literature on the impact of ESG measures on economic performance. Use of Australian firms as the target population. Relationship between environmental performance and economic performance remains understudied. Positive relationship between environmental	Secondary data from Thomson Reuters Inc.'s Asset4(r) dataset. ESG and economic performance scores assigned by experts.	Environmental performance. Social performance.	Social dimension is the biggest contributor to economic performance. Partial support for positive relationship between environmental performance and economic performance.	N/A	Contribute to sustainability management, CSR, and environmental management literatures. Analyze the impact of CSR on economic performance.
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					performance and economic performance. Social dimension is the biggest contributor to economic performance. Partial support for a positive relationship between environmental performance and economic performance. Governance performance does not have a significant effect on economic performance.					
14	Environmental, social, and governance (ESG) performance and financial outcomes: Analyzing the impact of ESG on financial performance.	ESG performance positively impacts corporate financial performance. ESG rating is more significant for large-scale companies.	ESG investment is growing in importance globally. ESG performance is related to lower capital costs and operational efficiency.	The research is based on stakeholder and transmitting signal theory. The study concludes that larger companies are more concerned about ESG because they are more socially visible.	N/A	Multiple regression analysis. Heterogeneity test.	ESG (Environmental Social Governance) performance	ESG initiatives support company sustainability and reputation. Integration of ESG improves corporate financial performance.	ESG performance has a significant positive impact on ROA. The positive impact of ESG rating on CFP is more pronounced in high-risk cases.	ESG was coined by the United Nations in 2004. Predicted global ESG assets to reach USD 53 trillion by 2025.

15	Carbon, indoor air, energy and financial benefits of coupled ventilation upgrade and enhanced rooftop garden installation: An interdisciplinary climate mitigation approach	Rooftop garden and ventilation upgrades can reduce CO2 emissions. Simultaneous improvements can decrease energy use and cost.	Cities contribute to climate change and face heat island effect. Buildings account for significant energy consumption and emissions. Inadequate ventilation affects indoor air quality in schools. Rooftop gardens can reduce energy costs and capture carbon.	N/A	N/A	Measurement of indoor CO2 concentrations. Calculation of ventilation rates. Modeling of five scenarios to assess impacts.	Ventilation rates, rooftop garden installation	Combined upgrade of ventilation systems and rooftop gardens. Improved IAQ, enhanced growth, decreased carbon footprint.	Total energy for heating > energy for cooling. Energy breakdown: 31k kWh ventilation, 51k kWh cooling, 31k therms heating ()	Increased plant growth in rooftop gardens (Buckley, 2020). Assessing impacts of building ventilation on CO2 concentrations and rooftop garden capabilities.
16	Climate change and financial stability: Natural disaster impacts on global stock markets	Statistical analysis of climate change impacts on stock markets. Heterogeneous responses to natural hazard shocks, European countries more affected	Climate change affects financial markets and economic systems. Natural disasters have direct impacts on domestic financial markets.	The paper presents a statistical analysis of the impacts of natural disasters on international stock markets. The study finds that climatological and biological disasters have the most significant	N/A	Seemingly Unrelated Regression (SUR) models. Event study methodology.	Natural disasters (biological, climatological, geophysical, hydrological, meteorological)	Climatological and biological disasters have the harshest impacts on international financial markets returns. European countries are particularly sensitive to natural disaster shocks.	Heterogeneous stock market responses to natural hazard shocks. Climatological and biological calamities induce extreme reactions.	Study of risk transmission from natural disasters. Effects of different categories of natural disasters on stock markets.

				effects on financial markets.						
17	Realizing the 2050 Paris climate agreement in West Africa: the role of financial inclusion and green investments	Study evaluates impact of financial inclusion and green investment on reducing greenhouse gas emissions in West Africa. Findings show financial inclusion and green investment have a monotonic effect on reducing emissions.	Paris Agreement calls for limiting global temperature rise. Financial inclusion and green investment reduce greenhouse gas emissions.	Theory of green economics focuses on human activities and environmental quality. Financial inclusion, green investment, and technological innovation influence ecological deterioration in West Africa.	N/A	N/A	Financial inclusion Green investment	Shift financial support towards eco-friendly alternatives. Enforce environmental laws and regulations to avoid pollution.	Residual CD is present in the studied panel. Heterogeneity is confirmed at the 1 level in the models.	Implications for region's fight against environmental contamination. Effect of financial inclusion, green investment, and technological innovations on environmental pollution in West Africa
18	Carbon emissions, carbon disclosure and organizational performance	Investigates carbon emissions, disclosure, and organizational performance. Mandatory carbon disclosure improves organizational performance.	Study investigates carbon emissions, disclosure, and organizational performance. Sample of 62 UK FTSE 100 firms in carbon-sensitive sectors.	Legitimacy theory posits that organizations disclose environmental information in response to social, environmental, political and economic pressure to maintain	Majority of prior studies focused on social-psychological or social-political perspectives. The paper reviews relevant literature and presents main hypotheses.	N/A	Emissions _{j,t-1}	Carbon disclosure mediates the relationship between carbon emissions and organizational performance. Mandatory reporting regulations in 2013 increased the effect of carbon	Carbon emissions are negatively associated with organizational performance. Firms with higher carbon emissions tend to employ more disclosure as a communicative legitimacy process.	Investigates the link between carbon disclosure and organizational performance. Constructs a comprehensive disclosure index for analysis

				their license to operate. Organizations need to balance institutional pressures and economic efficiency to guarantee their continued existence.				disclosure.		
19	Climate change accounting and the Australian mining industry: exploring the links between corporate disclosure and the generation of legitimacy	Examines disclosure practices in Australian mining industry. Highlights use of legitimizing strategies and communication media.	Paper explores sustainability management and reporting in accounting. Focuses on climate change accounting and carbon emissions.	Legitimacy theory emphasizes managing the relationship between an organization and its community. Legitimizing disclosures should be directed towards relevant publics.	Section 2: Prior literature on climate change reporting. Section 3: Literature on legitimacy theory.	Legitimising disclosure strategies at an industry level. Emphasizing real changes and substantive activities.	Disclosure strategies of industry bodies	Advances understanding of environmental disclosure practices. Provides insights into variations in legitimising strategies.	Companies pursue all four forms of corporate legitimising strategies concurrently. Industry bodies focus on changing societal expectations.	Growth in sustainability management and reporting. Link between sustainability information and disclosure in reports.

20	Climate change accounting research: keeping it interesting and different	Overview of climate change research in accounting and accountability . Challenges in accounting for carbon and GHG. Emissions.	Paper discusses climate change research in accounting. Highlights challenges in accounting for carbon emissions.	Institutional governance systems theory.	N/A	Overview of issues in the science of climate. Accounting analysis and shadow carbon account	Estimates of New Zealand's Kyoto GHG emissions liability. Fluctuations in the net physical quantum of emissions.	Urgent research needed on accounting and auditing issues. Avoid dominant focus on reporting and assurance.	Accounting for carbon emissions is challenging due to uncertainties in estimation methods. Reducing emissions in the near future is a significant challenge.	Eleven contributions to this special issue.
21	Accounting for Carbon: The Role of Accounting Professionals in Governing Climate Change	Accounting professional organizations involved in climate change debates. Examining the role of accountancy profession in governing climate change.	Accounting professional organizations involved in climate change debates. Examining the role of accountancy profession in governing climate change.	Theoretical frameworks : measurement, calculation, expertise. Foucauldian governmentality approach: power, self-regulation, governance .	Examines role of accounting profession in governing climate change. Reviews climate change activities of accounting professional bodies.	Developing new and modifying existing accounting practices. Identifying and modifying existing accounting technologies and practices.	N/A	Accounting profession positioning themselves as crucial in governing carbon. Climate change framed as a corporate problem solvable with existing accounting approaches.	N/A	Investigating implications of carbon markets for other disciplines. Assessing role of accountancy profession in governing carbon economy.
22	Climate Change Accounting and Reporting: A Systematic Literature Review	Paper focuses on climate change accounting and reporting. Identifies gaps and encourages further research in this area.	Sustainability accounting and reporting practices are emerging. The paper focuses on accounting and reporting for climate change.	Lack of frameworks based on accounting principles. Importance of environmental information for	Accounting is important in social processes. Environmental and social aspects in accounting.	Systematic literature review approach [62]. Science mapping analysis using bibliometrix [67].	Sustainability -oriented practices and reporting. Climate change mitigation actions and reporting.	Deeper involvement of accounting scholars and practitioners in SDG accounting and reporting. Increase in interest of accounting	Main perspectives relate to sustainability accounting and reporting. Lack of contributions about management of climate change-	Emerging sustainability-related accounting and reporting practices. Focus on accounting and reporting related to climate change aspects.

				corporate performance.				scholars and practitioners in climate change accounting and reporting.	related aspects.	
23	The role of accounting in supporting adaptation to climate change	Accounting supports climate change adaptation through risk assessment. Accounting values adaptation costs and benefits.	Accounting can support climate change adaptation Functions: risk assessment, valuation, and disclosure	N/A	N/A	N/A	N/A	Risk assessment function for climate change adaptation. Valuation function for adaptation costs and benefits.	N/A	Accounting function can support climate change adaptation. Impacts of climate change should be reflected in costing, reporting, and disclosure.
24	Accounting for climate change and the self-regulation of carbon disclosures	Examines influence of dominant environmental discourses on carbon disclosure regulation. Considers self-regulated carbon disclosure practices and their role in decision making.	Accounting profession integral to disclosure practices. Shift towards social and environmental disclosure.	GHG Protocol developed with corporate engagement. GHG accounting principles guide reporting information accuracy.	N/A	GHG Protocol as a reporting methodology. Other regimes, industry schemes, and national legislation.	Voluntary nature of reporting environment. Use of different regulatory regimes	Carbon disclosure comparability needs improvement. Qualitative features of financial accounting fall short.	Methodological diversity may inhibit usefulness of climate change-related data. Carbon disclosures are voluntary and not verified.	Corporate social reporting practice and research. Voluntary and mandatory regulatory regimes.

25	The impact of climate change risks on firm value: Evidence from the Korea	Examines relationship between climate change risks and firm value. Higher GHG emissions and energy consumption negatively impact firm value.	Valuation of companies based on financial factors faces limitations. Researchers use natural environmental factors for valuation.	Signal hypothesis predicts positive relationship with firm value. Pecking order theory predicts negative relationship with firm value.	GHG emissions impact on firm value. Companies with lower emissions have higher value.	Tobin's Q used as a measure of firm value. ROA used as a measure of firm value ().	Level of GHG emissions Ratio of energy consumption to annual sales	Higher levels of greenhouse gas emissions and energy consumption have a negative impact on firm value. Efforts to cut emissions below industry average are important.	Higher levels of greenhouse gas emissions and energy consumption have a negative impact on firm value. These relationships are stronger in industries with high climate change risks.	Utilizing natural environmental factors for firm valuation. Implementing policies and control systems to reduce emissions.
26	The Impact of Carbon Emissions on Corporate Financial Performance: Evidence from the South African Firms	Examines impact of carbon emissions on financial performance. Finds negative relationship between emissions and performance.	Carbon emissions impact on corporate financial performance. Lack of knowledge on the effect of carbon emissions - Green investment initiatives can manage financial performance.	Institutional theory explains corporate behavior in relation to green interest pressures.	Examines policies influencing carbon emissions in corporate context. Studies relationship between emissions and company financial performance.	Multiple regression techniques. Heteroscedasticity-robust standard error estimates [33].	Scope 1, Scope 2, and Scope 1 and 2 carbon emissions.	Green investment initiatives can effectively manage financial performance. Companies can gain higher environmental and financial performance.	Negative relationship between carbon emissions and financial performance. Green investment initiatives can effectively manage financial performance.	Addresses research void on carbon emissions and financial performance. Provides findings for African policy makers and businesses.
27	Relationship between Financial Performance and Corporate Disclosures regarding Climate Change Practices	Examines relationship between financial performance and climate change disclosures. Greek firms with better financial	Climate change policies and regulations increase business risks. Demand for disclosure of corporate climate	Stakeholder and legitimacy theory support the relationship between firm size and increased environmen	N/A	Content analysis. Firm-specific factors analysis.	Size (measured using the natural log of total assets). Financial performance (measured using return on assets).	Larger firms disclose more information on climate change practices. Firms with good financial performance disclose more	Average of 1.98 out of 12 disclosure items reported. Positive significant relationship between financial performance and increased	Outlines financial factors affecting disclosure of climate change practices. Examines relationship between firm-specific factors and environmental disclosures.

		performance disclose more information.	change practices.	tal disclosures. Larger firms can afford expenditures for cleaner technologies.				information.	corporate disclosures regarding climate change practices	
28	Money at risk: climate change and performance of Canadian banking sector	Study explores impact of weather catastrophes on Canadian banking sector. No significant impact on performance, but helps lower risk and improve stability.	Extreme weather events increasing due to global warming. Weather catastrophes costing billions globally. Canada's per capita greenhouse gas emissions high. Impact of weather catastrophes on Canadian banking sector assessed. Findings show no significant impact on bank performance. Insurance and reconstruction activities provide	Higher GDP growth leads to less loan losses. Large banks are more stable compared to smaller banks.	Impact of climate change on economies and financial systems. Focus on specific economic and environmental sectors. Impact of natural disasters on financial institutions and markets. Impact of weather catastrophes on bank performance and risk. Limited studies on weather catastrophes' impact on banking sector.	Regression estimation using pooled ordinary least square (OLS). Panel data techniques to estimate equations.	Natural log of loan losses (LLS). Z-score of each bank in a given year.	Climate risk management is important for banks. Other sectors may be impacted by weather catastrophes.	No significant impact of weather catastrophes on Canadian banks' performance. Weather catastrophes helped banks lower risk and improve stability.	First study to assess impact of climate change on Canadian banks. Examines association of banking variables with performance and risk.

			banking opportunities.							
29	Climate-related financial disclosure in integrated reporting: what is the impact on the business model? The case of Poste Italiane	Study explores paths for business model reconfiguration. Emphasizes importance of climate change disclosure for stakeholders.	Sustainable development is a strategic priority for companies. Climate change has led to low-carbon business decisions.	Legitimacy theory explains why companies report on social and environmental performance. Corporate reporting creates transparency and reduces information asymmetry.	Organizations adopting integrated perspective and corporate governance principles. Stakeholder theory emphasizes stakeholder engagement and decision-making.	Exploratory case study approach (Yin, 2015). Qualitative research design.	Corporate governance and SSC activities.	Integrating sustainability issues into corporate strategy and business models. Promoting corporate sensitivity to emerging climate risks.	Relevance of sustainability and climate change in business model and reporting needs improvement for stakeholder participation and awareness. Disclosure of climate change risks and opportunities is crucial for achieving SDGs and supporting stakeholder decision-making.	Assessing companies' approach to defining business models. Optimizing monitoring and reporting processes for transparency.

30	The impact of climate risk on accounting conservatism: evidence from developing countries	Climate risk decreases accounting conservatism in developing countries. Climate risk negatively affects financial reporting quality.	Paper examines impact of climate risk on accounting conservatism. Uses Climate Risk Index (CRI) to measure severity of losses due to extreme weather events. Finds that greater climate risk leads to lower accounting conservatism. Results hold after using different estimation methods. Analysis is limited to the period 2007-2016. Findings could be helpful for standard setters and policymakers. Climate risk decreases financial reporting quality.	Watts (2003a) offers four explanations for accounting conservatism: contracting, litigation, taxation, and regulatory. Accounting conservatism enhances debt contract efficiency and reduces litigation risk.	Climate change's negative impact on socio-economic system (). Climate risk harms firms' performance ().	Climate Risk Index (CRI) developed by Germanwatch. Different estimation methods.	Climate risk	Regulators may require disclosure of climate risks. Incorporating accounting conservatism can promote financial reporting transparency.	Climate risk leads to lower accounting conservatism. Results remain unchanged after robustness analysis.	Germanwatch reports on climate-related deaths and costs. Other studies examine climate risk on financing and capital structure.
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31	Climate Change Disclosure Impact on Indonesian Corporate Financial Performance	Examines impact of climate change disclosure on financial performance. Finds that CCD improves ROA and sales growth.	Paper examines impact of climate change disclosure on financial performance. Uses linear and non-linear approaches for analysis.	Legitimacy theory explains the relationship between CCD and CFP.	Prior research commonly uses company size as a control variable. The paper contributes to climate change accounting literature in Indonesia.	Linear and non-linear approaches. Content analysis using Task Force on Climate-Related Financial Disclosures (TCFD) recommendations.	CCD (Climate Change Disclosure)	CCD in larger firms affects ROA and ROS. Improving CCD quality increases stakeholders' perception and sales growth	CCD in large companies decreases ROS and improves ROA. Improvement occurs in the long term for ROA and sales growth after a certain level is met (U-curve).	Increase driven by TCFD, SASB, CDP, SEC. () Climate change impacts companies' sales. ()
32	Flood risk reduction and climate change adaptation of manufacturing firms: Global knowledge gaps and lessons from Ho Chi Minh City	Study on flood risk reduction and climate change adaptation. Focus on small and medium-sized manufacturing firms in Ho Chi Minh City.	Disasters and climate change risks are a growing concern for business leaders. Detailed knowledge about environmental and climate risks faced by the private sector is thin. This paper focuses on manufacturing firms in Ho Chi Minh City (HCMC) and their adaptation to flood impacts.	External factors influence firms' adaptive decision-making. State role crucial for individual flood adaptation.	N/A	Exploratory case study approach [75]. Semi-structured interviews and discussions with stakeholders.	Flood adaptation measures. External factors and processes.	Two-thirds of firms implement proactive or reactive adaptation strategies. External support systems strongly influence firms' adaptation measures.	Majority of firms cope reactively to prevent severe flooding effects. Lack of business capabilities and financial capacity hamper proactive adaptation.	Top global risks: extreme weather events, climate action failure, natural disasters () Gap in scientific knowledge on firm-level adaptation ()

33	The impact of climate change on the cost of bank loans	Firms in climate-exposed locations pay higher loan spreads. Exposure of a firm's customers to climate risk affects borrowing cost.D37.	Examines impact of climate risk on firms' cost of capital. Banks view climate change as relevant risk factor.	CDS can improve lending efficiency for high-quality borrowers. CDS undermines lenders' incentive to monitor risks.	Climate risk exposure categorized into physical, regulatory, and transition risks. Financial markets price climate risk in various assets.	Use of firm headquarters and customer exposure. Analysis of long-term loans of poorly rated firms.	Long-term climate change trend (TREND). TREND Dummy (indicator variable for high exposure to TREND risk)	Climate change is viewed as a risk factor by lenders. Enhanced climate risk disclosure requirements are necessary.	Firms in locations with higher exposure to climate change pay higher spreads on their bank loans. The exposure of a firm's customers to climate risk also affects the firm's cost of borrowing.	Examines the impact of climate risk on firms' cost of capital. Investigates whether banks incorporate climate risk into loan contracts.
34	The Impact of Climate Risk on Firm Performance and Financing Choices : An International Comparison	Climate risk affects firm performance and financing choices. Firms in countries with severe weather hold more cash, have less short-term debt, and are less likely to distribute cash dividends.	Climate impact on economic performance recognized and documented. Few studies on climate risk and firm financing choices.	Path analysis used to examine dependence . Financing policies affected by resilience and earnings volatility.	N/A	Estimation of climate risk on financial performance. Control for firm characteristics and fixed effects.	Climate Risk (CRI scores published by Germanwatch)	Managers consider climate risk when making financing choices. Firms in countries with severe climate risk hold more cash and rely less on short-term borrowing.	Likelihood of loss from extreme weather events associated with lower and more volatile earnings and cash flows. Firms in countries with severe weather hold more cash, have less short-term debt, more long-term debt, and are less likely to distribute cash dividends.	Examines effect of climate risk on firms. Uses Global Climate Risk Index (CRI) data.

35	Firm-level impacts of natural disasters on production networks: Evidence from a flood in Thailand	Examines impact of 2011 flood in Thailand on procurement patterns. Small firms reduce local procurement, old firms look to China.	2011 floods in Thailand impacted production networks. Study examines impact on Japanese affiliates in Thailand.	N/A	N/A	Estimation models for local procurement share. Decomposition of local procurement from different sources.	Age Dispatch dummy variable	Natural disasters do not have significant persistent effects on firms' subjective risks of local procurement. Firm size and overseas experience/knowledge affect the extent of ex-ante preparation and the ability to diversify procurement sources.	No significant change in local procurement share after floods. No significant difference in local procurement share between affected and unaffected firms.	Examines economic impact of natural disasters at firm level. Focuses on impact of flooding on procurement patterns.
36	Climate Risk and Capital Structure	Climate risk affects capital structure after the Paris Agreement. Leverage decreases due to physical climate risk.	Climate change is accelerating with documented temperature increase. Climate risk affects pricing of stocks, bonds, and real estate. Physical climate risks lead to lower leverage in post-2015 period. Paris Agreement raised	Three theories of capital structure: static tradeoff theory, pecking order, and market timing. Empirical evidence suggests firms borrow more with lower debt issuance costs, higher	N/A	Difference-in-differences regression. Matching bank-loan level dataset with other data sources.	Physical climate risk. CRIS post-2015 climate risk.	Climate risk affects firms' capital structure. Accurate disclosure of climate risk is important.	Greater physical climate risk leads to lower leverage. Reduction in leverage due to demand and supply effects.	Examining impact of physical climate risk on capital structure. Using firm-level measures to quantify climate risk.

			awareness of climate risks. Task Force on Climate-related Financial Disclosures (TCFD) established. Measuring firm-level exposure to climate risk is challenging. Two metrics used to measure physical climate risk.	corporate taxes, lower bankruptcy costs, higher liquidation value of assets, and lower operating costs and earnings volatility.						
37	Carbon policy risk and corporate capital structure decision	Examines relationship between carbon policy risk and corporate capital structure in China. Carbon policy risk reduces firms' financial leverage.	Examines carbon policy risk and corporate capital structure. Focuses on China's transition to a low-carbon economy.	Firms strategically choose capital structure based on trade-off theory. Carbon policy risk reduces firms' financial leverage.	China's environmental laws and regulations system improvements. Impact of environmental regulatory measures on firm behavior.	Difference-in-differences tests (DID). Instrumental variable regression. Placebo test.	Distance is the main independent variable.	Firms should proactively address carbon policy risks. Government should enforce environmental laws and regulations.	Carbon policy risk reduces firms' financial leverage. The coefficient indicates that carbon policy risk decreases book (market) leverage by 0.0058 (0.0012) and that book (market) leverage changes by 3.27 (1.51) when carbon policy risk changes by one standard deviation.	Examines carbon policy risk and corporate capital structure. Provides implications for China's carbon neutrality goal

38	Climate change financial disclosure and firm performance: empirical evidence from Indian energy sector based on TCFD recommendations	Examines climate change disclosure patterns of Indian firms. Positive relationship between disclosure and firm performance.	Climate change poses significant risks to firms globally. Disclosure of climate-related information can improve firm performance.	Risk society theory of sustainability reporting. Positive association between climate change disclosure and firm performance.	Environmental disclosures in annual reports since 1970s. TCFD recommendations for climate-related disclosures.	Content analysis of annual/sustainability reports. Panel data regression model.	Climate change-related financial disclosure	Firms should disclose more information on climate change to improve financial performance. Regulators should design and implement proper climate change disclosure policies.	Positive and significant impact of overall disclosure score on firm performance. Positive impact of governance, strategy, and risk management disclosure on firm performance.	Concrete actions for sustainability since 1987. New disclosure score based on TCFD recommendations.
39	Impacts of climate change risks on financial performance of listed firms in agriculture industries in Vietnam	Examined effects of climate change risks on financial performance. Positive impacts of rain and temperature, negative impact of wind.	Climate change poses threats to sustainable development. Climate risks affect financial performance of businesses. This paper investigates climate change impacts on listed agricultural firms in Vietnam. Temperature and rainfall have positive effects on financial performance. Wind has a	Agency theory suggests debt financing enhances firm performance. Larger firms may have positive/negative effects on financial performance.	Climate change increases systematic risk for firms. Leverage is negatively related to financial performance. Firm growth rate and size have a positive impact on financial performance. Controlling shareholder ownership ratio has no impact on financial performance. Provinces with better human capital have better performance. High provincial GDP growth rate improves firm	OLS regression, random regression, sub-sample analysis	Average temperature. Rainfall. Wind index. Humidity.	Helps researchers, businesses, practitioners, and policymakers understand the impact of climate change risks on agricultural firms' financial performance. Provides insights for developing and emerging countries to prepare necessary measures to reduce negative impacts.	Rain has a significant and positive impact on financial performance measured by ROA when measuring climate change at the firm's factory location. Temperature has a positive impact on financial performance measured by ROS.	Study examines impacts of climate change on financial performance. First study to investigate impact in Vietnam.

			negative impact on financial performance.		performance. Wind has negative impacts on financial performance variables. Rain and temperature have positive impacts on financial performance variables.					
40	The impacts of climate change risks on financial performance of mining industry: Evidence from listed companies in China	Climate change risks impact financial performance of mining companies. Different types of mining have different sensitivities to climate change risks.	Mining industry vulnerable to climate change risks. Impact on financial performance of mining companies.	Climate change risks have both positive and negative effects on the financial performance of mining companies. Mining companies should actively implement low-carbon strategies and disclose emission information to improve brand value.	Climate change risks impact various industries directly and indirectly. Mining industry is vulnerable to climate change risks.	Reviewing impact mechanism of climate change risks. Analyzing effect of climate change risks on mining companies.	Comprehensive climate risk index (CRI). Subdivided climate change risk indicators (CYRI, CYDI, CYTI, CYHI, CYFI).	Change traditional concepts and consider climate change risks. Fulfill emission reduction responsibilities and obtain financial support.	Climate change risks have both positive and negative effects on the financial performance of mining companies. The comprehensive climate change risk has a positive impact on the financial performance of listed mining companies.	Introducing climate change risk into financial performance analysis

41	Climate change risks and financial performance of the electric power sector: Evidence from listed companies in China	Climate change risks impact financial performance of power companies. Rainfall, drought, and freezing events affect performance.	Climate change risks impact financial performance of power companies. Study focuses on listed power companies in China.	Climate change risks impact financial performance of power companies. Clean energy and optimized power generation improve financial performance.	N/A	Panel data model. Mediating effects model.	Comprehensive Climate Risk Index (CRI)	Climate change risk affects financial performance of power companies, Rainfall and drought positively impact financial performance	Climate change risks have a significant positive correlation with the financial performance of listed electric power companies in China. The operating cost ratio is increased by climate risks, affecting the financial performance of electric power companies.	Analyzing impact of climate risk on financial performance. Elaborating on risks from supply and transmission-distribution sides.
42	Corporate climate risk management: Are European companies prepared?	Analysis of corporate climate risk perception and countermeasures. Most firms feel less exposed to physical and market risks than regulatory risks.	Paper analyzes corporate climate risk perception and countermeasures. Focuses on physical, regulatory, and market-related climate risks.	N/A	Empirical work on climate-related market risks is scarce. More radical climate action is expected in response to governmental regulations.	Empirical approach combining qualitative and quantitative analysis. Qualitative content analysis and quantitative analysis (ANOVA).	Regulated and non-regulated firms.	Policy makers should consider additional policies to enhance awareness of physical and market climate risks. Existing risk management procedures and standards might need to be updated to account for long-term risks.	Companies regulated under the ETS consider their regulatory risks to be higher than non-regulated companies. No significant differences in the evaluation of exposure to physical and market risks were found among companies from regulated and non-regulated industries.	Comprehensive overview of companies' perceptions of climate risks. Analysis of differences in risk perception between regulated and non-regulated industries.

43	Innovative Corporate Initiatives to Reduce Climate Risk: Lessons from East Asia	Businesses, investors, and insurers are incorporating climate risk assessments in their decision-making. East Asia and the rest of the world are making progress in reducing climate risks.	Examines corporate initiatives to reduce climate risks. Focuses on East Asia and global progress.	Climate risk management improves financial performance. Investments in reducing climate risk reduce overall systematic risk.	N/A	Developing international guidelines and common policies. Creating financial incentives to support investment decision-making.	Climate risk management and performance.	Financial regulations should support investment decision-making. Governments should develop common policy and legal frameworks.	Increases in climate risk or poor environmental performance by firms increase the cost of debt or lower debt capital. Firm managers are increasingly taking climate and sustainability reporting seriously and seeking guidance from policymakers.	Examining recent progress in corporate initiatives to reduce climate risks. Establishing national Emissions Trading Systems in East Asia.
44	Assessment of the impact of climate change and mining activities on streamflow and selected metal's loading in the Chindwin River, Myanmar	Study assesses impact of climate change and mining on Chindwin River. Future discharges and heavy metal loading analyzed.	Mining activities can negatively impact water quality. Heavy metal contamination poses health risks.	Heavy metal loads decrease in future periods. Measures needed to regulate mine drainage pollutants.	N/A	Future climate projections using four RCM's. Hydrological and water quality modeling using SHETRAN, PHREEQC, and LOADEST models	Hydrology of the upper Chindwin basin. Mining area and heavy metal loading. Climate change and future discharges.	Decreasing discharge trend in the Chindwin River. High levels of toxic heavy metal loads.	Climate change is projected to reduce future discharges by 3.4%-36.5% in most stations, except for a slight increase in one station. Heavy metal loading is expected to decrease under future climate conditions.	Coupling of SWAT and PHREEQC models for contaminant transport. Concerns regarding water quality associated with mining activities.

45	Climate Risk and Capital Structure	Climate risk affects capital structure after the Paris Agreement. Leverage decreases due to physical climate risk.	Climate change is accelerating with documented temperature increase. Climate risk affects pricing of stocks, bonds, and real estate. Physical climate risks lead to lower leverage in post-2015 period. Paris Agreement raised awareness of climate risks. Task Force on Climate-related Financial Disclosures (TCFD) established. Measuring firm-level exposure to climate risk is challenging. Two metrics used to measure physical climate risk.	Three theories of capital structure: static tradeoff theory, pecking order, and market timing. Empirical evidence suggests firms borrow more with lower debt issuance costs, higher corporate taxes, lower bankruptcy costs, higher liquidation value of assets, and lower operating costs and earnings volatility.	N/A	Difference-in-differences regression. Matching bank-loan level dataset with other data sources.	Physical climate risk. CRIS post-2015 climate risk.	Climate risk affects firms' capital structure. Accurate disclosure of climate risk is important	Greater physical climate risk leads to lower leverage. Reduction in leverage due to demand and supply effects.	Examining impact of physical climate risk on capital structure. Using firm-level measures to quantify climate risk.
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46	Climate change and credit risk: The effect of carbon tax on Italian banks' business loan default rates	Climate change poses systemic risks to the financial sector. Carbon tax has modest impact on Italian banks' default rates.	Paper analyzes impact of carbon tax on Italian banks' credit risk. Uses micro-founded climate stress test approach.	N/A	N/A	Micro-founded climate stress test approach. Counterfactual analysis.	Carbon tax levels (€50, €100, €200, €800 per ton of CO ₂).	Carbon taxes within the range of €50-200 per ton of CO ₂ have a limited impact on banks' default rates in the short term. The effect of an €800 carbon tax would be more significant but still contained.	Modest credit risks for banks from carbon tax. Default rates increase but remain below historical peaks.	Estimation of potential impact of carbon taxes on default rates. Novel methodology for estimating banks' credit risk.
47	Climate change and credit risk	Climate change affects firm credit risk. High carbon footprint increases default risk.	Climate change affects pricing of financial assets. Exposure to climate risk affects creditworthiness.	Merton distance to default (DD) model. Applying option pricing theory to risk of insolvency.	Climate-related risks and their impact on financial stability. Links between environmental footprint and corporate debt.	Distance-to-default measure. Market-based measure of corporate default risk.	"Merton Distance to Default" (D).	Stricter climate policies may impact issuers' creditworthiness. Exposure to climate risks affects firms' creditworthiness.	Companies with higher carbon emissions have a lower distance to default. An increase in carbon emissions reduces the firm's distance to default by about 0.002 on average.	Negative relation between distance to default and CO ₂ emissions. Impact of 2015 Paris Agreement on creditworthiness.
48	Climate transition risk and bank performance: Evidence from China	Climate transition risk negatively affects bank performance. The impact weakens with larger bank size.	China's commercial banks face climate transition risk. Impact of risk on bank performance investigated.	Commercial banks face climate transition risk. Climate transition risk affects bank performance.	N/A	Climate transition risk measurement method for commercial banks. Construction of Model (2) and Models (5)-(6) to test the impact and mediation effect	Weighted carbon dioxide emissions of industrial loans.	Climate transition risk inhibits bank performance. Banks should strengthen climate transition risk management.	Climate transition risk has an inhibitory effect on bank performance. The inhibitory effect weakens with the increase of bank size.	Study impact of climate transition risk on bank performance. Investigate incorporation of climate risk in risk management.

						of climate transition risk on bank performance and loan scale.				
49	Risk management and Firm value: Evidence from Weather Derivatives	Active risk management policies increase firm value. Weather derivatives lead to higher valuations, investments, and leverage.	Paper examines the effect of risk management on firm value. Exploits introduction of weather derivatives as exogenous shock.	Modigliani and Miller (1958) show that hedging is irrelevant for value. Risk management has real consequences on firm outcomes.	N/A	OLS estimation for dichotomous variable. Alternative specifications do not affect results.	Weather derivatives. Firms with significant EDD weather beta before 1997.	Active risk management policies increase firm value. Derivatives lead to higher valuations, investments, and leverage.	Active risk management policies increase firm value. Hedging leads to higher valuations, investments, and leverage.	Active risk management policies increase firm value. Weather derivatives lead to higher valuations, investments, and leverage.
50	The Impact of Climate Risk on Firm Performance and Financing Choices : An International Comparison	Climate risk affects firm performance and financing choices. Firms in countries with severe weather hold more cash, have less short-term debt, and are less likely to distribute cash dividends.	Climate impact on economic performance recognized and documented. Few studies on climate risk and firm financing choices.	Path analysis used to examine dependencies. Financing policies affected by resilience and earnings volatility.	N/A	Estimation of climate risk on financial performance. Control for firm characteristics and fixed effects.	Climate Risk (CRI scores published by Germanwatch)	Managers consider climate risk when making financing choices. Firms in countries with severe climate risk hold more cash and rely less on short-term borrowing.	Likelihood of loss from extreme weather events associated with lower and more volatile earnings and cash flows. Firms in countries with severe weather hold more cash, have less short-term debt, more long-term debt, and are less likely to distribute cash dividends.	Examines effect of climate risk on firms. Uses Global Climate Risk Index (CRI) data.

51	The impacts of climate change risks on financial performance of mining industry: Evidence from listed companies in China	Climate change risks impact financial performance of mining companies. Different types of mining have different sensitivities to climate change risks.	Mining industry vulnerable to climate change risks. Impact on financial performance of mining companies.	Climate change risks have both positive and negative effects on the financial performance of mining companies. Mining companies should actively implement low-carbon strategies and disclose emission information to improve brand value.	Climate change risks impact various industries directly and indirectly. Mining industry is vulnerable to climate change risks.	Reviewing impact mechanism of climate change risks. Analyzing effect of climate change risks on mining companies.	Comprehensive climate risk index (CRI). Subdivided climate change risk indicators (CYRI, CYDI, CYTI, CYHI, CYFI).	Change traditional concepts and consider climate change risks. Fulfill emission reduction responsibilities and obtain financial support.	Climate change risks have both positive and negative effects on the financial performance of mining companies. The comprehensive climate change risk has a positive impact on the financial performance of listed mining companies.	Introducing climate change risk into financial performance analysis N/A
	The Impacts of Climate Change Risks on Financial Performance: Evidence from Listed Manufacturing Firms in Vietnam	Examines impact of climate change risks on financial performance. Manufacturing companies in Vietnam, 2015-2019.	Climate change impacts financial performance of manufacturing firms. Vietnam ranks 6th in countries most affected by climate change.	Agency theory suggests capital structure as a disciplinary mechanism. Debt financing mitigates agency costs and enhances firm performance.	Climate change impacts on nature and human activities. Climate risks affect industries and economic activities.	Quantitative and qualitative methods. Econometric regression model.	Climate change risks. Humidity risk.	Climate change risks negatively impact financial performance. High humidity has a strong negative correlation with financial performance.	Climate change has a negative impact on financial performance. Humidity risk has a significant and negative correlation with financial performance.	Top five risks: extreme weather events, failed climate action, natural disasters, biodiversity loss, and man-made environmental disasters (). Vietnam ranked 6th among countries most negatively impacted by climate change ().



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