CLIMATE CHANGE AND FIRM PERFORMANCE: EVIDENCE FROM LISTED MANUFACTURING COMPANIES IN ZIMBABWE

by

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DECLARATION

Student number: 43219357

I, Moses Bonyongwe, declare that **CLIMATE CHANGE AND FIRM PERFORMANCE: EVIDENCE FROM LISTED MANUFACTURING COMPANIES IN ZIMBABWE** is my own work and that all the sources that I used or quoted have been indicated and acknowledged by means of complete references.

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DEDICATION

To my beloved son, Andre Kenya Iker, and my wife, Bertha, who inspire my academic pursuits. To Samuel and Mutsa, may this achievement serve as a benchmark for your own endeavours. In loving memory of my parents, who despite being denied the gift of education, instilled in me the value of knowledge. And to my dear brother Collen and my father-in-law Mathew Chipenzi, though you are no longer with us, I know you would have celebrated this milestone with immense joy.

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During the development of the thesis, AI-assisted tools, namely ChatGPT and Grammarly, were employed to enhance clarity and language quality. The use of these tools was solely supportive, with all substantive ideas and analyses originating from the researcher.

ABSTRACT

Climate change has become a material governance and performance issue for firms operating in climate-sensitive sectors. This study examined the relationship between climate change management practices and firm performance among listed manufacturing firms in Zimbabwe. The study was motivated by the increasing exposure of manufacturing firms to physical, transition, regulatory and reputational climate risks within a context of energy insecurity, macroeconomic instability, policy pressure and resource constraints. An explanatory sequential mixed-methods design was adopted. The quantitative phase analysed a balanced panel of 13 listed manufacturing firms over the 2021-2024 period, producing 52 firm-year observations. Firm performance was measured using return on assets (ROA), return on equity (ROE) and Tobin's Q. Climate change risk reporting (CCR) and climate change strategy (CCS) were measured using disclosure-based scores derived from annual reports, sustainability reports and publicly available corporate documents. Random-effects panel regression, fixed-effects sensitivity checks, restricted Hausman testing, diagnostic tests, lagged models and robustness checks were used. The qualitative phase used documentary thematic analysis to explain and contextualise the statistical results.

The findings show that CCR and CCS do not have consistently robust direct effects on ROA, ROE or Tobin's Q. CCR appears to function mainly as a risk-identification, compliance and legitimacy signal rather than an independent short-term performance driver. CCS shows stronger practical relevance, but its direct financial effect is constrained by implementation costs, limited climate finance, infrastructure weaknesses and uneven firm capabilities. The strongest evidence is found in the moderation results: the interaction between CCR and CCS is positive and significant for accounting-based performance, particularly ROA and ROE, especially in lagged models. This suggests that climate strategy operates as a conditional resilience capability, shaping whether climate risk exposure becomes financially damaging or manageable. Tobin's Q is more consistently associated with firm size than climate variables, indicating that market valuation in this context may reflect scale, visibility and organisational capacity more than climate strategy alone. The study contributes empirically by providing firm-level evidence from Zimbabwe, theoretically by integrating institutional, legitimacy, stakeholder and resource-based perspectives, and practically by offering a framework for assessing climate governance, strategy, implementation and resilience outcomes in manufacturing firms.

Keywords: Climate change risk reporting; Climate change strategy; Firm performance; Manufacturing firms; Zimbabwe; ROA; ROE; Tobin's Q; Mixed methods; Conditional resilience

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LIST OF ABBREVIATIONS AND ACRONYMS

ACT	**Any law or legislation**
AFS	Annual Financial Statements
CAT	Cap-and-Trade
CCA	Climate Change Awareness
CCR	Climate Change Risk
CCS	Climate Change Strategies
CCS_1	Carbon Capture and Storage
CCUS	Carbon Capture Utilization and Storage
AFR	Annual Financial Report
CO_2	Carbon Dioxide
DEF	Data Extraction Form
EMA	Environment Management Authority
ERM	Enterprise Risk Management
ESG	Environmental, Social and Governance
ETS	Emissions Trading Schemes
EU	European Union
FP	Financial Performance
FS	Firm Size
GDP	Gross Domestic Product
GHG	Greenhouse Gases
IEA	International Energy Agency
IM	Information Matrix
IC	Industry category
KPI	Key Performance Indicator
LEV	Leverage
LDC	Least Developed Countries
M&M	Modigliani – Miller Theory
OLS	Ordinary Least Squares
ROA	Return on Assets

ROE	Return on Equity
RBV	Resource-based View
R&D	Research and Development
SDGs	Sustainable Development Goals
SI	Statutory Instrument
SMEs	Small and Medium-sized Enterprises
SSA	Sub-Saharan Africa
TCFD	Task Force on Climate-related Financial Disclosures
TQ	Tobin's Q
TW	Terawatt
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollars
VIF	Variance Inflation Factor
WEO	World Energy Outlook
ZSE	Zimbabwe Stock Exchange

“Climate Change is no longer an environmental variable at the margins of business, it is the defining economic force reshaping risk, strategy, and the future of firm survival”

Author’s own reflection, grounded in the empirical insights of this study

CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

The intersection of climate change and corporate finance represents a critical paradigm in modern economic theory. As global climate change crisis intensifies, the traditional view of environmental stewardship as a peripheral ethical concern has been replaced by the recognition of climate change as a core determinant of firm value, and long-term sustainability (Krueger, et al., 2020). Its influence has evolved beyond environmental concerns to become a major determinant of corporate financial stability (Liu, et al., 2024). Contemporary research highlights the increasing importance of climate change governance in shaping firm strategy and performance (Wang, et al., 2024; Liu, et al., 2024; Wang, et al., 2025).

The Natural-Resource-Based View (NRBV) suggests that sustainable strategies can enhance competitive advantage and financial returns (Busch & Lewandowski, 2017)**,** whereas other studies caution that stringent environmental mandates may impose compliance costs that reduce profitability (Samuel & Sibindi, 2019). Climate change presents the business world with a unique business risk as its impact is global; long-term in nature and its harm is essentially irreversible (Winn, et al., 2011). Increasingly, financial markets are influenced by climate-related uncertainties, thereby integrating environmental risk into asset pricing and corporate valuation (Cevik & Miryugin , 2022). In the context of corporate finance, firm performance is generally conceptualised along two distinct dimensions; accounting-based efficiency and market-based valuation.

In this study, firm financial performance will be proxied by Return on Assets (ROA) and Return on Equity (ROE). ROA measures the operational efficiency by determining how a firm utilises its total assets to generate earnings (Petersen & Schoeman, 2008). This is complemented by ROE, which evaluates profitability from the shareholders' perspective, reflecting the return on the capital invested by equity holders (Petersen & Schoeman, 2008). While these two metrics provide a retrospective view of historical performance, Tobin's Q, defined as the firm's market value to the replacement cost of its assets, serves as a forward-looking proxy for market performance (Flammer, 2021). A Tobin's Q greater than one suggests that investors value the firm beyond its physical book value, capturing intangible assets such as strategic positioning, resilience, and governance quality (Flammer, 2021).

Climate risk is not a single, uniform threat, but a complex, multifaceted phenomenon encompassing physical, transition, and reputational risks that vary by sector, location, and timeframe (Karydas & Xepapadeas, 2018; Díaz-Noriega, et al., 2020). Physical risks involve the direct threat of extreme weather events or long-term shifts in climate patterns, which can cause physical asset damage and supply chain disruptions (TCFD, 2017). Transition risks stem from the shift toward a low-carbon economy, encompassing policy changes, carbon taxes, and technological breakthroughs that may render existing business models "stranded" (TCFD, 2017; Díaz-Noriega, et al., 2020). Reputational risks arise from changing consumer preferences and investor sentiments; firms perceived as environmental laggards face a higher cost of capital and potential loss of market share as stakeholders increasingly demand transparency and green accountability (Wills & Keyes, 2017).

To quantify these variables, researchers utilise climate risk scores, which aggregate a firm's exposure to the hazards based on geographic and sector-specific data. Complementarily, climate change strategic management scores assess the quality of internal corporate responses, including board-level environmental oversight and carbon-reduction targets (TCFD, 2017). Higher strategic management scores indicate proactive and long-term risk mitigation rather than reactive compliance, thereby aligning with investor preferences for sustainable value creation (Krueger, et al., 2020). This study therefore investigates the multidimensional relationships between climate-related risks and firm performance among listed manufacturing companies in Zimbabwe, examining how governance and stakeholder pressures influence accounting-based profitability and market valuation.

1.2 BACKGROUND OF THE STUDY

Climate change represents one of the most critical challenges of the twenty-first century, with impacts that are unprecedented in human history (Iqbal & Ghauri, 2011; Lai, et al., 2023). Defined as long-term variations in the climatic conditions exceeding a decade, whether natural or anthropogenic (Mitchell, 2017), contemporary climate change is largely driven by human economic activities, particularly fossil fuel combustion and cement production (Park, 2015). The acceleration of industrialisation and urbanisation has significantly contributed to the escalating accumulation of greenhouse gases (GHGs) in the atmosphere, thereby intensifying the frequency and severity of climate-related events globally (Giang, et al., 2021). GHGs such as carbon dioxide (CO_2), trap heat within the atmosphere, leading to rising temperatures and altered precipitation patterns (Woo, et al., 2019).

The current fossil fuel trajectories could result in temperature increases of 4-6 degrees Celsius above pre-industrial levels, threatening food security, human health, biodiversity and economic systems (Tangcharoensathien, et al., 2022; Muluneh, 2021; Abbass, et al., 2022). Climate change is potentially the greatest market failure in history (Stern, 2008), with projected global Gross Domestic Product (GDP) losses ranging from 5-20 per cent annually if mitigation efforts remain inadequate. Although these projections have been debated (Moore & Diaz, 2015), there is a broad consensus that climate change will significantly reduce global economic output, particularly in tropical and economically vulnerable regions (Kalkuhl & Wenz, 2020; Tol, 2024). Sub-Saharan Africa (SSA) experiences disproportionately greater economic impacts because firms and communities in the region possess limited adaptive capacity to climate-related stresses (Odusola & Abidoye, 2015). An increase of 3.5 degrees Celsius in the global temperatures could result in a reduction in global output by 7-14 per cent by the year 2100, with disproportionate impacts on developing economies (Tol, 2024).

Despite making the least contribution to global climate change, SSA remains disproportionately vulnerable to climate shocks due to its dependence on rain-fed agriculture and limited adaptive capacity (Agyei-Sakyi, 2024; Omotoso , et al., 2023). Each 1-degree Celsius increase in temperature is associated with a 1.8 per cent reduction in per capita income growth across fragile economies (Omotoso , et al., 2023). Although global initiatives such as the 2015 Paris Climate Summit and Sustainable Development Goal 13 aim to transition economies toward low-carbon pathways (UN, 2020), Africa continues to lag in implementation (Advocates for International Development, 2021; Mpiere, et al, 2025).

An important question regarding climate action is whether SSA countries should mitigate their GHG emissions or should concentrate on developing resilience. However, the UN proposed cooperation between nations and investing in sustainable solutions: fossil fuel subsidies must end, and polluters must pay for their pollution-related harm (Rayer , et al., 2021) and those responsible for climate-change-related harm must pay for their climate debts (Tzouvanas, 2019; Zhu, 2023), proposals which remain to be fulfilled.

Zimbabwe epitomises this paradox. Contributing approximately 0.03 per cent of global GHG emissions, it is ranked among the most climate-vulnerable countries globally (Zvirevo, 2019). The country aims to reduce carbon emissions by 40 per cent below business-as-usual levels by 2030 (Sithole, et al., 2023). However, continued reliance on fossil fuels, which account for approximately 24 per cent of total power generation, presents structural challenges to decarbonisation, particularly for industrial operations (Akpan, et al., 2024).

In Zimbabwe, this relationship is particularly complex. Accounting for approximately 15.3 per cent of Zimbabwe's GDP, the manufacturing sector has emerged as one of the country's leading economic sectors, contributing a larger share to GDP than either the mining sector or the agriculture sector individually, thereby positioning itself as a key driver of economic growth (Zimbabwe Ministry of Finance, 2025). However, the sector is heavily reliant on a climate-sensitive agricultural supply chain, sourcing over 60 per cent of its raw materials from rain-fed farms (Chitiyo, et al., 2019). Consequently, climate vulnerability in agriculture propagates through industrial supply chains, resulting in fluctuations in capacity utilisation and reduced financial performance for manufacturing firms (Castro-Vincenzi, et al., 2024).

The catastrophic impact of Cyclone Idai in 2019 serves as the primary motivator for this study, offering a grim "stress test" of the manufacturing sector's vulnerability to acute climate events. The cyclone resulted in over USD 600 million in damages, but its most profound industrial impact was the destruction of critical infrastructure (Chabata, 2025), including over 1,200 kilometers of power lines and 1,500 kilometers of road networks (Chatiza, 2019). These disruptions halted the movement of raw materials and finished goods and impaired electricity supply, demonstrating that climate risk operates as a dual threat: physical-asset destruction and disruption of vital supply-chain linkages (Moyo, et al., 2023; Nhamo & Chikodzi, 2021). Compounding these challenges, limited managerial experience in climate risk management in least developed economies further constrains firms' capacity to respond effectively (Bhave, et al., 2016).

The sector demonstrates "double materiality": it both contributes to environmental degradation through carbon-intensive production and suffers operational constraints due to climate-induced energy deficits and weather events (Kenya Private Sector Alliance, 2014). Furthermore, this fragility in developing economies is exacerbated by a volatile regulatory landscape, where frequent policy shifts, a fluctuating multi-currency system (Newman, et al., 2023) and the overlapping environmental licensing requirements, create an unpredictable environment that threatens long-term viability of manufacturing firms (Samuel & Sibindi, 2019). Consequently, the relationship between climate change and firm performance remains empirically contested (Hillmann , et al., 2022).

The manufacturing sector is particularly vulnerable to climate change due to its high exposure, sensitivity, and substitutability (Giang, et al., 2021), rendering it one of the most significantly impacted sectors. According to the Eyo, et al., (2024), achieving sustainable business operations in the manufacturing sector requires decarbonisation. This can be achieved through efficient resource use, implementing low-carbon solutions, and adoption of circular economy practices. It is vital for national governments to promote climate awareness and demonstrate both political and economic willingness to manage climate change risks, particularly in developing economies (Silwimba & Fadum, 2022). Kumar & Aggarwal, (2025) consider climate awareness as a precondition for management to implement CO_2 reduction initiatives in the manufacturing sector. Implementing green energy initiatives, enforcing climate change regulations, and ensuring compliance will be crucial steps in enhancing awareness and mitigating climate-related risks.

Climate change presents a mixture of business risks and opportunities (LIGS University , 2024; Massey, et al., 2021). Manufacturing companies face supply chain disruptions, fluctuations in raw material availability, shifts in consumer preferences, and rising energy costs and are subject to ever-changing government policies and regulations aimed at reducing carbon emissions (Reid & Toffel, 2009; Patnaik & Fabrizio, 2023). Governments and private-sector businesses both have roles to play in mitigating the risks posed by climate change. Governments and businesses face severe threats, requiring tailored climate policies and internal strategies to mitigate impacts and adapt to climate crises (LIGS University , 2024). LIGS University further states that given the unique challenges each nation and company face, effective climate change strategies and risk management practices are crucial for anticipating and responding to climate-related outcomes.

Given the manufacturing sector's economic significance and climate exposure, Zimbabwe provides a compelling empirical setting to examine how climate risk and corporate climate strategy influence firm performance. To the best of the researcher's knowledge, no study has assessed the relationship between climate change and firm performance in the Zimbabwean context. This study therefore contributes to the literature by analysing the impact of climate-related risks and governance responses on accounting-based and market-based performance of listed manufacturing companies in Zimbabwe, thereby informing policy design and corporate strategy for climate-resilient industrial development.

1.3 RATIONALE OF THE STUDY

The rationale for this study is grounded in the urgent need to address the resilience gap exposed by the failure of industrial infrastructure during Cyclone Idai. Despite the introduction of Statutory Instrument (SI) 143 of 2019, which mandates Zimbabwe Stock Exchange Listed (ZSE) listed companies to disclose their Environmental, Social, and Governance footprints, many firms remain reactive rather than proactive in their disaster management (Sifelani, et al., 2022; Jeke, et al., 2025; Chabata, 2025). This study is further justified by the lack of empirical evidence quantifying the financial impact of climate shocks on listed manufacturing firms in Zimbabwe.

Existing global studies provide contradictory results regarding whether climate adaptation improves market value or merely increases operational costs (Lewandowski, 2017). Empirical evidence largely documents a positive association between comprehensive climate strategies and improved financial performance (Secinaro, et al, 2020; Deepmala & Pandey, 2021; Nichitaa, Nechitaa, Mane, Irimescua, & Manea, 2021; Pais Seles, Lopes, Jabbour, Fiorini, Yusoff, & Thome, 2018; Giang, et al, 2021; Mondal & Bauri, 2022; Riyad & Antonio, 2021; Lu, et al, 2021). Other researchers found no relationship between climate change and firm performance association (Petijean, 2019; Kumar & Firoz, 2018).

However, dissenting voices argue that environmental initiatives can increase operational costs, potentially eroding competitive advantage (Aupperle, et al., 1985; Eleftheriadis & Anagnostopoulou, 2014). Although some firms offset these costs through innovation-driven value (Busch & Lewandowski, 2018), empirical findings remain inconclusive, with Lewandowski, (2017), and Hillmann , et al., (2022) reporting contradictory results. This inconsistency underscores the need for jurisdiction-specific investigations, as advocated by (Wang, et al., 2022; Wang, 2023),

By investigating listed manufacturing companies, who are subject to public disclosure requirements and heightened regulatory scrutiny, this study will provide a definitive framework to align environmental stewardship with financial metrics like return ROA, ROE, and Tobin's Q. In an era where climate-related damages could erode Zimbabwe's GDP by 10 per cent to 12 per cent by 2050, understanding this relationship is important for national economic survival (Abalo, et al., 2025). Despite adopting various measures to address climate change, Zimbabwe continues to face its impacts largely due to policy inconsistency (Mapuranga, et al., 2026). Thus, studying the performance of listed manufacturing firms through the lens of such shocks is essential to develop a framework for corporate climate resilience in Zimbabwe.

Focusing on listed manufacturing firms provides a unique window into corporate climate transparency and financial accountability. In Zimbabwe, this investigation is timely, due to regulatory shift under Statutory Instrument (SI) 143 of 2019, which mandates that companies listed on the ZSE disclose their Environmental, Social, and Governance (ESG) footprints (Jeke, et al., 2025). Despite these requirements, many firms continue to operate with a resilience gap, where climate-induced resource scarcity and energy deficits often stemming from low water levels at Lake Kariba handicap operational efficiency (Zimbabwe Ministry of Finance, 2025). Consequently, energy challenges in Zimbabwe have far-reaching impacts on the economy, manufacturing sector production, and other sectors, given the central role of energy in driving economic development across most Southern African Countries (Hlongwane & Daw, 2023). By analysing listed firms, this study addresses the urgent need to quantify how climate risk exposure correlates with traditional financial metrics like ROA, ROE, and Tobin's Q, especially in an environment where internal green barriers frequently impede sustainable performance (Machingura , et al., 2025)

The profit maximisation paradigm (Friedman, 1970) argues that environmental practices may undermine shareholder value by increasing operational costs and reducing profitability, the primary objective of investors. Similarly, (Wu & Tham, 2023) contend that environmental regulations exert a dual effect: while they may impose additional compliance costs, they can also stimulate research and development, foster technological innovation, and ultimately enhance productivity and profitability, consistent with the Porter hypothesis (Porter & Linde, 1995). Hillmann , et al, (2022) contend that the climate change-firm performance nexus remains inconclusive, as resilience-building may increase costs while simultaneously being perceived by investors as value-enhancing; moreover, empirical findings across jurisdictions are mixed, with several studies reporting

Given that the manufacturing sector accounted for approximately 28 per cent of global energy-related GHG emissions in 2021, with projections indicating a potential increase of 50-150 per cent in the absence of accelerated energy-efficiency interventions (Mitchell, 2017), a critical examination of the climate change-firm performance nexus within this sector is both timely and necessary.

1.4 THESIS STATEMENT

This research posits that the relationship between climate change and financial performance in Zimbabwe's manufacturing sector is both significant and context-dependent, shaped by the complex interplay of climate risk management strategies, firm-specific characteristics, regulatory and institutional factors.

1.5 PROBLEM STATEMENT

Sub-Saharan Africa is widely regarded as one of the most vulnerable regions to the adverse impacts of climate change, yet its climate resilience remains underexplored in the academic literature (Sono & Jin, 2021; Mawejje, 2024; Cevik & Miryugin , 2022). This gap is particularly pronounced in Zimbabwe, where the manufacturing sector is caught in a cycle of double materiality. The sector is vital to the country's GDP growth, but its reliance on a rain-fed industrial model has resulted in fluctuating capacity utilisation and declining financial performance due to climate-induced energy and raw material shortages (Zimbabwe Ministry of Finance, 2025).

The theoretical lens of sustainability and resilience theory highlights that the capacity of industrial sectors to absorb and adapt to climate shocks is central to economic stability. In Zimbabwe, the manufacturing sector is critical for industrialisation, value addition, foreign currency generation, and technological upgrading, which are particularly significant in developing and emerging economies seeking to reduce dependence on primary commodities (Szirmai & Alcota, 2013: 54-55). Despite structural challenges such as limited capital investment, infrastructural deficits and policy inconsistencies (Nyavaya, 2020; Murombo, 2019), the sector remains a core driver of economic growth due to its potential for economies of scale, employment generation, productivity enhancement, and foreign exchange earnings (Ali & Pal, 2025; Moyo & Jeke, 2019).

However, these structural vulnerabilities are compounded by a volatile regulatory environment characterised by policy inconsistency (Mapuranga, et al., 2026) and overlapping mandates, which increase the cost of doing business and hinder long-term planning (Zimbabwe National Competitiveness Commission, 2025). The catastrophic impact of Cyclone Idai (2019), which caused extensive damages and paralysed industrial logistics, underscores that current reactive disaster risk management approaches are insufficient (Sifelani, et al., 2022). Although mandatory ESG reporting under SI 134 of 2019 exists, empirical research linking climate risk exposure to firm value remains scarce. Without a clear understanding of the climate change-firm performance nexus, listed manufacturing companies are ill-equipped to survive future climate shocks or navigate green barriers in global markets, threatening Zimbabwe's broader economic stability.

From an institutional and policy lens, international carbon regulations such as the European Union's (EU) Carbon Border Adjustment Mechanism (CBAM) pose a significant challenge to Sub-Saharan African economies (Erdogdu, 2025), particularly Zimbabwe's manufacturing sector, which is heavily reliant on fossil fuel-powered energy. While these compliance requirements increase costs for developing countries, they simultaneously incentivise the adoption of green technologies, enhancing the competitiveness and resilience of local manufacturing firms (Erdogdu, 2025). As carbon taxes on exports to the EU become a reality, Zimbabwean firms face heightened production costs, reduced competitiveness, and potential market loss, creating an urgent need to explore strategies for climate-resilient and sustainable industrial performance.

Despite emerging evidence that climate change imposes significant macroeconomic costs in Zimbabwe, including reducing GDP by up to 12 per cent and disrupting raw material supply chains central to manufacturing, empirical studies examining the impact of climate variability on performance outcomes of listed manufacturing firms are lacking. Existing literature predominantly focuses on agriculture or climate adaptation/mitigation policy, leaving a critical gap regarding firm-level performance outcomes. Studying the climate change-firm performance nexus is therefore crucial, as the manufacturing sector's ability to remain productive and profitable under climate stress has direct implications for employment, economic stability, and industrial policy. As Kanyenze , et al., (2011:485) contend, revitalising the manufacturing sector remains a central priority for the Government of Zimbabwe, positioning it as the cornerstone of Zimbabwe's economic stabilisation Programme.

The environmental regulatory framework in Zimbabwe, primarily governed by Environmental Management Act (2002) and associated regulations, imposes strict requirements on manufacturing firms to control pollution and limit emissions (Zimbabwe Environmental Management Act, 2002). Compliance with these regulations, including obtaining emissions licenses and conducting environmental assessments, is rigorously enforced through fines and business closures (Maphosa, 2024). However, many manufacturing firms face significant challenges in meeting these requirements due to limited access to pollution prevention technologies (Machingura & Zimwara, 2020) and fragmented nature of climate-related legislation, with key laws like the Climate Change Response Act (2019) yet to be fully implemented. This regulatory environment creates operational and financial pressures that may affect the performance of listed manufacturing firms in Zimbabwe, highlighting the need to explore how climate change regulations impact their business outcomes.

1.6 RESEARCH AIMS AND OBJECTIVES

The escalating impacts of climate change have transformed environmental concerns into critical strategic issues for firms operating within climate-sensitive sectors, particularly in developing economies like Zimbabwe. Despite the enactment of regulatory measures such as SI 134 of 2019, which mandates ESG disclosures for listed companies, there remains a significant gap in understanding how climate management practices influence firm performance amidst a volatile regulatory and socio-economic environment. This study is anchored in the recognition that climate change poses physical, transitional, and reputational risks that can undermine the resilience and competitiveness of manufacturing firms, which are vital drivers of Zimbabwe's economic stability and growth.

Building on the theoretical foundations of institutional theory, legitimacy theory, stakeholder theory and resource-based view (RBV), the overarching aim of this study is to examine the complex interplay between climate change awareness, governance mechanisms, stakeholder pressures, internal resources, and firm performance. The study seeks to contribute to the emerging body of knowledge by providing context-specific insights into how manufacturing firms in Zimbabwe respond to and manage risks, and how these strategies translate into financial outcomes.

This study seeks to evaluate the relationship between climate change management practices and the financial performance of listed manufacturing firms in Zimbabwe. The specific objectives are:

1. To critically examine the relationship between climate change risk and firm financial performance.
2. To examine the moderating effects of climate change governance mechanisms on the relationship between climate-related risks and firm financial performance.

3. To determine how internal and external factors intersect to constrain climate change adaptation, influencing firm resilience, sustainability, and financial performance,
4. To develop a comprehensive framework for assessing climate change adaptation practices among manufacturing firms in Zimbabwe, emphasising their contribution to resilience and sustainability.

1.6.1 Research Questions

This study explores the intersection of climate change governance, firm performance, and sustainability in Zimbabwean manufacturing, through five key research questions:

RQ1: What is the relationship between climate change risk reporting (CCR) and the financial performance of listed manufacturing firms in Zimbabwe, measured by ROA, ROE and Tobin's Q?
RQ2: What is the relationship between climate change strategy (CCS) and the financial performance of listed manufacturing firms in Zimbabwe?
RQ3: Does climate change strategy moderate the relationship between climate change risk reporting and firm financial performance?
RQ4: How do internal capabilities, governance mechanisms and external regulatory or stakeholder pressures shape climate change adaptation, resilience and sustainability among listed manufacturing firms in Zimbabwe?
RQ5: What framework can be developed to assess climate change adaptation and mitigation practices among listed manufacturing firms in Zimbabwe?

1.6.2 Research Hypotheses

Climate change risk encompasses potential adverse impacts, such as extreme weather events, regulatory changes, and resource scarcity, which can threaten the operational stability and profitability of manufacturing firms. Prior research indicates that high levels of climate risk negatively affect firms' financial outcomes by disrupting supply chains, increasing operational costs, and creating uncertainty among investors (Ghadge, et al., 2019; Mondal & Bauri, 2022). Therefore, it is hypothesized that higher climate risk scores correlate with reduced firm financial performance.

H_1: Climate change risk reporting (CCR) is significantly associated with the financial performance of listed manufacturing firms in Zimbabwe (Khatib, *et al*., 2023; Vu & Nguyen, 2024).

Effective climate change strategies constitute a fundamental component of a firm's capacity to mitigate exposure to climate-related risks and to shape its financial performance (Khatib, et al., 2023; Sharma, et al., 2022). Robust governance structures strengthen organisational resilience by attenuating the adverse financial consequences associated with climate-induced disruptions. Accordingly, the following hypothesis is advanced:

H_2: Climate change strategy (CCS) is significantly associated with the financial performance of listed manufacturing firms in Zimbabwe (Khatib, et al., 2023; Sharma, et al., 2022).

A third hypothesis was introduced to test whether CCS moderates the relationship between CCR and firm performance; accordingly, the following hypothesis is advanced:

H_3: Climate change strategy (CCS) moderates the relationship between climate change risk reporting (CCR) and firm financial performance.

1.7 SCOPE OF STUDY

This study examines the relationship between climate change and financial performance of ZSE-listed manufacturing companies (2021-2024), focusing on the environmental-economic sustainability pillar of corporate sustainability (Correia, 2019). The scope encompasses all ZSE-listed manufacturing companies as of 2024, spanning four years to facilitate a comprehensive analysis. Climate change risks and climate change strategies serve as predictor variables, while financial performance as proxied by ROA, ROE and Tobin's Q is the response variable. This study aims to provide insights into the economic and environmental implications of climate change responses by manufacturing companies and regulatory authorities in Zimbabwe's manufacturing sector.

1.8 DELINEATION AND LIMITATIONS OF STUDY

This study is demarcated by its examination of the accounting dimensions of climate change management strategies, specifically investigating 13 Zimbabwean manufacturing companies listed on the ZSE during the post-Paris Agreement period (2021-2024), an era marked by economic recovery following the COVID-19 pandemic's disruptions (Al-Qahwachi & Riaz , 2021). The analysis is based solely on secondary data. The study's limitations include its geographic scope, and its reliance on secondary data sources, which may restrict the depth of insight. Furthermore, the absence of primary data collection may limit the study's ability to capture nuanced perspectives on how business organisations navigated both climate change and pandemic-related challenges. Despite these limitations, this study seeks to contribute valuable insights into the nexus between climate change management strategies and corporate financial performance within the Zimbabwean manufacturing sector.

1.9 DEFINITIONS OF TERMS AND CONCEPTS

Climate change is the long-term shift in the Earth's weather patterns, resulting from rising temperatures and the occurrence of extreme storms (Karaoulanis, 2022).

Carbon risk is the loss of company value caused by legal, technological, market and reputational pressures arising from society's transition to a low-carbon economy (Wang, et al., 2022)

Firm performance may be viewed in terms of various dependent variables: profitability, firm growth, firm market value, customer satisfaction, employee satisfaction, environmental performance, corporate governance performance, and social performance (Salvam, et al., 2016). In this study, it shall mean firm profitability.

Climate change risk reporting (CCR) refers to the extent to which firms disclose climate-related physical, transition, regulatory, reputational and operational risks in their annual and sustainability reporting.

Climate change strategy (CCS) refers to disclosed firm-level actions, policies and governance arrangements directed at mitigation, adaptation, energy efficiency, emissions reduction, renewable-energy adoption, resilience planning and sustainability integration.

Firm financial performance is operationalised through ROA, ROE and Tobin's Q, enabling the analysis to distinguish accounting profitability from market valuation.

For the purpose of this study, an Act refers to any law or legislation included in the Revised Edition of the Statute Law of Southern Rhodesia, as authorised by the Revised Edition of the Laws Act of 1937, as well as any subsequent laws enacted by the Zimbabwean legislature from January 1, 1939, onwards (Veritas, 2005).

1.10 UNDERLYING ASSUMPTIONS

This study is based on several key assumptions. Firstly, it assumes that the financial and sustainability information disclosed by listed manufacturing firms in Zimbabwe is reliable and accurately reflects their climate change practices and performance. Secondly, it presumes that the proxies and scoring methods used to measure climate risk and sustainability practices are valid indicators of the underlying constructs. Third, it assumes that accounting ratios and financial metrics used to evaluate firm performance remain sufficiently stable and comparable despite shifts in Zimbabwe's economic environment. Lastly, it assumed that governance structures within these firms actively pursue both climate risk mitigation and shareholder value enhancement, thereby aligning sustainability efforts with long-term financial goals.

1.11 RESEARCH DESIGN AND METHODOLOGY

This study adopts a two-phase sequential mixed-methods approach to explore the relationship between climate change risks and the financial performance of listed manufacturing companies in Zimbabwe. The research begins with a quantitative phase, involving data collection and analysis from 13 listed manufacturing firms in Zimbabwe. This phase aims to identify patterns and relationships between climate risks, governance mechanisms, and firm financial performance. Building on these findings, the second phase involves a qualitative investigation, providing deeper insights into how institutional governance influences this relationship and offering contextual understanding. Together, these phases work to provide a comprehensive view of how climate change risks impact manufacturing firms and the role governance plays in moderating this effect.

1.11.1 Population

The research population for this study consisted of 15 manufacturing companies listed on the ZSE at the time of data collection. Two companies were used for the pilot study and the remaining 13 made up the study sample for the investigation. The companies were identified through a comprehensive review of the ZSE's website and individual company websites. Given the relatively small population size, a census approach was adopted for the quantitative component of the study, encompassing all 13 listed manufacturing companies to ensure exhaustive representation and optimal data quality. Subsequently, five manufacturing companies were purposively selected for the qualitative case study, which aimed to provide in-depth insights into the research phenomenon. The qualitative findings served as a validation mechanism for the quantitative results, facilitating a more comprehensive understanding of the research topic through methodological triangulation.

1.11.2 Sample and Sampling Procedure

The quantitative component of this research employed a census approach, involving an exhaustive documentary analysis of all manufacturing companies listed on the ZSE for the period 2021 to 2024. As 13 companies met the specified inclusion criteria, the study encompassed the entire population of the listed manufacturing companies, thereby enabling a comprehensive quantitative documentary analysis.

To provide a nuanced understanding and validation of the quantitative findings, five manufacturing companies were purposively selected for the qualitative research component. This facilitated an in-depth documentary examination of climate change risks, and practices adopted by Zimbabwean manufacturing companies, as well as their impact on firm performance. The qualitative insights obtained from these case studies served to contextualise and corroborate the quantitative results, providing a richer understanding of the research phenomenon. The selection of the five companies for the case study was based on their comprehensive sustainability reporting, market dominance, established governance structures, and ease of access to their annual financial reports (AFR).

1.11.3 Data Collection

This study employs a secondary research approach, leveraging existing data from published AFR and government publications to investigate the relationship between climate change, firm performance, government policy, and regulatory developments.

1.11.4 Pilot Study

A pilot study was conducted to assess the content validity and reliability of the data extraction forms, utilizing a purposive sample of two manufacturing firms listed on the ZSE. These companies were then excluded from the final research data collection to avoid data contamination.

1.11.5 Data Analysis

Quantitative data underwent a statistical analysis and coding using the R software, facilitating the examination of trends, and correlations. Conversely, the qualitative data was subjected to thematic analysis, wherein codes were assigned to the salient themes; categories were analysed using NVivo software to identify meanings and contextual relations.

1.11.6 Research Credibility

This study enhances research credibility through a mixed-methods approach, integrating quantitative and qualitative methods to provide a comprehensive understanding of the relationship between climate change and firm performance. By combining both methodologies, the study achieved data triangulation, validation of findings and deeper insight into the research questions (Carter, et al., 2014), allowing for credibility, dependability, confirmability, and transferability of the research findings (Moon, 2019).

1.12 ETHICAL CONSIDERATIONS

This study, which utilised secondary data from publicly available sources such as company websites and the ZSE, adhered to ethical standards by ensuring confidentiality, properly acknowledging sources, and avoiding any potential misrepresentation of others' work. Company names were anonymised to prevent reputational damage, and all data collected was used solely for research purposes and kept confidential.

1.13 SIGNIFICANCE OF THE STUDY

The study contributes to the existing body of knowledge in the following ways:
Empirical insights: the findings provide a nuanced understanding of climate change on firm performance, informing governance structures on effective response strategies.

1.13.1 Theoretical Contributions

The research links climate change to theoretical frameworks such as Legitimacy, institutional, stakeholder, and RBV, guiding management in their responses to climate challenges.

1.13.2 Policy Implications

The study informs policymakers about the development of evidence-based carbon regulatory policies and contributes to the implementation of the Zimbabwe Climate Change Act.

The study further develops a framework for assessing the climate change adaptation and mitigation practices by Zimbabwean manufacturing companies.

1.14 CHAPTER REVIEW

This section outlines the structure of the thesis.

Chapter 1: Introduction

Chapter 1 introduces the research background, justification, aims, objectives and questions. It also outlines the theoretical framework, methodology, research assumptions, ethical considerations, and highlights the study's contributions.

Chapter 2: Literature Review

Chapter 2 reviews existing literature on climate change, focusing on its causes and effects on business operations, particularly financial performance. It discusses corporate theories shaping organisational environmental practices, climate risks, and corporate responses to climate change risks.

Chapter 3: Research Methodology

Chapter 3 describes the research methodology, philosophy and justification. A mixed-methods approach was adopted, and the chapter explains data collection methods, analysis, the justification for the documentary analysis strategy and the selection of five companies used in the multiple case study.

Chapter 4 and 5: Data Analysis and Interpretation

Chapter 4 presents the analysis and interpretation of quantitative data. Chapter 5 presents the qualitative findings and triangulates them with the quantitative results to enhance research credibility.

Chapter 6: Discussion and Conclusion

Chapter 6 presents the conclusions and provides recommendations for business management, policymakers, and areas for further research.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

Chapter 1 outlined the background of the study, as well as the aims, objectives, and significance of the research. The study critically examines the relationship between climate change and firm performance, with a focus on financial implications, examines the moderating effects of climate change governance on the relationship between climate-related risks and firm performance; to determine how internal and external factors intersect to constrain climate change adaptation, and to develop a framework for assessing the climate change adaptation and mitigation practices by Zimbabwean manufacturing companies.

This chapter investigates the theoretical and empirical literature that supports the nexus between climate change and firm performance within the manufacturing sector. Following the objectives of the study, this review synthesises the existing research regarding the influence of climate change awareness on firm preparedness, profitability, and resilience. Specifically, this chapter examines the role of governance mechanisms related to climate change, focusing on risk management in mitigating climate-related risks. It identifies best practices and strategies within the industry that enhance firm performance, sustainability, and adaptability in response to climate change. Through a critical analysis of the existing literature, this chapter comprehensively explains how sustainability theories influence organisational behaviour and the intricate relationships between climate change, firm performance of the manufacturing sector. The review also investigates the interplay between internal and external factors that affect climate adaptation, resilience, and financial performance, establishing a foundation for the subsequent chapters.

2.2 CONCEPTUAL FRAMEWORK

Theoretical and conceptual frameworks underpin a study, forming its intellectual and structural foundation. They inform and guide the formulation of research questions and hypotheses (Mutsagondo, 2025; Oyewobi, et al., 2025), thus facilitating the development of a suitable methodological approach for the study. A conceptual framework is a diagrammatic representation of key concepts, assumptions, and theories that underpin a study (Antunes, et al., 2025), thereby serving as a roadmap for the investigation. However, many researchers overlook the significance of the conceptual framework, failing to adequately integrate it with the methodology and findings of their study (Chalawila & Muchanga, 2022). Figure 2.1 depicts a diagrammatic representation of the conceptual framework adopted by this study.

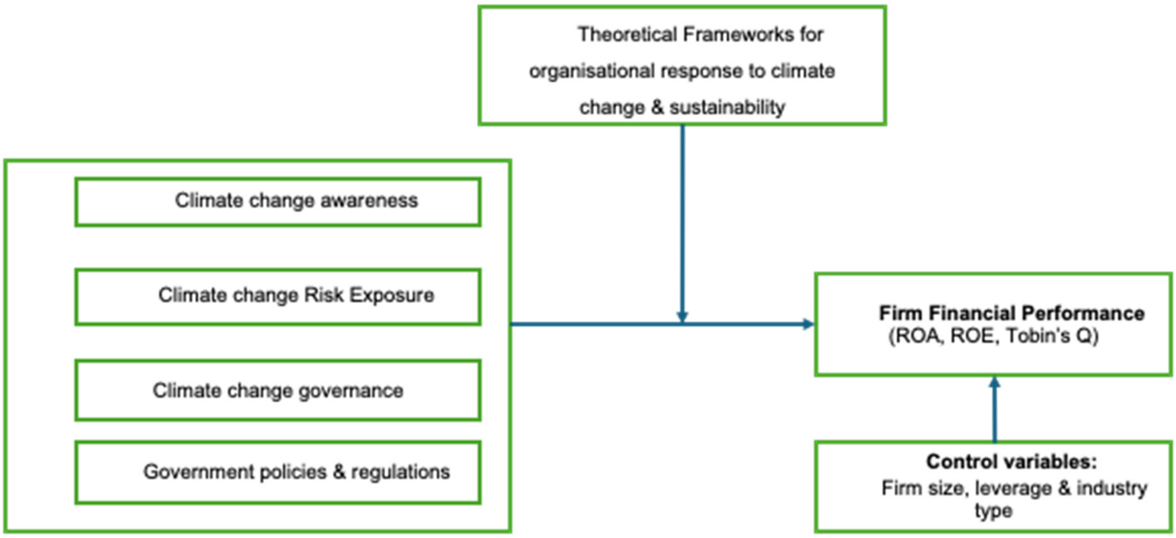

Figure 2. 1:Conceptual Framework

Source: Author's own impression (2025)

The framework posits that climate change governance mechanisms, internal capabilities, and external environmental factors directly impact climate change adaptation and mitigation strategies. These strategies, in turn, influence firm resilience, sustainability, and financial performance. The conceptual framework considers this relationship in two phases; the first phase evaluates the effect of climate change variables (awareness of risks and opportunities, firm-climate strategies and practices, and government climate policies and regulations) on firm performance in the Zimbabwean context. The second phase of the model seeks to integrate the stakeholder, institutional, legitimacy and RBV theories in explaining the climate change-firm performance relationship. The model emphasises the interconnectedness of governance, internal and external drivers, and their cumulative effect on firm outcomes within the Zimbabwean manufacturing context.

2.3 THEORETICAL FRAMEWORK

This study employs a theoretical framework as a foundation for the empirical literature related to climate change and business sustainability in the Zimbabwean context. The theoretical framework is used to examine the reasons why businesses adopt some climate change practices, and the potential benefits of such practices. A theoretical framework provides a foundation upon which a research inquiry is built (Grant & Osanloo, 2014) , and reflects the hypothesis of the study. Theoretical frameworks are the lenses that researchers use to view the world and the concept under study. They shape our understanding of reality, influencing how we perceive, process information, and make judgements, (Smith & Stewart, 2014:150). This study draws insights into multiple sustainability theories to explore the behaviour of companies in relation to environmental practices as they try to justify their continued existence in their markets.

The climate crisis has forced companies globally to take steps towards reducing GHG emissions and make sustainability disclosures, as they bow to stakeholder pressures. But what drives this action? Companies seek to bridge the information gap, demonstrate legitimacy to their shareholders, and account for their actions on the environment (Sun, et al., 2022). There is also a need for companies to behave like industrial leaders in their markets (DiMaggio & Powell, 1983), hence increased and improved sustainability reporting. This has led to an increased environmental disclosure in sustainability reports. While sustainability reporting is on the rise, the institutional and stakeholder pressures lead to significant variability in these reports, highlighting the need for standardised transparency reporting (Herold, 2018). This study adopts sustainability theories to form the bedrock of the study.

Sustainability has emerged as an essential framework for managing organisations, integrating environmental, social and economic factors to foster a holistic and triple-bottom-line approach to organisational management (Chang, et al., 2017). Recent developments in sustainability have shaped the evolution of sustainability theories that influence the environmental behaviour of many listed companies. This study discusses legitimacy theory, stakeholder theory, institutional theory and resource-based theory to explain the relationship between climate-related practices and firm performance of manufacturing firms. Theories such as institutional theory (Comyns , 2016), legitimacy theory (Reid & Toffel, 2009), and institutional theory have been employed to justify the existence of businesses in society and to emphasise the importance of addressing climate change. The traditional shareholder theory, which prioritises shareholder value maximisation (Wang, et al., 2022) has been challenged by scholars who argue that businesses have a broader responsibility to society beyond profit maximisation. As such, companies are facing mounting pressure to address climate change, driven by stakeholder demands (Liesen et al., 2015; Comyns, 2016) and government regulations (Reid & Toffel, 2009). However, a surprising study reveals that governance and access to resources, not stakeholders, ultimately dictate climate risk management (Ko & Tai, 2020), hence the inclusion of RBV in this theoretical framework.

2.3.1 Institutional Theory and Climate Adaptation

Institutional theory explains firms' climate-related behaviours as responses to external pressure: coercive (regulatory mandates), normative (societal and professional expectations), and mimetic (imitation of peers) (DiMaggio & Powell, 1983). These processes are particularly relevant in the context of climate change, where firms are increasingly pressured to adopt sustainable practices to enhance their legitimacy and performance in a rapidly evolving market landscape (Fany, 2022). The convergence of organisational behaviours in response to climate change can be understood through the lens of isomorphic pressures. Coercive pressures, stemming from regulatory frameworks and legal mandates compel firms to adopt sustainable practices. For instance, the environmental regulations in various jurisdictions require corporations to implement measures that mitigate their carbon footprints (Palthe, 2014). This regulatory environment not only influences organisational behaviour but also shapes market expectations, as firms that fail to comply risk losing legitimacy and competitive advantage (Latif, *et al.*, 2020).

Normative pressures, rooted in societal expectations and professional standards, further drive firms towards sustainability. As stakeholders increasingly demand transparency and accountability regarding environmental practices, organisations are motivated to align their operations with these normative expectations (Li *et al.*, 2018). This alignment is critical, as firms perceived as environmentally responsible are more likely to attract investment and gain customer loyalty, ultimately enhancing their performance.

Mimetic pressures also play a significant role in shaping organisational responses to climate change. In uncertain environments, firms often look to successful peers for guidance on best practices (DiMaggio & Powell, 1983). This emulation can lead to widespread adoption of similar sustainability strategies, as firms seek to maintain legitimacy and competitive parity. However, this mimetic behaviour raises concerns about the depth of commitment to sustainability, as organisations may prioritise appearances over substantive change.

In Zimbabwe's manufacturing sector, regulatory frameworks compel firms to reduce emissions, while stakeholder demands drive transparency in sustainability reporting, essential for maintaining legitimacy and competitive positioning (Palthe, 2014). However, mimetic pressures risk superficial compliance or "greenwashing," which may undermine genuine environmental performance (Villena & Dhanorkar, 2020). Firms that successfully align with institutional expectations reduce market uncertainties and enhance performance through strengthened reputation and stakeholder trust (Berthod, 2018). Yet, a focus on conformity over innovation may weaken long-term competitiveness (Kostova & Roth, 2002). Cultivating a sustainability-oriented culture internally fosters innovation and employee commitment, bolstering firm resilience and performance (Scott, et al., 2017).

2.3.2 Legitimacy Theory: Navigating Societal Expectations

The pursuit of legitimacy is a central theme in institutional theory, particularly in the context of climate change. Legitimacy theory highlights the importance of firms aligning with societal values to secure ongoing support and mitigate risks (Suchman, 1995; Fernando & Lawrence, 2014). Firms that conform to institutional theory not only enhance their legitimacy but also reduce market uncertainties, which can positively impact their performance (Berthod, 2018). Manufacturing firms use environmental disclosure to legitimise operations, reduce reputational damage, and enhance financial outcomes (Mousa & Hassan, 2015; Thomas & Lamm, 2012). This legitimacy is multi-dimensional: pragmatic (cost and efficiency gains), moral (ethical responsibility), and cognitive (transparent communication) (Asyifa & Burhany, 2022). Enhanced legitimacy can translate into tangible benefits, such as increased market share and profitability, as consumers increasingly favour environmentally responsible companies.

Failure to adapt disclosures to evolving societal expectations risks legitimacy loss and financial penalties (Munteanu , et al., 2020). Legitimacy acts as a strategic asset, enabling firms to access markets, influence policy, and gain regulatory trust, crucial in Zimbabwe's emerging regulatory climate (Dowling & Pfeffer, 1975). Firms must balance legitimacy demands with shareholder value by integrating transparency and accountability into their strategies (Munoz , et al., 2017; Lakhan & Herber, 2022).

However, the relationship between legitimacy and firm performance is a complex one. While short-term gains may be realised through compliance with institutional pressures, the long-term implications of isomorphic behaviour warrant further examination. Firms that adopt sustainability practices solely for legitimacy may struggle to innovate and differentiate themselves in the marketplace, potentially undermining their competitive advantage (Kostova & Roth, 2002). However, compliance costs may affect a firm's financial performance in the short-term.

2.3.2.1 Implications of legitimacy theory on climate change and firm performance

Organisations must be responsive to societal issues (Lindblom , 1994)**.** Organisations often engage in environmental disclosure to demonstrate their commitment to societal values and expectations (Mousa & Hassan, 2015: Lindblom, 1994). As such, manufacturing firms can legitimise their operations by reducing carbon and disclosing

(Fernando & Lawrence, 2014) their activities and their environmental impact. According to Mousa & Hassan, (2015) organisations use voluntary environmental disclosures to gain, maintain or repair their legitimacy. To successfully achieve their legitimacy objectives, organisations must continuously monitor and adapt to changing societal expectations. Organisations that fail to align their practices with social norms are prone to the risk of reputational damage (Munteanu , *et al.*, 2020 ; Alrazi, *et al.*, 2015), and loss of legitimacy, resulting in sanctions from stakeholders (Suchman, 1995). Organisations may adopt specific strategies to enhance their legitimacy, such as engaging in corporate social responsibility (CSR) initiatives or sustainability practices, where they reduce the amount of carbon emissions, and engaging in water conservation initiatives. These strategies are often influenced by the need to conform to institutional pressures, including regulatory requirements, and stakeholder expectations (Dowling & Pfeffer, 1975).

Legitimacy theory highlights the importance of managing risks associated with public perceptions (Gunningham, *et al.*, 2004). Environmental scandals such as the BP Oil Spill of 2010 in the Gulf of Mexico region (Farber, 2014), attract substantial public attention and have severe backlashes to a company's operational licence and, consequently its financial performance. The desire to remain legitimate has forced many organisations to align their behaviour with societal expectations (Dowling & Pfeffer, 1975). To achieve market growth, organisations need reputational capital. Joyce & Thomson, (1999) posit that organisations endowed with reputational capital will gain access to profitable markets, influence government policies and obtain the trust of regulatory bodies, are accepted by local communities and face the least environmental risks from stakeholders. As such, legitimacy is a resource that organisations can depend on for their market survival (Dowling & Pfeffer, 1975: Shocker & Sethi, 1974). In times of crisis, organisations must act swiftly to restore their legitimacy, and this is achieved through effective disclosure and transparency (Hybels, 1995).

Legitimacy theory provides valuable insights into how organisations navigate their social environments and the importance of aligning their practices with societal expectations. In the context of climate change, firms that successfully adapt their strategies to meet environmental standards and engage with stakeholders are more likely to enhance their legitimacy and, consequently, their financial performance. As organisations continue to face scrutiny regarding their social and environmental impacts, the principles of legitimacy theory will continue to play a critical role in shaping organisational behaviour, and strategies for sustainable adaptation.

2.3.2.2 Navigating the Tension between legitimacy and shareholder value

While the pursuit of legitimacy drives firms to adopt sustainable practices, some scholars argue that societal demands can be unsustainable and may divert management focus from shareholder value maximisation (Munoz , et al., 2017). This tension highlights the need for businesses to balance societal expectations with economic performance. As noted by Dagilien (2018) and cited in (Lakhan & Herber, 2022), organisations must weave narratives of transparency and accountability to harmonise profit and purpose, thereby legitimising their actions in the eyes of stakeholders.

Legitimacy theory provides a valuable framework for understanding the climate change-firm performance nexus. By integrating pragmatic, moral, and cognitive dimensions of legitimacy, firms can navigate the complexities of societal expectations while enhancing their environmental performance. According to Sharma, et al.,(2019), social performance positively influences the profitability of organisations. Hence, aligning societal norms and organisational practices not only fosters stakeholder support but also contributes to long-term profitability in an increasingly sustainability-focused market. As businesses strive to legitimise their operations, the interplay between corporate legitimacy, environmental sustainability, and financial performance becomes increasingly critical in the context of climate change

2.3.3 Resource-Based Theory

Resource-Based View centres on firms' internal resources and capabilities as drivers of competitive advantage in climate adaptation (Barney, 1991). Manufacturers that develop green technologies or eco-efficient processes can differentiate themselves and improve performance (Sitompul, et al., 2024). Climate change challenges also spur innovation, creating opportunities for cost leadership and sustainable product development (Qing, et al., 2023). Dynamic capabilities enable firms to adapt resources effectively in response to environmental demands. However, RBV's limitation lies in underestimating external institutional pressures; firms lacking legitimacy or stakeholder support may fail despite resource advantages (Priem & Butler, 2001).

2.3.4 Stakeholder Theory: Balancing Diverse Interests for Sustainability

Stakeholder theory stresses the importance of addressing the needs of diverse groups, beyond shareholders, including communities, regulators, and environmental advocates (Susith & Stewart , 2014). Effective management of climate risk requires strategic foresight and responsiveness to stakeholder expectations to sustain operations and performance (Massey, et al., 2021). Nonetheless, firms face challenges balancing conflicting stakeholder demands in a complex socio-political environment (Bongo, 2024).

This study adopts the view that Institutional theory explains the regulatory, normative and mimetic pressures that encourage listed firms to disclose climate-related risks and adopt climate strategies. Legitimacy theory explains why firms may use climate disclosures and sustainability narratives to maintain social approval, investor confidence and regulatory acceptance. Stakeholder theory explains how investors, regulators, customers, communities and creditors influence climate-related reporting and strategic responses. The resource-based view explains why firms with stronger internal capabilities, governance routines and financial resources may be better positioned to convert climate strategy into resilience and performance. Together, these theories support the empirical distinction between CCR as a disclosure/risk-reporting construct, CCS as a strategic-response construct, and firm performance as an outcome reflected in both accounting and market measures.

2.3.5 Integrative Perspective for Zimbabwean Manufacturing Firms

Manufacturing firms in Zimbabwe face rising climate-related risks such as resource scarcity and cost pressures that demand transparent sustainability practices and strategic adaptation (Mondal & Bauri, 2022). This study applies an integrated institutional-legitimacy-resource-stakeholder framework to analyse how these firms navigate external pressures and internal capabilities to maintain legitimacy, foster innovation, and enhance financial performance amid escalating climate challenges.

The manufacturing sector is increasingly facing pressure to reduce its environmental footprint, particularly in relation to climate change. The institutional-legitimacy framework provides a nuanced understanding of the complex relationships between institutional pressures, legitimacy-seeking behaviour, and climate change mitigation strategies in manufacturing companies. By examining these relationships, this framework offers insights into how manufacturing companies can effectively respond to climate change issues while maintaining legitimacy and enhancing their financial performance.

2.4 EMPIRICAL LITERATURE REVIEW

This section critically examines empirical studies that have investigated the relationship among climate change risk, governance mechanisms, and firm performance, providing evidence-based insights that inform the analytical direction of the present study.

2.4.1 Business Risks, Opportunities, and Responses to Climate Change

The impacts of climate change are multifaceted and uncertain, yielding risks and opportunities for enterprises (Massey, *et al.*, 2021). As a global crisis, climate change poses significant threats to governments and businesses across diverse geographical locations and economic sectors (Díaz-Noriega, et al., 2020). However, the climate-related challenges and hardships faced by businesses are heterogeneous, with each entity confronting unique obstacles (LIGS University , 2024).

Manufacturing firms play a crucial role in economic development, but their activities also have a substantial environmental impact throughout their supply chain, contributing to climate change, water and air pollution, resource depletion, and land use changes (Karduri, 2018). Certain economic sectors are more vulnerable to climate risks due to their dependence on the natural environment (physical impacts) or exposure to regulatory changes (regulatory risks), (Lash & Wellington, 2007). These risks have a potential impact on firm performance in the manufacturing sector.

The impact of climate change is not uniforml, but it is a complex, multifaceted issue requiring tailored strategies and strategies for company, industry, and sector. Physically exposed sectors are tourism, agriculture, fishing and mining, these sectors are directly affected by climate-related activities such as rising sea levels, droughts, and extreme weather conditions, which can disrupt their operations and existence, whilst regulatory exposed sectors are energy and manufacturing industries. These sectors face potentially increasing regulatory risks related to carbon emissions limits and environmental contamination laws, which impact their operations and profitability (Busch & Hoffman, 2007).

Climate change creates unique uncertainties in the availability of raw materials (Er-Kara, *et a*l., 2021), continued operational capacity of assets and regulatory requirements. Climate change is poised to precipitate a significant market shift, with far-reaching implications for businesses. As presciently predicted by Hoffman, (2007), this shift is characterised by an increased demand for GHG emission reduction technologies, the emergence of novel financial instruments for emission trading, and innovative mechanisms for global technology transfer. Moreover, companies face mounting pressure to retire sources of GHG emissions rendering fossil fuel infrastructure financially useless. The impact of this shift is heterogeneous, with varying degrees of exposure to climate change risks affecting different companies. This necessitates the application of distinct mechanisms to identify physical, transition, and liability risks (Massey, *et al.*, 2021). Failure to adapt to these environmental risks can result in going concern threats, leading to significant losses for equity investors and potential capital flight (Cooper, 2020).

There are three views on environmental regulations. Firstly, the restrictive hypothesis, states that environmental regulations result in a decline in firm financial performance, crowding investment in research and development and inhibit technological progress (Jaffe, *et al.*, 1995: Millimet & Osang, 2003). However, Chang, (2013), believes that strict environmental regulations would increase profits, but inhibit technological progress. However, these findings contradict Porter's hypothesis, which believes that strict environmental regulations promote innovation in firms, thereby increasing their financial performance**.** Michael Porter maintains that reasonable and strict environmental regulations stimulate innovation, production technology advancement, and improved output (Porter & Linde, 1995), leading to better firm financial performance. Management should correctly position their business to maximise the opportunities climate change risks present and to minimise the threats that come with it.

The traditional neo-classical economic paradigm posits that environmental regulations, aimed at mitigating climate change, entail compliance costs that impose economic burdens on firms, thereby disrupting their economic decision-making process and productive capacities (Jaffe & Stavins, 1995). This compliance costs hypothesis suggests that regulatory measures can lead to inefficiencies and reduced competitiveness, as firms are forced to allocate resources to meet stringent environmental standards, potentially hindering their ability to optimize economic outcomes. Heterogeneous firm responses to climate environmental regulations have been observed, with some firms exiting the market due to insurmountable compliance costs, while others have relocated to jurisdictions with less stringent carbon constraints, and a subset have merely undertaken partial adjustments, such as reducing coal consumption, rather than fully optimizing their behaviour to meet regulatory requirements (Cao, *et al.*, 2021). This varied spectrum of firm responses highlights the complexity of climate policy implementation and the need for a nuanced understanding of firm-level decision-making dynamics.

As noted by Carney, (2015), a restrictive carbon budget will limit the operational capacity of manufacturing firms, leading to financial risks as the global economy transitions to a low-carbon economy. This transition is driven by changes in policy, technology, and physical risks, resulting in a reassessment of company values as costs and opportunities become clear. The consequences of increasing operational costs will include impacts on profitability, competitive risks for manufacturing firms, and energy suppliers passing on costs to consumers (Lash & Wellington, 2007). These developments may impact a company's sales revenue, profits, and growth by altering customer demand for its products or services. This demand shift may be driven by changes in customer preferences towards green products as opposed to brown products, technological advancements, or legislative changes that restrict or outlaw certain products (Wills & Keyes, 2017).

Adapting to climate change is crucial for economies. The urgent need to address climate change has led to a global shift towards a low-carbon economy, driving policy changes that promote renewable energy, sustainable practices, and reduced GHG emissions to mitigate the devastating impacts of climate change (Abbass, *et al.*, 2022).A comprehensive approach involving both public and private sectors is necessary. Governments can play a key role in adaptation programs with broad benefits, addressing market flaws that hinder private adaptation, and ensuring fair distribution of adaptation costs and benefits. Bellon & Massetti, (2022) assert that economic theory can guide decision-making to maximise the impact of public spending while considering each society's unique priorities and preferences.

2.4.2 Climate Change and Supply Chain

Climate change presents businesses with a double edge sword: while it brings risks and uncertainties, it also offers opportunities to enhance operational efficiencies and unlock value in the supply chain. Businesses can capitalise on climate change vulnerabilities by forging innovative partnerships with government, supply chain stakeholders, and even competitors to develop resilient infrastructure and mitigate risks (Schwartz, 2007). By proactively addressing climate change, companies can enhance their reputation, build goodwill, and advance their interests. An exemplary case is Coca-Cola's collaboration with the World Wildlife Fund to protect global water resources and improve its water management practices (Schwartz, 2007).

Climate change and environmental performance bring some advantages to manufacturing companies in the form of: increased access to export markets, improved productivity and reduced waste, securing a social licence to operate, and access to large sources of finance, especially for international investors keen on environmental investment (Gentry, 1998). Environmental performance provides a business with an opportunity to reduce costs in doing business and to increase profits (Yale/UNDP, 1998). The report further states that companies with strong environmental performance experience reduced pollution fines, enhanced reputation among customers, access to affordable finance, and improved production efficiency. These companies have opportunities to participate in developing and influencing national climate policies, as well as investing in and distributing pollution control products. Patnaik & Fabrizio, (2023) note that, the existential threat posed by climate change has precipitated a paradigmatic shift in the development and deployment of low-carbon products, obligating businesses to engage in dynamic product portfolio management and exhibit a heightened sense of adaptability and responsiveness to shifting customer demands and market contingencies.

The governance of organisations is confronted by the complex task of navigating the dichotomy of climate change, wherein lies both peril and opportunity. Pais Seles, *et al*., (2018), demonstrated that embracing the opportunities presented by the climate crisis can yield synergistic benefits across environmental, operational, and financial performance metrics and catalyse the emergence of novel business entities such as the solar energy industry. In response to the existential risks posed by climate change, companies will likely invest in research and development aimed at mitigating and adapting to the crisis, thereby optimizing resource utilisation and fostering innovation in products and energy sources. This notion is substantiated by Haydock, *et al*., (2017), who posit that a low-carbon economy would precipitate a paradigmatic shift in the business landscape, unlocking new opportunities for firms to produce renewable energy and energy-efficient technologies, carbon markets, as well as services such as green bonds and material recycling, thereby redefining the contours of a sustainable and resilient business model.

Climate change poses a high-impact global risk, yet few studies have examined its implications for supply chain management, revealing a notable research lacuna (Er-Kara, *et al.*, 2021). Climate change exerts a profound influence on business operations, permeating every stage of the value chain, from sourcing and production to distribution and sales impacts all business operations. This impact occurs across various stages, including raw material extraction and transportation, manufacturing process, product distribution, disposal, and recycling.

Climate change profoundly disrupts the global supply chain, impacting production across industries (Ghadge, et al., 2020). Supply chain dynamics and climate change are intricately linked, with sustainability practices crucial for success (Kara, *et al.*, 2020). Kara, *et al.*, further state that climate change precipitates a trifecta of supply chain disruptions, encompassing diminished raw material availability, constrained supplier capacity, and heightened inventory stockouts. These disruptions, in turn, culminate in escalated material costs and procurement and logistics anomalies, ultimately compromising firms' productivity and profitability (Er-Kara, *et al.*, 2021: Pankratz & Schiller,2021). This exogenous risk poses a substantial threat to an organisation's operational efficacy and financial viability, potentially culminating in diminished performance outcomes and compromised bottom-line results (Lim-Camacho, *et al.*, 2017: Bergmann, *et al.*, 2016).

The executive leadership of organisations are confronted with the existential threat posed by climate change and the daunting task of looking for an approach that can best mitigate the likelihood of business disruptions and enhance supply chain resilience. This necessitates a sophisticated understanding of the intricate relationship between climate-related risks, supply chain vulnerabilities, and business continuity. As Patnaik and Fabrizio (2023) insightfully note, supply chain resilience is predicated on both the reduction of disruption risks and the cultivation of adaptive supply chains capable of rapid recovery from disruptions. As such, businesses must develop and implement comprehensive contingency plans, foster strategic partnerships with alternative suppliers to ensure backup supply arrangements in the event of disruptions and embrace adaptive management practices that prioritise resilience, sustainability, and long-term viability in the face of climate-related uncertainties and disruptions (Patnaik & Fabrizio, 2023). However, this may not be possible given the scale and uncertainties associated with climate change effects and lack of experience by some managers in the least developed economies.

2.4.3 Climate Change Awareness and Firm Performance

As the global community grapples with the far-reaching consequences of climate change, businesses are facing unprecedented challenges in navigating the associated risks and opportunities. Climate change poses significant economic risks to businesses, making emission reduction in manufacturing crucial. Awareness of these impacts is vital for management to act (Tol, 2018). Climate change risks pose threats to business survival, it impacts their financial performance, firm value and return on investment. Companies operating in extremely polluting industrial settings (high-profile firms) are more exposed to carbon risk because of policy, legislation, technology and markets during the transition to a low-carbon economy (Wang, et al., 2022). Political and legislative requirements place high climate compliance risk on these firms.

As Tol, (2018) notes, recognising climate risk is essential for manufacturing firms to incorporate it into corporate governance and risk management strategies, enabling proactive mitigation by risk management committees. Climate-related risk awareness has emerged as a critical factor in firm performance, as companies that fail to acknowledge and adapt to climate-related risks may suffer significant financial losses, damage to reputation, and even existential threats (Hong , et al., 2019). On the other hand, firms that proactively identify and manage climate-related risks can unlock new opportunities, enhance their resilience, and contribute to a sustainable future (Miah , *et al.*, 2021), hence firm profitability.

To effectively manage climate change, businesses should anticipate, measure, and respond to climate-related risks (Silwimba & Fadun , 2022). Proactive businesses are better equipped to handle emerging risks. Manufacturing companies should be aware, predict, and prepare for climate change dangers, enabling them to adapt through scenario planning and trend forecasting based on current climate risks. These sentiments were also echoed by Karimi, *et al*., (2021) who commended that businesses should take a hazard-based approach to climate change, predicting and preparing for potential scenarios and future trends based on current risk trends. This proactive strategy enables adaptation and resilience in the face of climate change dangers. Global cooperation and information sharing are crucial in this endeavour. By fostering collaboration and knowledge exchange, stakeholders can identify and implement successful mitigation strategies, ultimately contributing to a resilient global economy (Cuddihy, 2000).

As global energy use and manufacturing output are projected to surge by 2050, the current regulatory framework is inadequate to address emerging environmental challenges (Cuddihy, 2000). Cuddihy further states that businesses must adopt sustainable development strategies that balance economic, environmental, political, and social considerations to ensure long-term profitability and minimise environmental harm.Therefore, prioritizing environmental liability and risk management is essential for sustainable development. Businesses must adopt proactive, integrated approaches to ensure a viable future, balancing economic growth with environmental and social responsibility.

This necessitates a paradigm shift in corporate strategy, recognizing environmental liability as a critical component of business operations (Cuddihy, 2000). By doing so, companies can navigate the complex landscape of environmental challenges, capitalize on new opportunities, and contribute to a sustainable global economy.
Lack of awareness of the effects of climate change is detrimental to business as it can lead to a lack of preparedness to respond to climate change effects and to identify and take advantage of the new business opportunities it presents. As the awareness of

climate-related risks grows, businesses have become better equipped to assess and quantify their financial implications (Silwimba & Fadun, 2022: Huynh, *et al.*, 2020). Silwimba & Fadun further state that, companies can harness traditional risk management tools to effectively navigate climate-related risks, enhancing their ability to minimise these threats and boost their resilience in the face of a changing climate. This approach enables businesses to build on existing expertise, streamlining their response and increasing their chances of success in mitigating climate-related risks.

Those responsible for governance must be cognisant of the diverse climate-related risks that can imperil business operations and financial performance. Climate change risk encompasses a multifaceted spectrum of physical, transition, and liability risks (Kiryas & Xepapadeas, 2018; Diaz-Noriega, *et al.,*2020, Rothwell, *et al.*, 2020), constituting a critical domain within risk management. Notably, climate risk has ascended to prominence, increasingly dominating the field due to its pervasive and systematic implications (Hillson, 2023:207).

2.4.4 Climate Change Risks, Regulatory Impacts, and Strategic Responses in Manufacturing Firms

Climate change presents diverse and unpredictable risks and opportunities across industries, with manufacturing facing unique challenges due to its environmental impact and regulatory exposure (Massey, et al., 2021; Díaz-Noriega et al., 2020). Manufacturing contributes significantly to economic growth but also to pollution and resource depletion, intensifying climate risk (Karduri, 2018). While sectors tourism and agriculture face direct physical risks, manufacturing and energy industries grapple with regulatory pressures that increase operational costs and threaten profitability (Busch & Hoffman, 2007).

Climate change disrupts raw material availability and shifts market demand toward eco-friendly products, requiring firms to identify and manage physical, transition, and liability risks to avoid financial distress (Cooper, 2020; Er-Kara, et al., 2021;Massey, et al., 2021).The impact of environmental regulations on firm performance is debated: some argue regulations hinder innovation and profits (Jaffe & Stavins, 1995), while others, including Porter, content that well-designed regulations drive innovation and improve financial outcomes (Porter & Linde, 1995). Firms respond variably — some exit markets, others relate, or partially adapt — highlighting the complexity of regulatory effects (Cao, et al., 2021).

The shift to a low-carbon economy imposes operational constraints and financial risks, as firms balance rising costs with changing consumer preferences for greener products (Lash & Wellington, 2007; Wills & Keyes, 2017). Governments play a critical role by incentivising sustainable practices, with economic theory guiding effective public spending to align with societal priorities (Abbass, et al., 2022). Proactive firms can leverage climate risks to enhance operational efficiency, reputation, and access to finance, exemplified by partnerships like Coca-Cola's collaboration with WWF on water management (Yale/UNDP, 1998; Patnaik & Fabrizio, 2023).

Governance faces the dual challenge of managing climate risks and capitalising on opportunities. Embracing climate challenges can yield environmental, operational, and financial benefits and foster innovation in emerging sectors like renewable energy (Pais Seles , et al., 2018). However, climate change also disrupts supply chains, reducing raw materials, supplier capacity, and increasing costs, threatening productivity and profitability (Ghadge, et al., 2019; Er-Kara, et al., 2021).

2.4.4.1 Climate Change Risks and Governance Challenges for Manufacturing Firms

Companies in highly polluting industries face elevated carbon risks due to policy, legislation, technology, and market pressures during the transition to a low-carbon economy (Wang, et al., 2022). Strict political and legislative demands increase their climate compliance risk. Tol, (2018) argues that manufacturing firms must integrate climate risk into their governance and risk management, such as forming dedicated committees, to proactively address these risks. Failure to do so can lead to financial losses, reputational damage, and existential threats (Hong , et al., 2019), while proactive management can enhance resilience and profitability (Miah , et al., 2021).

Effective climate risk management requires anticipating, measuring, and responding to risks through scenario planning and trend forecasting (Silwimba & Fadum, 2022; Karimi, et al., (2021). Global cooperation and knowledge sharing further support mitigation efforts (Cuddihy, 2000). However, rising global energy use and manufacturing output highlight the inadequacy of current regulations, necessitating sustainable strategies balancing economic, environmental, political, and social factors (Cuddihy, 2000). This demands a paradigm shift recognising environmental liability as central to business operations.

Lack of climate awareness impedes preparedness and opportunity recognition, but growing awareness enables firms to assess risks financially and apply traditional risk management tools to enhance resilience (Silwimba & Fadun , 2022). Governance must recognise the complex nature of climate risks, including physical, transition, and liability, which are increasingly dominating risk management due to their systematic impact (Kiryas & Xepapadeas, 2018; Rothwell et al., 2020; Hillson, 2023).

2.4.5 Climate Change Governance

Risk governance involves the different methods used by businesses manage risks characterized by uncertainty, complexity, and ambiguity, including those linked to climate change (van Asselt & Renn, 2011). Risk management is a routine practice for businesses. It involves identifying, assessing, quantifying, and mitigating the risk with the aim of reducing operational costs while ultimately increasing shareholder value (West & Brereton, 2013).

Climate governance forms a critical element of ESG frameworks, which enhances corporate value through the processes of risk mitigation, identification of opportunities, fostering stakeholder engagement, and promoting long-term sustainability (Mishira, et al., 2024). Mishira et al., further assert that the effective integration of climate considerations into governance structures enables corporations to adapt and survive in rapidly evolving business environments, thereby positively impacting financial performance. This requires businesses to establish robust frameworks that incorporate climate risk in their strategic business planning and ensure transparency in ESG disclosure (Edwards, et al., 2017).

2.4.5.1 Integration of Climate Change into strategic Risk Management

Climate change impacts businesses at both macro and micro levels, necessitating industry-wide or firm-specific mitigation practices (ACCA, 2009; Hoffman, 2006). Exposure to regulatory, litigation, and environmental liabilities heightens the need for strategic climate risk management. Given its unique complexity and scale, climate change increasingly shapes business strategy, with firms failing to address it risking competitive disadvantage (Patnaik & Fabrizio, 2023).

The multifaceted and uncertain nature of climate impacts presents both risks and opportunities, requiring tailored responses from companies (LIGS University , 2024; Massey, et al., 2021). Governance structures must embed climate risks within ERM and strategic planning to effectively navigate regulatory uncertanities, particularly for fossil fuel-dependent sectors vulnerable to policy shifts and carbon pricing (Blyth, et al., 2007).

Risk management- systematic identification, assessment, and mitigation of threats and opportunities, is linked to improved manufacturing performance (Hakkarainen, et al., 2020; Abere & Saka, 2023). Cultivating a strong risk-awareness culture is critical for optimising firm outcomes (Banjo, et al., 2021). Sharpe, (2019) categories risk mitigation into avoidance, acceptance, reduction, and transfer, strategies that manufacturing firms can apply through diversification, climate-resilient infrastructure, energy efficiency, sustainable supply chains, insurance, and green financing.

Business risk, stemming from market and regulatory uncertainties, and financial risk, linked to capital structure, are intensified by climate change’s impacts on operations, supply chains, and market stability (ACCA, 2022). Integrating climate resilience into risk frameworks is essential for long-term viability. Governance must address interconnected physical, transition, and liability risks related to climate change to mitigate losses and seize opportunities (Kiryas & Xepapadeas, 2018), although governance does not always drive carbon disclosure (Darus, et al., 2020). Adopting climate risk integration within enterprise risk management (ERM), as recommended by the Task Force on Climate-related Financial Disclosures (TCFD), equips firms to manage the complexities of climate risks and enhance adaptability in a changing environment (Hillson, 2023).

2.4.5.2 Risk and Uncertainty

Risk and uncertainty are terms that are frequently used interchangeably (Hillson, 2023:6). Hanger-Kopp, et al., (2019) define risk as an uncertainty that, if realised, will significantly affect the achievement of business objectives. Uncertainty is characterised as a state of incomplete knowledge, driven by information gaps and/or conflicting viewpoints, whereas risk refers to the potential detriment to individuals, environments, economies, societies, and infrastructure because of uncertainty, which may arise from climate policies such as carbon taxation and the introduction of a 'carbon budget' (IPCC, 2015:155). The inherent uncertainty and complexity associated with climate change highlight the necessity for businesses to implement proactive and adaptive strategies to alleviate its far-reaching social and economic consequences. As noted by Heal and Millner, (2013) and Massey, et al., (2021), the global and long-term character of climate change, coupled with its potential irreversibility and substantial uncertainty, demand a transformative shift in business practices and policies to ensure resilience and sustainability.

Climate change impacts are characterised by a quintuple threat of physical, transition, regulatory, reputational, and liability risks (Kiryas & Xepapadeas, 2018; Rothwell, et al., 2020). The following sections provide a detailed exploration of these interrelated risks and their implications for corporate profitability.

2.4.5.3 Physical Risks

As explained by Díaz-Noriega, et al., (2020) and Karydas & Xepapadeas (2018), physical risks encompass the potential impacts of climate-related events on a company’s assets, infrastructure, and operations. These risks manifest in acute (event-driven) and chronic (longer-term shifts). Acute physical risks emerge from extreme weather events, such as hurricanes, wildfires, or floods, which can impair physical assets or disrupt business operations (Díaz-Noriega, et al., 2020; Karydas & Xepapadeas, 2018). Conversely, chronic physical risk arises from gradual and long-term alterations in the earth's climate, such as rising temperatures, sea-level rise, or shifts in precipitation patterns, which can render certain business activities unfeasible or require alternations to operations (Karydas & Xepapadeas, 2018; Díaz-Noriega, et al., 2020), leading to increased operational costs.

Physical climate risks cause direct and indirect economic consequences, including property damage, infrastructure disruptions, supply chain failures, agricultural losses, and loss of life, ultimately culminating in reduced asset values, and decreased corporate profitability (Ranger, et al., 2022:19). The macroeconomic consequences of physical risks, lead to reductions in production output and productivity (Scott, et al., 2017). Furthermore, physical risks will trigger a surge in demand for recovery and reconstruction efforts, encompassing disaster relief, infrastructure re-building, and economic revitalization initiatives. However, companies can mitigate climate physical risks by developing a strategic approach that protects physical assets, such as insurance and relocation to environments that are less prone to extreme weather events.

2.4.5.4 Transition Risk

The Basel Committee on Banking Supervision, (2021) defines transition risk as the risk of financial losses or opportunities arising from the shift to a low-carbon economy, driven by changes in public policies, technological development, and market sentiments, as the world transitions to a more sustainable and environmentally friendly future. Transition risk may trigger a comprehensive reassessment of asset values as changing costs and opportunities emerge, potentially exposing a huge amount of fossil fuel reserves stranded (Scott, et al., 2017:102).

The Paris Agreement signatories pledged to transition the global economy to a decarbonised production system through a multifaceted approach encompassing regulations, markets, and technology. This paradigm shift entails significant risk implications for companies, including regulatory and legal risks, market risk, technological risks, and reputational risks (Ozturk & Toprak, 2025). Notably, transition risk poses a significant threat to carbon-intensive assets, potentially rendering them stranded and unprofitable as they become less viable in a decarbonised economy. According to Scott, et al., (2017: 102-103), The International Energy Agency (IEA) estimates that an additional $26 trillion in investment in renewables and energy efficiency will be required to achieve the 2°C target, which may lead to a significant devaluation of fossil fuel assets. Examples, such as the 95% decline in market capitalisation of top US coal producers since 2010, illustrate the potential for disruptive changes in asset valuations driven by climate public policies, technological advancements, and customer change preferences (Scott, et al., 2017:102-103).

The financial risk of an abrupt transition to a low-carbon economy may escalate if investment portfolios remain misaligned with climate targets, potentially culminating in a “Climate Minsky Moment” – a sudden, system-wide adjustment that jeopardises financial stability (Scott, et al., 2017:103-104). Scott, et al., further state that failure to adapt investment strategies to conform to climate policies may lead to a profound mismatch, triggering a rapid re-pricing of carbon-intensive assets with far-reaching implications beyond direct financial losses, including reduced productivity and economic growth. Hence, a smooth and orderly transition is necessary to save markets from sudden economic shocks.

2.4.5.5 Regulatory Risk

Climate change induces market uncertainty due to evolving regulatory frameworks aimed at mitigating its effects (Wills & Keyes, 2017). Governments implement regulations to limit GHG emissions, increase production costs and capital expenditure requirements (Díaz-Noriega, et al., 2020; Wills& Keyes, 2017), which impacts firm performance (Hwan & Hee, 2018; Mahapatra, 1984). Raising operational complexities and regulatory compliance costs diminish financial outcomes (Hwan & Hee, 2018). Furthermore, regulatory uncertainty constrains proactive climate change strategies and carbon management accounting practices, hindering adaptive responses by companies (Bui & de Villiers, 2017). However, Porter argues that strict environmental regulations stimulate innovation, production technology advancement, and improved output (Porter & Linde, 1995).

2.4.5.6 Reputational Risks

Environmental issues will significantly impact business transactions, with unforeseen liabilities posing a competitive disadvantage. Companies must integrate environmental liability into their policies and practices through effective risk management to mitigate this risk (Cuddihy, 2000). This enables businesses to anticipate and avoid ecological damage expenditures, minimise future regulatory compliance costs, and reputational risks and translate these liabilities into monetary terms.

A company's commitment to addressing climate change can have a profound impact on its intangible assets, such as brand reputation, customer trust, employee loyalty, and social licence to operate (Wills & Keyes, 2017). Non-compliance with GHG emissions regulations risks customer boycotts, fines, and reputational damage, promoting institutional investors to engage with companies and drive shareholder resolutions on climate risk management (Wills & Keyes, 2017). However, companies that comply enhance their reputation in the markets and achieve improved economic performance.

2.4.5.7 Liability Risk

The concept of liability risk in the context of climate change is a rapidly evolving area of research. Massey, et al., (2021) highlight the importance of considering climate change impacts to avoid legal liability while Mason (2020) provides a comprehensive analysis of the legal frameworks and theories underlying climate change liability. Kumar, (2020) examines the role of disclosure and transparency in managing climate-related risks, while Hwang (2020) explores the governance and management strategies necessary to mitigate liability risks. These studies demonstrate the critical need for entities to prioritise climate change considerations to avoid legal liability and ensure long-term sustainability.

The Bank of England describes liability risk as the risk that arises from companies' exposure to legal claims related to their role in climate change, inadequate risk management, or deceptive reporting practices (Bank of England Prudential Regulation Authority, 2015:5). This risk can result in financial penalties, legal liabilities, and reputational damage, impacting on firm financial performance, hence the need for effective climate risk management. However, liability risk can be mitigated if those charged with governance act in good faith, with the utmost care, skill, and diligence, prioritising the company's interests, and exercising the same level of prudence and attention that a diligent and experienced business professional would demonstrate in similar circumstances (Zimbabwe Companies and Other Business Entities: Cap. 24:31, 2019:96). In the context of climate change, directors have a legal duty to consider and manage financial risks that are foreseeable and material to the company. Such engagements by directors in planning are meant to protect the company from possible financial losses either through climate impacts or third-party legal actions against the company when it fails to fulfil contractual obligations.

2.4.6 Climate Change Risk and Firm Capital Structure

Climate risks challenge traditional capital structure theories like Modigliani-Miller (M & M), as firms reassess equity and debt decisions under environmental pressures. High-emission firms often pay lower dividends due to earnings uncertainty and reputational damage, which depress sales and profitability (Balachandran & Nguyen, 2018.). Studies reveal that greater climate risk exposure correlates with reduced leverage, reflecting risk aversion by firms and lenders, and constraints on growth opportunities (Miah , et al., 2021). This underscores the need to update financial theories to incorporate environmental externalities affecting firm financing and value.

Climate change mitigation depends heavily on capital from equity and debt providers to fund GHG reduction and adaptation efforts (Bhandary , et al., 2021). However, firms often hesitate to internalise environmental costs due to low CSR returns, lender risk aversion toward low-carbon technologies, and information gaps, limiting access to climate finance (Bhandary , et al., 2021).

Investors increasingly value proactive climate risk management, as firms that transparently report climate risks reduce information asymmetry, boosting investor confidence and firm value (Hwan & Hee, 2018). Companies in high climate-risk regions face higher capital costs due to perceived vulnerabilities, necessitating stronger risk mitigation to reduce financing expenses (Parka & Noh, 2018; Hwan & Hee, 2018).

2.4.6.1 Carbon Risk and Cost of Debt Capital

Research shows that firms with high carbon risk face elevated borrowing costs and restricted credit access, as lenders grow cautious of climate vulnerabilities (Owolabi, et al., 2024). Companies in high-risk areas tend to be less productive and profitable, exacerbating financial constraints (Cevik & Miryugin , 2022). Conversely, lenders reward firms demonstrating strong climate mitigation with lower-cost debt across industries (Lee & Choi, 2021; Wang, et al., 2022). However, manufacturing firms in developing regions often face a vicious cycle where climate vulnerability drives up debt costs, limiting adaptation capacity and undermining financial performance (Trinh, et al., 2024).

2.4.6.2 Carbon Risk and Cost of Equity Capital

Empirical evidence links superior environmental performance to higher stock prices and market valuations, while firms with large carbon footprints face valuation discounts due to heightened risk perceptions (Trinks, et al., 2017). Carbon premiums reflect investor willingness to pay more for low-carbon firms, lowering their cost of equity, whereas high emitters face increased equity costs (Oestreich, & Tsiakas, 2015; Parka & Noh, 2018; Bolton & Kacperczyk , 2021; Nguyen, et al., 2025). Nonetheless, debate persists about the carbon premium’s existence: some find higher returns compensate for climate risks (Oestreich & Tsiakas, 2015), while others argue limited investor understanding prevents effective carbon risk pricing, causing market inefficiencies (Wang, et al., 2022).

2.4.6.3 Climate-related Risks Influence on Firm Value

This section examines how climate-related risks, regulatory pressures, and strategic adaptation influence firm valuation, highlighting their role in shaping financial performance and investment attractiveness. Evidence from (Kurnia, et al., 2021) illustrates contrasting outcomes: in Indonesia, carbon emission disclosure enhances firm value by signaling competitive advantage, whereas in Australia, the associated disclosure costs outweigh benefits, ultimately reducing cash flows.

Climate-related risks increase uncertainty around future cash flows, raising discount rates and market risk premiums as investors demand higher returns (Karydas & Xepapadeas, 2018; ACCA, 2022).Transition risks, such as divesting from carbon-intensive assets, can erode shareholder wealth by rendering assets unproductive and companies unprofitable (Miah , et al., 2021). Accurate pricing of these risks is essential for efficient capital allocation and informed investment decisions. Rauh & Zeeuw, (2022) warn that the shift from a brown to green economy may distort capital allocation, raise financing and labour costs, and create market inefficiencies. This transition tends to advantage large firms capable of leveraging resources to invest in low-carbon technologies and supply chain upgrades, potentially enhancing their financial performance. As climate action intensifies, carbon risk will increasingly influence firms' cost of capital and their capacity to fund sustainable investments.

2.4.7 Climate Change and Sustainable Business Strategies

Climate change poses complex risks to environmental, human, and economic well-being, driving the need for sustainable business practices that balance ecological stewardship with long-term profitability (Cantore, et al., 2016; Raiser, et al., 2017). Achieving a low-carbon economy requires sustainable industrial development, technology transfer, and efficient energy management (Zakari, et al., 2022). Technological innovations, particularly Industry 4.0, enhance climate mitigation by improving energy efficiency, emissions reduction, and operational safety in manufacturing (Payel, et al., 2023).Such innovations are crucial for transforming production processes and economic development, yet their success depends on strong political support to drive adaptation efforts.

While technology can boost resource and energy efficiency and promote renewable energy use in manufacturing (Van den Bergh, 2013), challenges remain. Rebound effects may reduce net gains (Balaid , et al., 2020a), and technology availability alone does not ensure effective mitigation. Cleaner production through eco-innovation shows promise for reductions but suffers from limited data for decision-making (Munodawafa & Johl , 2019). Big data offers potential to optimise production and emissions control, though implementation issues such as data quality and privacy are significant, especially in SSA (Munodawafa & Johl , 2019).

A critical focus for manufacturing is improving boiler efficiency, given fossil fuels supply 85 per cent of global energy and drastic reductions require massive investment in carbon-free power generation, which may strain developing economies reliant on fossil fuels (Kalghatgi, 2020), Although technological innovations can improve environmental performance, they often demand high capital investments that may offset efficiency gains (Ferrat, 2021). Nonetheless, innovation remains vital for mitigating carbon emissions and enhancing firm competitiveness by enabling sustainable growth and meeting evolving customer demands (Porter, 1980). By optimising processes and adopting smart technologies, manufacturers can achieve significant energy savings, boost productivity, and promote sustainability.

2.4.7.1 Carbon Capture and Storage

Carbon Capture and storage (CCS_1) is a crucial technology for reducing industrial emissions in hard-to-abate sectors like the manufacturing sector. By capturing carbon emissions from sources like cement factories and natural gas wells, and storing them underground, CCS_1 can significantly mitigate climate change impacts while supporting a low-carbon transition. Because fossil fuel is responsible for the larger proportion of carbon emissions, there are only two ways to achieve a carbon-neutral economy: either to ban the extraction and use of fossil fuel or to capture and store any carbon produced in the fossil burning, and manufacturing industries (Mitchell-Larson , et al., 2020). However, banning the use of fossil fuels is not feasible if renewable sources of energy are not sufficient to meet the increasing energy demand.

Technological advancements in the manufacturing process that reduce carbon emissions are essential if the global economy is to achieve the net zero carbon emission goal. A combination of fossil alternative energy sources and carbon capture and storage are vital in achieving this goal. For example, research at Larfage Cement production has yielded promising results in reducing carbon emissions in the cement production process. Cement manufacturing contributes about 8% of global carbon dioxide emissions through fossil-fuel heating and decomposition of limestone (Lu, et al., 2024), however, technical research shows that decarbonisation through the electrochemical process is emerging as a promising strategy for addressing carbon emissions within the industry. This innovative technique holds the potential to integrate carbon capture, circulation, and storage systems, thereby progressing towards the objective of achieving carbon-neutral or even carbon-negative cement production.

Carbon capture and storage is a carbon reduction strategy used by heavy carbon-emitting industries, large-scale power generators and hard-to-abate sectors to harvest carbon dioxide for economic use (Bhavsar, *et al.*, 2023; The Royal Society, 2021; Underschultz,*et al.*, 2016). This technique involves capturing carbon and isolating it from the atmosphere, and then making an economic use of the gas in future. Given the cost implications of this strategy Bhavsar, (2023), posited that this strategy should be considered as the last line of defence in heavily polluting industries. This technique is a form of the carbon take-back obligation policy, which makes carbon producers responsible and accountable for carbon they produce (Kuijper , et al., 2021). CCS is ideal for heavy carbon emitters such as fuels, cement, chemical, and iron and steel manufacturers. The emissions can come from various sources, including chemical reactions, fugitive emissions, refrigeration and air conditioning, and emissions from product use (Haszeldine, 2021).

Current climate change efforts aimed at achieving carbon neutrality are insufficient in the absence of the adoption of CCS_1 technology by heavy carbon emitters (Witte, 2021). Carbon capture has therefore emerged as the preferred carbon reduction strategy. Emerging from CCS_1 is carbon capture utilisation and storage (CCUS) which goes beyond just storage but extends to future use of the captured carbon in oil fields, treatment of alkaline industrial waste, and conversion of carbon into some other chemicals to make GHG economically viable. According to Bhavsar, *et al.*, (2023), and Underschultz, *et al*., (2016), the harvested carbon dioxide is made useful in the following ways: enhanced oil or gas recovery, carbon dioxide feedback in the production of fuel and chemicals, mineralization or non-geological storage of carbon, desalination and water production, and methanol Synthesis Process.

Bhavsar, further states that in addition to carbon capture and storage, sequestering carbon in deep geological formations is an important strategy which offers the advantage of lowering carbon without reducing industrial output. However, there are some obstacles to the implementation of CCS_1, in the transition to a low-carbon economy. There is a need to increase public awareness and perception of CCS_1 if it is to be socially accepted. There is still a dearth of market incentives and restrictions, and government regulations to allow the transportation and storage of carbon and the capital outlay involved in CCS_1 technology is inhibitive, especially to capital-starved businesses (Bhavsar, et al., 2023). However, for CCS_1 strategy to be effective, economic policies to promote its uptake should be put in place, especially if the investment is to pay back before it is replaced by zero-carbon energy options. Government policies such as subsidies in CCS_1 technology, technology-based performance standards, and carbon pricing through emissions trading and taxes are vital in driving economies towards a low-carbon economy. Governments can make it mandatory for firms that any carbon produced should be balanced by its storage (Haszeldine, 2021).

Mandatory carbon take-back obligation policies are a cost-effective strategy that is more acceptable to developing nations as compared to cap–and–trade regime which is not flexible. Whilst the benefits of using CCS_1 technology in carbon reduction are clearly defined, the effects of using this technology in future are not, especially given the possibility of underground carbon reservoir leaks (Yelebe & Samuel, 2015). The deployment of CCS_1 technology in future is a matter of the business case, dependent on several factors such as the price of carbon, regulatory constraints imposed by regulatory authorities on emitters, technological advances that are capable of reducing carbon emissions and the costs associated with implementing CSS1 (Underschultz, et al., 2016).

2.4.7.2 Energy Efficiency in the Manufacturing Sector

The manufacturing sector is at a crossroads, torn between economic objectives and sustainability goals (Dolge, et al., 2021). However, energy efficiency strategies can reconcile these competing interests, yielding environmental benefits, cost savings, and improved economic viability, ultimately strengthening global market competitiveness (Dolge, et al., 2021). To achieve improved energy efficiency, there is need for increased technological innovations. However, Marti-Ballester, (2017) suggests that enhancing energy efficiency and adopting sustainable energy sources do not yield significant improvements in corporate financial performance.

The integration of combined heat and power (CHP) technology has emerged as a vital component of a low-carbon paradigm, offering a multifaceted approach to mitigating climate change by optimizing energy conversion, reducing energy losses, and minimising carbon footprint (Bonilla, et al., 2002). Cogeneration, or combined heat and power (CHP), has emerged as a vital strategy for enhancing industrial competitiveness. By simultaneously generating electricity and heat from a single fuel source, CHP increases energy efficiency, reduce costs, and minimises environmental impact (Brown , et al., 2013). This synergistic approach benefits manufacturers in several ways.

The competitiveness-enhancing effects of CHP are multifaceted. Cost leadership is achieved through reduced energy costs, while differentiation is attained through environmental benefits and energy efficiency. Furthermore, increased productivity results from reliable energy supply and reduced downtime.

International frameworks like the Paris Agreement and the United Nations Sustainable Development Goals (SDGs) promote collaborative efforts to address climate change. The Paris Agreement (Article 10) and SDGs 9 and 12 emphasis the need for sustainable industrial development, technology transfer, and efficient resource management, which enables energy efficiency, necessary for the achievement of a low-carbon economy (Zakari, et al., 2022).

Technological innovations can strategically enhance climate change mitigation and adaptation efforts by leveraging digital technologies in predictive analytics, data-driven policy decision-making, and optimised resource allocation, thereby improving the efficacy and efficiency of national climate change strategies (Lee & Mwebaza, 2022). Nwankwo, et al., (2020) note that innovative technology in green technology plays a crucial role in reducing corporate carbon emissions, and in improving firm competitiveness. As such, the integration of industry 4.0 technologies in boiler operations provides the potential to yield improved energy efficiency, emissions reduction, and enhanced safety protocols (Payel, et al., 2023). These technologies such as Industry 4.0 are essential in improving the production process and transforming economic development patterns. However, these innovative technology initiatives need to be anchored by political will and would drive vital adaptation projects that can lessen the devastating effects of climate change on manufacturing firms.

Combating climate change requires addressing its impact on production and consumption patterns. Technological change can help by improving resource efficiency, increasing energy efficiency (Stern, 2007) and promoting use of renewable energy in the manufacturing sector (Van den Bergh, 2013). However, even with advanced technology and innovations, rebound effects can occur (Balaid , et al., 2020a) and technology availability alone does not guarantee effective climate change mitigation and adaptation. Cleaner production through eco-innovation can play a key role in reducing CO_2 emissions and supporting sustainable development but lacks sufficient data for informed decision-making (Munodawafa & Johl , 2019). Big data technology can bridge this gap, providing firms with valuable insights to optimise production and mitigate emissions. However, this assertion by Munodawafa & Johl, (2019) overlooks potential challenges and limitations in implementing big data technology, such as data quality, privacy, and integration issues.

An area where manufacturing industries should focus their attention on is the efficiency of boilers in the manufacturing sector. According to Kalghatgi, (2020), 85% of the global energy needs are supplied by fossil fuel and reducing this by 60% will require the world to build new energy capacity of about 9.4-Terawatt (TW) carbon-free continuous power, such as solar or nuclear power. This means the existing energy infrastructure of oil, gas, steel, aviation and cement manufacture must be dismantled (Kalghatgi, 2020). Such changes are unlikely to happen as they will leave many assets stranded, huge unemployment and will cripple the economies of developing nations that lag in technological development and still rely on fossil fuel for powering industrial operations.

As noted by Ferrat, (2021), the adoption of technological innovations aimed at reducing carbon emissions can lead to improved environmental performance, but may also require significant investments in capital goods, potentially offsetting the cost benefits of production efficiencies. However, (Porter, 1980) argues that innovation can play a crucial mitigation role in the relationship between carbon emissions and firm performance, enabling companies to achieve sustainable growth and competitiveness by identifying novel opportunities to meet evolving customer needs, developing solutions to reduce carbon emissions, and improving overall performance and competitiveness. By optimizing processes, upgrading equipment, and implementing smart technologies, manufacturers can unlock significant energy savings, enhance productivity, and contribute to a more sustainable future.

2.4.7.3 Transitioning to Renewable Energies

As the manufacturing sector seeks to reduce its reliance on fossil fuels, renewable energy emerges as a vital strategy for mitigating climate change. Harnessing power from solar, wind, hydro, and geothermal sources can significantly decrease GHG emissions, operating costs, and dependence on volatile energy markets, as such governments are bolstering their climate change policies to facilitate a transition to a low-carbon economy (Busch & Hoffmann, 2011). According to Barnard, (2014), the IEA & World Energy Outlook (WEO) predicts that the future of human prosperity hinges on the ability of technological advancement to secure a reliable and efficient source of renewable energy and achieving a low-carbon, efficient, and environmentally friendly system of energy supply. This shift is of paramount concern to external stakeholders, particularly considering dwindling fossil fuel reserves and price increases, which have a profound impact on manufacturing costs. Moreover, the imperative to GHG emissions across various industries has led to additional expenses, prompting corporations to adopt strategies that promote the development of renewable energy and low-carbon management models.

SSA's vast renewable energy potential remains underutilised due to various obstacles, including inadequate policies, limited technology diffusion, and financial constraints (Haruna, et al., 2023). This underutilisation exacerbates carbon risk for manufacturing firms, threatening their performance and competitiveness. The financing of renewable energy initiatives faces economic, commercial, and regulatory hurdles (Owusu-Manu, et al., 2021) hindering the transition to a low-carbon economy. Addressing these challenges is crucial for unlocking the region's renewable energy potential, mitigating carbon risk, and enhancing firm performance.

The global energy sector faces two key challenges: decarbonisation and reliability. While renewables excel at reducing emissions, their intermittent nature calls for complementary solutions. Nuclear energy, with its high-capacity factors (over 90%) and its recent classification as a green energy source (EU, 2022), offers a compelling option for ensuring a stable and clean power supply (SDG 7) (Awogbemi et al., 2024). This paradox requires a thorough examination of nuclear energy's role within the evolving energy landscape. However, the high capital expenditure element involved may elbow developing countries out of this energy solution.

2.4.7.4 Climate Disclosure and Firm Performance

While often mandated, proactive reporting (like following TCFD or GRI standards)is a strategy to reduce information asymmetry between the firm and its investors. As climate risks escalate, stakeholders increasingly demand transparency in governance and climate risk management, making robust climate-related financial disclosures essential for informed decision-making (Megeid, 2024). Investors, lenders, and underwriters rely on disclosures to evaluate a firm's climate responsiveness. Though accounting standards do not explicitly mandate climate reporting, material climate risks must be disclosed to support resilient financial systems, aligning with TCFD guidelines (Megeid, 2024).

For manufacturing firms, transparent climate risk reporting is critical to managing risks, meeting investor expectations, and enhancing long-term financial performance (KPMG & Eversheds Sunderland, 2020:19). Omitting climate disclosure risks incomplete financial information, potentially misleading markets. Regulatory adoption of international climate reporting standards is increasing accountability, directly influencing firm sustainability and financial outcomes (Farooq & Muhammad, 2025; Fard, 2012).

Integrating ESG factors through effective climate risk management strengthens company resilience and financial performance (Friede , et al., 2015). However, carbon risk disclosure has mixed effects: it can improve market efficiency and access to finance but may also trigger capital flight from high-risk firms and enable "greenwashing," raising stakeholder scrutiny (Cooper, 2020; Qing, et al., 2023). Businesses manage climate risks not only for sustainability but also to optimise financial performance, attracting investors who value effective risk management (Hwan & Hee, 2018). Disclosure of greenhouse gas emissions enhances governance, reputation, and profitability, offering economic benefits and competitive differentiation (Lee & Lee, 2022).

2.4.8 Challenges to Climate Change Adaptation in LDCs

Least Developed Countries (LDCs) are battling with dual challenges of industrial development and climate change. Whilst manufacturing companies in LDCs play a crucial role in driving economic growth, creating employment opportunities, and contributing to national development they however make a significant contribution carbon emissions and other GHG pollutants, making it a crucial player in the transition to a low-carbon and sustainable economy (Karduri, 2018). However, their path to a low-carbon future is faced with significant challenges and difficulties owing to different factors.

According to (Jabbour, et al., 2015: 245-257) a successful transition to a low-carbon economy is influenced by cultural, legal, technological, political, business strategy, and supply chain efficiency. These factors intersect and influence one another, underscoring the complexity of transitioning to a sustainable economic model. Karduri, (2018) claims that manufacturers face many challenges in reducing their carbon footprint namely, technological hurdles, energy intensity, financial resources, supply chain, regulatory compliance, and behavioural change. These challenges are even more acute in SSA, where firms struggle to address climate change due to high upfront investment requirements for capital equipment and climate technologies, limited technological access, internal skills shortages. Weak regulatory frameworks, and low carbon pricing (Kouloukoui, et al., 2025). These factors collectively undermine effective decarbonisation efforts by companies in the region.

The decarbonisation challenges are more pronounced in LDCs, where resource constraints and capability gaps hinder corporate transition efforts, making it necessary for national governments to intervene and facilitate a successful low-carbon transition. Governments now acknowledge the pivotal role of energy conservation and environmental technologies in fostering business competitiveness, thereby spearheading the formulation of innovative carbon-related policies and regulations that shape the trajectory of low-carbon technology development (Sun, et al., 2020).

2.4.9 Climate Change Sustainable Developments in SSA

Realizing a decarbonized society, as envisioned by the Paris Agreement (2015), requires a transformation of the economic and societal system (Arimura & Matsumoto, 2021). Rapid economic growth in emerging economies has led to increased carbon emissions (Yang & Luo, 2020). To achieve the 1.5-degree Celsius goal and net-zero GHG emissions by 2030, countries must decarbonize their economies (Kumar, et al., 2025). This requires businesses to invest in new technologies and pay carbon taxes for non-compliance and SSA should not be left behind as the world transitions towards a low-carbon economy.

The Kyoto Protocol (1997) pioneered carbon credit markets, and Article 6.4 of the Paris Agreement mandates member states to establish such markets, fostering a global market and carbon financial markets (Yang & Luo, 2020).These developments in the carbon credit markets present a lucrative opportunity for SSA countries to generate revenue. The Congo basin, for instance, could capitalise on its vast forest cover by selling carbon credits to private companies in developed economies seeking to offset their emissions (Belianska, et al., 2022). This revenue stream could constitute a substantial source of finance for climate-related projects in SSA, thereby fostering sustainable development and climate resilience in the region. By harnessing the potential of carbon credits, SSA countries can align their economic development with global climate goals, fostering a sustainable future for generations to come.

2.4.10 Policy And Regulatory Environment for Climate Change

Governments are encouraged to use fiscal tools like carbon pricing (taxes, cap-and-trade) and financial incentives (subsidies, rebates) to curb energy consumption and promote efficiency, aligning with climate goals (Bernal & Ocampo, (2020). The Paris Agreement (2015) has accelerated policy actions worldwide, promoting countries to adopt measures such as carbon disclosure mandates and green investment initiatives to redirect finance towards low-carbon development (Steffen, 2021).

Post-Kyoto, climate regulations have become more coordinated globally, focusing on transparency, carbon reduction, and financial system resilience to support sustainable economies (Ozturk & Toprak, 2025). Market-based mechanisms like cap-and-trade (CAT) effectively reduce emissions and stimulate clean energy innovation, especially when paired with robust carbon pricing, however, poorly designed caps can undermine incentives (Lessmann & Kramer, 2024). Carbon taxes also drive emissions reductions but increase operational costs, potentially reducing profits and raising consumer prices, as seen in energy-intensive sectors like cement manufacturing (Kumar, et al., 2025)

Governments must enforce climate policies, while businesses need to develop strategies to manage risks and comply with regulations (LIGS University , 2024). Policy measures such as removing fossil fuel subsidies, implementing carbon pricing, and enhancing energy efficiency standards encourage shifts toward renewables and reduced emissions (Tsai , 2020). For example, higher fossil fuel costs incentivise energy efficiency improvements in industrial boilers.

Manufacturing firms under stringent emissions caps, like emissions trading schemes (ETS), show improved environmental performance and increased green innovation, particularly when supported by strong financial resources and governance (Ren, et al., 2022). However, high R&D costs limit smaller firm's ability to innovate, raising concerns about the capacity of firms in developing economies with weaker financial and governance structures to respond effectively to such policies (Nguyen, et al., 2024).

2.4.11 Zimbabwe's Climate Change Regulatory Landscape

Zimbabwe's environmental governance framework is anchored in the Environmental Management Act (2002) and Regulations (2009), which provide the legal foundation for environmental conservation and management. Although the Climate Change Response Act (2019) is yet to be gazetted, it is poised to establish a dedicated legal framework for climate change mitigation and adaptation. In the interim, existing legislation, including the Forest Act, and Energy Act, are being leveraged to address carbon emissions and environmental protection, demonstrating a piecemeal approach to climate governance. This fragmented legal landscape underscores the need for a comprehensive and integrated legal framework to address the complexities of climate change effectively.

According to Section 64 of the Environmental Management Act (Chapter 20:27), the operation of any trade or establishment is prohibited from emitting substances or energy that may cause or contribute to air pollution, unless an emissions licence has been obtained from the relevant authorities (Zimbabwe Environmental Management

Act, 2002). Furthermore, section 149 (b) empowers the Minister, in consultation with the Agency, to promulgate regulations that affect the control or prohibition of activities detrimental to the ozone layer, including the restriction or prohibition of appliances, equipment, or devices that utilise or contain ozone-depleting substances (Zimbabwe Environmental Management Act, 2002). This legislation aims to mitigate the harmful impacts of air pollution and ozone depletion.

Failing to comply with environmental laws has led business entities to face fines and, in some cases, closure. However, manufacturing and mining companies' efforts to reduce GHG emissions are hampered by lack of pollution prevention equipment (Machingura & Zimwara, 2020). In 2024, EMA fined and shut down two mines for operating without the necessary environmental impact assessment certificates (Maphosa, 2024). One of these companies incurred a fine of USD$15000, significantly affecting its bottom line. Previously, in 2020, the authority closed a tiling company due to non-compliance with regulations requiring manufacturers to install carbon emissions sampling points (Herald, 2020). Changes in energy utilization and environmental legislation are positively impacting how manufacturers conduct their business and their commitment to environmental stewardship.

Recent developments have led the government of Zimbabwe to propose introducing the National Energy Efficiency Policy. The policy aims to reduce energy costs, enhance industrial competitiveness, and mitigate climate change by optimising energy utilisation, aligning with global sustainable developmental stewardship objectives (Chingwere, 2024).

Despite growing global recognition of the critical link between climate change and firm performance, empirical evidence regarding this relationship within the context of Zimbabwe's manufacturing sector remains scarce. While international studies have yielded mixed results, some indicating that climate risk management enhances firm profitability and market value, others suggesting increased costs and potential negative impacts, there is limited understanding of how these dynamics manifest in

Zimbabwe, a highly climate-vulnerable and resource-constrained developing economy. This knowledge gap is significant because manufacturing firms in Zimbabwe operate under unique environmental, regulatory, and socio-economic conditions that may alter the typical climate-performance relationship observed elsewhere. Addressing this gap, is essential for informing local policy, guiding corporate climate strategies, and ensuring that the sector's resilience amid escalating climate risks. This thesis aims to fill this gap by empirically examining how climate-related risks, governance mechanisms, and stakeholder pressures influence the financial performance of listed manufacturing firms in Zimbabwe, thereby providing context-specific insights that can support sustainable industrial development and climate resilience in the country.

2.5 CHAPTER SUMMARY

This chapter explored the nexus between climate change and firm performance in the context of manufacturing firms. The literature shows that climate change can affect firms through physical disruption, transition risk, regulatory cost, reputational exposure and access to capital. However, the empirical relationship between climate-related practices and firm performance remains contingent on sector, country context, measurement choices and time horizon. Climate-finance studies show that investors price climate and carbon risk in some contexts (Krueger, Sautner & Starks, 2020; Bolton & Kacperczyk, 2021; Ilhan, Sautner & Vilkov, 2021), but evidence from Sub-Saharan African manufacturing firms remains limited. The Zimbabwean setting is therefore analytically useful because listed manufacturing firms operate under simultaneous climate vulnerability, energy insecurity, inflationary pressure, regulatory uncertainty and growing sustainability-disclosure expectations. The present study addresses this gap by combining panel-based quantitative evidence with qualitative documentary analysis, thereby examining both statistical associations and the governance mechanisms through which firms respond to climate-related pressures.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 INTRODUCTION

The previous chapter explored the existing literation on climate change, theories, awareness, risks, and strategies that manufacturing companies adopt in mitigating the climate-related impacts on the operations of manufacturing companies. The study seeks to critically examine the relationship between climate change and firm performance, with a focus on financial implications, examine the moderating effects of climate change governance on the relationship between climate-related risks and firm performance; to determine how internal and external factors intersect to constrain climate change adaptation, and to develop a framework for assessing the climate change adaptation and mitigation practices by Zimbabwean manufacturing companies.

This chapter outlines the research methodology adopted to investigate the relationship between climate change and firm performance. A detailed examination of the research philosophy, approach, strategy, and methods is presented, ensuring a comprehensive understanding of the research process. The chapter discusses the underlying research philosophy approach, and strategy, followed by an explanation of the research techniques and procedures, including data collection and analysis methods. Additionally, the chapter addresses concerns related to reliability, validity, and ethical considerations, and describes the pilot study conducted to validate the research instruments. By providing a transparent and rigorous account of the research methodology, this chapter establishes the foundation for reliable, valid, and generalisable findings, contributing to the existing body of knowledge on climate change and firm performance.

This study is treated as an exploratory mixed-methods documentary study using a short longitudinal firm-year panel for the quantitative component and documentary thematic analysis for the qualitative component. The quantitative dataset covers 13 listed manufacturing firms observed over four financial years, 2021 to 2024, producing 52 firm-year observations. The qualitative component examines publicly available annual reports, sustainability disclosures, company websites, Zimbabwe Stock Exchange materials and relevant government or industry documents. The two strands are integrated through triangulation, with the qualitative evidence used to explain, contextualise and qualify the panel results rather than to substitute for econometric inference.

3.2 PURPOSE OF RESEARCH

Research has been defined as a deliberate, systematic, and rigorous inquiry into a specific phenomenon, entailing a meticulously designed process to address research questions (Ugwu, Ekere & Onoh, 2021; Khatri, 2020). This process involves a comprehensive and structured approaches to collect, analyse, and interpret data to provide answers to research questions, ultimately yielding a nuanced understanding of the phenomenon under investigation. Ugwu, et al., (2020) posit that research serves as a versatile instrument for resolving complex problems, tackling societal challenges, and acquiring new knowledge. Consequently, researchers must possess a profound comprehension of the research process and its constituent elements to harness its full potential. Makombe, (2017) identifies four fundamental components of research: research paradigm, methodology, design, and method. These interconnected elements form the backbone of a research study, guiding the investigator's approach and ensuring a systematic inquiry.

3.3 RESEARCH PHILOSOPHY AND PARADIGM

According to Kuhn, (1962), a research paradigm represents a philosophical way of thinking, while Guba & Lincoln, (1994), define research paradigm as a basic system that informs research. Okesina, (2022) further clarifies that a research paradigm reflects a researcher's philosophical orientation that shape research questions, methodology, and interpretation of research findings. The choice of paradigm is critical, as it determines the intent, motivation, and expectations of the research (Guba & Lincoln, 1994). Therefore, researchers must explicitly identify and justify their research paradigmatic stance to ensure a coherent and rigorous research approach.

A research paradigm embodies the foundational principles that shape a researcher's worldview, influencing how they perceive, interpret, and interact with reality (Khatri, 2020). Kivunja and Kuyini, (2017) emphasise that research paradigms play a crucial role in guiding scholars' inquiry, dictating what warrants investigation and how findings should be interpreted. By defining a researcher's philosophical orientation, research paradigms have far-reaching implications for every research decision, from the nature of reality and knowledge sources to methodology and methods. Consequently, all research endeavours are anchored in underlying philosophical assumptions, underscoring the importance of paradigmatic clarity.

The fundamental perspectives and assumptions that underpin a research paradigm, encompassing reality, knowledge, methodological approaches, and values, collectively constitute its core components. A research paradigm is composed of four interconnected elements: epistemology, ontology, methodology, and axiology (Guba & Lincoln, 1985:107; Kivunja & Kuyini, 2017; Ngulube, 2022:442). Together, these elements form a cohesive framework that shapes the research process and informs every aspect of the inquiry.

3.3.1 Ontology

Ontology deals with the theory of reality (Khatri, 2020). Ontology, a fundamental branch of philosophy, scrutinises the underlying assumptions that shape our understanding of reality, existence, and social phenomena (Scotland, 2012). According to Kivunja & Kuyini, (2017), ontology examines the researcher's belief system, probing the nature of being, existence, and the basic categories of entities and their relationships. By uncovering these philosophical assumptions researchers can elucidate their epistemological stance, informing how they construct meaning from data and approach research problems. In essence, ontology orients a researcher's thinking, shaping their understanding of a problem's significance, approach, and potential solutions.

3.3.2 Epistemology

Epistemology, a vital component of research paradigms, concerns the theory and philosophy of knowledge, examining how knowledge is acquired, constructed, and validated from diverse sources (Khatri, 2020). It encompasses the study of the nature, scope, and limits of knowledge and the methods and criteria used to evaluate knowledge claims. Epistemology interrogates the nature of knowledge within a discipline, encompassing the processes of knowledge acquisition and validation (Saunders, Lewis & Thornhill, 2007:103). Saunders, et al, further state that epistemology critically examines the dynamics between the knower (researcher) and the known (phenomenon), enabling an understanding of how knowledge is constructed, evidence is gathered, and beliefs are justified. According to Kivunja & Kuyini, (2017), the researcher's epistemological stance is crucial in positioning themselves within the research context, enabling the discovery of novel insights beyond existing knowledge. To articulate their epistemological approach, researchers can draw from four knowledge sources: intuitive (beliefs, faith intuition), authoritative (expert opinions, literature), logical (rationalist epistemology), and empirical (sense experiences, objective facts) (Slavin, 1984). Epistemology plays a vital role in establishing the researcher's approach to uncovering knowledge in the social context. By acknowledging their epistemological assumptions, researchers can ensure a rigorous and transparent research process. It determines the adoption of a research methodology, for example quantitative, qualitative, and mixed method study.

3.3.3 Axiology

Axiology, a crucial component of research paradigms, focuses on the ethical dimensions of research, encompassing the principles and values that guide researcher's behaviour. It involves defining, evaluating, and understanding the moral concepts of right and wrong, ensuring that research is conducted with integrity, respect, and responsibility (Kivunja & Kuyini, 2017). In essence, axiology serves as the moral compass for research, shaping the decisions and actions of researcher throughout the research process (Khatri, 2020).

Research philosophy constitutes the foundational epistemological and ontological assumptions that underpin the research endeavour, informing the methodological choices and shaping the construction of knowledge (Winit-Watjana, 2016). It embodies the researcher's paradigmatic stance, influencing the inquiry process and the interpretation of findings.

A research philosophy underpins the design and methodology of a study, shaping assumptions about knowledge and reality. This foundational framework influences the research approach, dictating the methods used for data collection and analysis (Mbanaso, et al., 2023). Positivism, interpretivism, and pragmatism are common philosophies that guide research, each with distinct assumptions and implications. According to Gannon, et al., (2022), the selection of a research philosophy is pivotal in crafting a study that adeptly addresses complex research problems. This foundational choice serves as a demarcation between novel investigations and extant literature, underscoring the necessity for an innovative approach to inquiry. By choosing an appropriate research philosophy, researchers can ensure a cohesive and rigorous investigation that contributes meaningfully to the existing body of knowledge (Gannon, , et al., 2022).

3.3.4 Positivism

Positivist, an ontological stance, underpins natural scientists' focus on observable social reality, aiming to generate law-like generalisations akin to scientific findings (Saunders et al., 2007:103). Saunders et al., further state that this approach employs extant theory to formulate hypotheses that inform research design and data collection strategies. Subsequent hypotheses testing and confirmation (total or partial) or refutation led to iterative theory development, subject to further empirical scrutiny and refinement. The researcher maintains objectivity, remaining independent and detached from the research subject, with no mutual influence or impact.

Paradoxically, pursuing a value-free perspective in research reveals an inherent value position. As Gill & Johnson, (2002) astutely observe, positivist researchers often adopt a highly structured methodology to facilitate replication, prioritising quantifiable observations and statistical analysis. This approach underscores the tension between objectivity and the researcher's implicit values, highlighting the need for critical reflection in research design (Saunders, et al. 2007:104). However, this approach has been criticised for neglecting the complexity of social phenomena and the researcher's influence on observations.

In response, post-positivism emerged, combining elements of positivist and interpretive paradigms. It adopts critical realist ontology, acknowledging an independent reality but recognising the imperfect nature of its apprehension due to social complexity and the researcher's potential biases (Abdul, Rehman & Alharthi, 2016). This approach addresses positivism's weaknesses, offering a more nuanced understanding of social phenomena.

3.3.5 Interpretivism/ Constructivism

The interpretive paradigm, also known as constructivism, seeks to understand social phenomena through individuals' experiences and meaning (Fard, 2012). Researchers employing this approach explore phenomena inductively, acknowledging that reality is constructed through individual interpretations (Krauss, 2005). This paradigm's ontology is relativist, recognising multiple realities (Okesina, 2022), while its epistemology is subjective, involving both researcher and participant in the knowing process (Nguyen, 2019).

Interpretivist researchers acknowledge the value-laden nature of their study, reporting their biases and the context-dependent information gathered (Kivunja & Kuyini, 2017). However, critics argue that subjective and contextual interpretive research hinders generalisability (Cohen, et al., 2007) and can be resource-intensive (Okesina, 2022). Additionally, personal subjectivity may influence the study's outcome (Shah & Al-Bargi, 2013).

3.3.6 Critical Theory

The critical paradigm, emerging from the Frankfurt School with its main proponents, Adorno, Horkheimer, Marcuse, and Habermas, who criticise positivism and interpretivism as knowledge acquisition methods on world's social issues (Shah & Al-Bargi, 2013; Fard, 2012). Critical theory scholars believe that social reality is constructed through reproduction of historical events, shaped by dominant social, cultural, and political forces (Kivunja & Kuyini, 2017). This paradigm seeks to uncover tacit assumptions, values, and power structures, promoting emancipatory awareness, and transformative social change (Okesina, 2022). Ontologically, critical theory acknowledges multiple realities, emphasising the role of oppression and power dynamics, and privileging the voices of marginalised groups (Guba Yvonn and Lincoln, 1994; Fard, 2012). Epistemologically, it advocates for a subjective, transactional, and culturally sensitive approach, recognising the interplay between researcher and participant values within a specific context. While objectivity is pursued through rigorous research design, the inherent subjectivity of this approach can sometimes obscure strategies for achieving desired outcomes (Okesina, 2022).

3.3.7 Pragmatism Paradigm

The pragmatism paradigm rejects singular paradigm orientations and instead advocates for a pluralistic worldview that combines multiple perspectives to study phenomena (Alise & Teddlie, 2010). Pragmatism offers a nuanced approach to social research by acknowledging the strengths and weaknesses of positivists and interpretivists paradigms. This paradigm employs a non-singular reality ontology, relational epistemology, and value-driven axiology (Kivunja & Kuyini, 2017), facilitating the integration of mixed methods to address research questions effectively (Okesina, 2022). Pragmatism seeks to balance subjectivity and objectivity throughout the research process (Shannon-Baker, 2016). However, critics argue that it lacks a robust conceptual framework to reconcile objective and subjective epistemologies (Shah & Al-Bargi, 2013). Moreover, paradigm mixing can result in methodological flaws due to closed paradigm boundaries (Guba, Yvonn & Lincoln, 1994).

3.3.8 Critical Realist Paradigm

Critical realism, a paradigmatic approach heralding a post-positivist shift in social science inquiry, has garnered substantial traction over the past few decades (Zhang, 2023). Critical realism is a philosophy that espouses a dual ontology, wherein objective reality possesses an existence independent of human perception while conceding that subjective interpretation actively mediates our comprehension of this reality (O'Mahoney & Vincent, 2014). Critical realism presents a nuanced, middle-ground approach to knowledge acquisition, integrating intensive and extensive research methods to foster a systematic understanding of the complex interplay between material and social structures. It sits between the Positivist-Subjectivist spectrums (Zachariadis, et al., 2010). This philosophical stance recognises that research findings can vary in accuracy, and knowledge can be obtained and interpreted through diverse perspectives (Popper, 2014); O'Mahoney & Vincent, 2014).

The primary function of critical realism lies in distinguishing between objective reality and subjective truth (Abdul, 2015). Realist researchers pursue explanatory depth by uncovering the underlying mechanisms and causal forces that produce observed phenomena (Taylor, 2021).This ontological stance posits a stratified reality comprising multiple layers, where hidden mechanisms interact to generate emergent properties and observable outcomes (Eastwood, et al., 2018). Eastwood, et al., further state that realists seek to uncover the complex interplay between these strata, revealing the generative mechanisms that shape the world we experience.

Bhaskar (1989) and other critical realist scholars advocate for a critical realist approach, where understanding social phenomena requires uncovering the generative social structures (Saunders, Lewis & Thornhill, 2007:105). Bhaskar further contends that the social sciences can reveal latent structures through a dialectical interplay between practice and theory, accessing aspects of reality beyond immediate observation. Realism, an epistemological stance, posits the existence of a mind-independent reality that is amenable to scientific investigation. This perspective converges with positivism in its assumptions of a scientific approach to knowledge development, undergirding empirical data collection and interpretation (Saunders, Lewis & Thornhill, 2007:104-105).

This meta-theoretical position distinguishes itself from positivism by initially focusing on ontological questions regarding existence, followed by epistemological concerns related to knowledge creation (Bergin, et al., 2008). Critical realism posits that reality exists independently of researcher perceptions (Miller & Tsang, 2011), but conceives it as a complex, stratified, and open system (Cruickshank, 2012). This ontology comprises three domains: the real, actual, and empirical (Brown, 2014). The real domain encompasses underlying structures and causal powers (Bergin, et al., 2008), which generate events in the actual domain. The empirical domain, where events are observed and experienced, is shaped by hermeneutic processes (Downward & Mearman, 2007). Critical realism's stratified ontology acknowledges the interplay between events, experiences, and underlying structures, powers, and tendencies (Potamaki & Wight , 2000), hence capturing the intricate relationship between social and natural phenomena. Critical realism seeks to uncover not only empirical regularities but also the underlying causal mechanisms and contingent relations that shape social natural phenomena, thereby providing a comprehensive and explanatory understanding of complex systems (Song & Shen, 2019).

By combining diverse methodologies, critical realism facilitates a comprehensive grasp of causal mechanisms, structural relationships, and contextual dynamics underlying social phenomena (Zachariadis, et al., 2010). The next section will examine the choice and justification of the research philosophy adopted by this study.

3.4 THE RESEARCH APPROACH

A research approach is an element of research methodology which affects the specific research methods adopted by a study. Individuals employ a tripartite reasoning framework to comprehend reality, consisting of deductive, inductive and a combined inductive-deductive approach. Qualitative research employs inductive reasoning, a discovery-oriented approach that generates theories and ideas from collected data. This methodology involves identifying patterns to build conclusions and theories, culminating in grounded theory development (Hair, et al., 2019:306). Hair, et al. further states that, in contrast, deductive reasoning begins with pre-existing theories and hypotheses, followed by data collection and analysis to test these assumptions. This dichotomy underscores the fundamental distinction between qualitative and quantitative research.

Qualitative research is employed when the research problem or approach is poorly understood, and existing literature provides incomplete or partial explanations (Hair, et al., 2019:306). This methodology is particularly suited for investigating complex, subconscious, psychological, or cultural phenomena that evade quantitative measurement through surveys and experiments. Its primary purpose is to explore, describe, and gain an in-depth understanding of a research question, laying the groundwork for subsequent quantitative testing. Deductive research tests existing theories through predefined hypotheses (Kumar, 2024; Creswell & Clark, 2018) whereas inductive approaches generate new theories from empirical data, revealing novel insights (Kumar, 2024; Creswell & Clark, 2018). Deductive methods refine existing knowledge, while inductive methods explore research questions, interactively discovering new understandings.

The deductive research approach commences with theory-driven hypothesis derivation, which is then operationalised by researchers specifying the relationships between variables (Saunders, et al., 2016:117). Saunders et al further state that subsequently, empirical testing of these operational hypotheses is conducted, followed by a thorough analysis and evaluation of outcomes. Findings may necessitate theory refinement or revision, completing the deductive research cycle. Saunders et al further state that deductive reasoning is distinguished by several key features. Primarily, it seeks to explain causal relationships between variables, relying on quantitative data to inform conclusions. Controlled experimentation and structured methodologies ensure replicability, while rigorous design and reliability. Assurance safeguards against methodological flaws. Ultimately, deductive research aims to generate predictive models, providing valuable insights for future investigation. This systematic approach facilitates rigorous theory testing, validation, and refinement, yielding reliable and generalisable findings for advancing knowledge in various disciplines.

On the other hand, the inductive research approach emphasises contextual understanding, making targeted, small-scale investigations more appropriate. Inductive research involves analysing data to identify patterns and formulating a theory, focusing on contextual understanding (Saunders, et al., 2016:119; Kumar, 2024). Saunders, et al., further state that this approach often suits small, in-depth samples, allowing for refined exploration of phenomena in their natural setting, hence using case studies.

Researchers can employ a mixed-methods research design, seamlessly integrating deductive and inductive approaches to leverage the strength of both. This combined methodology is particularly suited for studies where existing literature provides a robust foundation for theoretical frameworks and hypotheses, while also requiring exploratory phases to garner in-depth, contextual understanding (Saunders, et al., 2016:119). In such cases, the deductive approach facilitates theory testing and validation, while the inductive approach enables emergent theme identification and contextualisation. By combining these methods, researchers can triangulate findings, enhance validity and reliability (Hafsa, 2019), and provide comprehensive insights into complex phenomena.

Climate change encompasses both physical and social aspects, influencing firm performance. A mixed-methods research approach best explores complex relationships. This study employs a convergent mixed-methods design, merging deductive and inductive approaches to capitalise on their contemporary strengths and foster a more comprehensive understanding of the research phenomenon. By combining the theoretical rigour of deductive reasoning with the exploratory insights of inductive analysis, this study triangulates its findings, enhancing the validity and reliability of the results.

3.4.1 Methodology

Research methodology involves a comprehensive approach to investigation, including design, methods, and procedures for data collection, participation selection, and analysis (Kivunja & Kuyini, 2017). Methodology outlines the logical and sequential process of conducting research, addressing assumptions, limitations, and mitigating strategies. Moreno, (1947) posits that methodology fundamentally explores how we acquire knowledge about the world, focusing on the methods used to obtain desired data, insights, and understandings that ultimately answer research questions and contribute to the existing body of knowledge (Kivunja & Kuyini, 2017). It helps the researcher to determine the research approach to be adopted, such as a survey, case study, documentary analysis or experiment, and the selection of data collection methods, e.g. interviews, questionnaires, and observations.

3.5 THE RESEARCH STRATEGY

This study adopted a mixed-methods research strategy grounded in documentary analysis to investigate the relationship between climate change and the financial performance of manufacturing firms listed on the ZSE. Documentary analysis formed the primary research strategy because the study relied on existing secondary data sources, including annual financial reports, government publications, and industry documents.

Documentary analysis involves the systematic review, evaluation, and interpretation of existing documents to generate empirical evidence. In this study, documentary sources included AFR, company websites, and publications from regulatory and industry institutions. The use of documentary analysis was informed by previous studies that relied on similar approaches to examine environmental and corporate performance relations (Michalisin & Stinchfield, 2010; Secinaro, et al., 2020).

The interpreted documentary data provided insights into the climate change practices and financial performance of listed manufacturing firms in Zimbabwe. This strategy was considered appropriate because it is time-efficient and cost-effective, particularly when analysing multiple firms over several years (Singh & Kumar, 2025). It enabled the extraction of data from numerous firms without the logistical and financial constraints associated with primary data collection methods such as surveys or interviews. Additionally, documentary analysis facilitated a more objective examination of the relationship between climate change and firm performance, thereby reducing the influence of research bias (Easterby-Smith , et al., 2012).

This study utilised longitudinal panel framework, assessing climate change and firm performance over four financial periods from 2021 to 2024.

3.5.1 Case Study

Case study research entails a detailed investigation of a real-world phenomenon, utilising multiple sources of evidence (Saunders, et al., 2016:139; Cohen, et al., 2007:253). This strategy is particularly suitable for exploratory and explanatory research, allowing researchers to address “how” and “why” questions using secondary data sources. Qualitative inquiries uncover causal relationships and contextual dynamics, recognising the complex interplay of events, human interactions, and factors unique to each case (Cohen, et al., 2007:253). Cohen, et al. further state that, through rich, narrative descriptions, case studies capture the intricacies of real-world contexts, acknowledging their distinctiveness and fluidity.

This study employed a multiple case study design as part of the qualitative component. Multiple case studies enhance the robustness of findings by allowing comparisons across cases and verifying the consistency of results (Saunders, 2016:140; Yin, 2003). The qualitative sample comprised five firms selected from the population of 13, using purposive sampling to ensure variation in organisational size and climate-related exposure. The sample included two large firms, one medium-sized firm, and two small firms, enabling the study to capture heterogeneity in governance structures, disclosure practices, and adaptative capacities. Large firms were intentionally selected because they typically possess large boards of directors and more extensive sustainability disclosures, offering richer insights into formal governance responses to climate risks. In contrast, small firms, characterised by smaller boards and limited disclosure practices were included to illuminate the constraints and adaptive behaviours of resource-constrained organisations.

To further enhance analytical depth, the sample incorporated firms differentiated by their dependence on climate-sensitive inputs: three firms reliant on agriculture-input dependent raw materials (category A) and two firms not dependent on agriculture-input (category B). This distinction was essential because agriculture-linked firms are more directly exposed to climate variability, supply disruptions, and resource-availability risks, thereby offering valuable perspectives on climate-induced operational vulnerabilities. Collectively, this purposive sampling ensured representation across firm size, governance capacity, and climate-exposure categories, enabling a nuanced exploration of how different types of manufacturing firms in Zimbabwe perceive and respond to climate-related risks.

The case studies enabled an in-depth documentary examination of climate change risks, and strategic responses adopted by manufacturing firms. Through detailed analysis of corporate disclosures and sustainability practices, the case studies provided contextual explanations for the quantitative findings.

3.5.2 Triangulation

Triangulation was employed to enhance the credibility and validity of the research findings. The study triangulated results from quantitative panel data analysis and qualitative thematic analysis. According to Gerlich, (2024), triangulation allows researchers to corroborate findings from different sources and methods. In this study, quantitative results were supported and contextualised by qualitative insights derived from documentary content analysis. Although triangulation strengthened the reliability of the findings, it required extensive analytical effort to integrate both strands of evidence.

3.5.3 Research Choice and Philosophical Orientation

The selection of a philosophical framework should be guided by research objectives and nature of research problem (Abdul, Rehman & Alharthi, 2016). This study adopted a mixed philosophical approach, integrating elements of positivism and interpretivism within a critical framework. The quantitative component of the research follows a positivist paradigm, which emphasis empirical measurements and hypothesis testing using numerical data. Previous studies examining climate change and firm performance have predominantly used quantitative approaches (Hanaysha, et al., 2021; Secinaro, et al., 2020).

However, understanding organisational responses to climate change strategies requires contextual interpretations. Consequently, the qualitative component follows an interpretivist perspective, which seeks to understand the motivations and organisational dynamics influencing climate strategy adoption. These perspectives are integrated within a critical realist philosophy, which acknowledges the interaction between observable events and underlying structural mechanisms Bhaskar (1975, 1989), Critical realism is particularly suitable for climate change research because it allows researchers to examine the interactions between firms, institutional environment, and environmental challenges.
This study borrows its methodology from Cornell & Parker, (2010) who adopted a critical realist perspective using mixed-method study to examine support action on global warming. By adopting the same methodological and philosophical approach enables this study to uncover underlying structures influencing firm responses to climate change, identify opportunities for transformative change, and inform evidence-based policies. This epistemological orientation was crucial for advancing understanding of the complex relationship between climate change, firm performance and societal well-being.

This study adopts an exploratory mixed-methods documentary design (Ivankova, et al., 2006; Haynes-Brown, 2023), consisting of two phases: Quantitative Phase - panel data regression analysis of firm-level financial and cliamte variables, followed by Qualitative Phase - multiple case study analysis used to interpret and contextualise quantitative results.The quantitative phase was conducted first to identify statistical relationships between change variables and firm performance. The quantitative strand is a short longitudinal panel because the same listed manufacturing firms are observed across the 2021 to 2024 period. The qualitative strand is documentary and interpretive, based on thematic analysis of corporate, regulatory and industry documents.

Integration occurs at the interpretation stage through triangulation, where qualitative themes are used to explain convergence, complementarity, divergence or silence in relation to the quantitative results.

3.6 TIME HORIZON

The design employed a short panel longitudinal firm-year panel design (Burbridge, 1999), examining firms over a four-year period from 2021 to 2024. Because the same manufacturing firms are observed repeatedly, the design is longitudinal at firm-year level, although the short time dimension limits the strength of statistical inference. The dataset consists of 13 manufacturing firms listed on the ZSE, observed annually across four financial years. This produced a balanced panel dataset of 52 firm-year observations: Firms x 4 years = 52 observations. This panel structure enabled the analysis of variation across firms and over time, allowing the study to control for unobserved firm heterogeneity, analyse temporal changes in climate strategies, and examine firm responses in the post-Paris Agreement policy environment.

The selected time frame focuses on the period following the adoption of the Paris Agreement in 2015, enabling the evaluation of how global climate policy initiatives influenced corporate climate strategies within Zimbabwe's manufacturing sector.

3.7 Data Collection

A research technique is a specific method or procedure used to collect, analyse, and interpret data in a research study (Swarooprani, 2022). Research techniques can be qualitative, quantitative, or mixed methods. These techniques are essential for researchers to collect, analyse, interpret data and draw conclusions to answer research questions or hypotheses (Clarke, 2020).

3.7.1 Population and Sampling

The population consisted of all manufacturing firms listed on the ZSE as of December 2024. To identify these firms, the researcher downloaded the full list of listed companies from the ZSE website and reviewed company profiles and operational activities through corporate websites and annual reports. Firms were included in the study if their primary business activities involved manufacturing, defined as the transformation of raw materials or components into finished goods through production processes such as assembly, fabrication, or processing.

The screening process identified 15 manufacturing firms, which constituted the study population. Two companies were used for the pilot study and the remaining 13 companies formed the research sample. Because the population size was small, the quantitative analysis adopted a census approach, meaning that all 13 firms were included in the study.

For the qualitative component, five firms were purposively selected for case study analysis. Selection criteria included: availability of sustainability disclosures, market dominance, established governance structures, and accessibility of annual financial reports.

3.7.2 Data Sources

The study relied exclusively on secondary data sources. These included AFR Company websites, Zimbabwe Stock Exchange publications, and government publications. AFR were the primary source of financial data because they provide reliable and regularly published information on corporate performance to stakeholders (Flack, 2007). These reports are extensively utilised in the analysis of corporate social reporting owing to their credibility (Tilt, 1994). They furnish essential information regarding company performance to stakeholders (Deegan & Rankin, 1997) and are published regularly (Neimark, 1992). Furthermore, AFRs provide substantial insights into social disclosure (Gray , et al., 1995a). Climate change risk scores and climate risk strategy scores were adapted by the researcher based on the Refinitiv database model, which provides an index score encompassing four categories: GHG emissions management, renewable energy usage, energy efficiency, and climate change policy commitments. Financial variables such as ROA, ROE and Tobin’s were calculated from AFRs obtained from company reports and ZSE records.

3.7.3 Data Collection Instruments

The DEFs were designed to collect quantitative and qualitative data from publicly available AFRs, government and industry. DEFs were utilised to systematically capture financial metrics alongside qualitative indicators of climate change risk exposure and strategic environmental performance practices from the firms' AFRs. The data was extracted from Annual Financial Statements (AFS), company websites, and ZSE website. The documentary content analysis strategy sort to answer the, "what", "how" and "why" questions regarding manufacturing firms' response to climate change (Saunders, et al., 2016:181).

3.7.4 Data Collection Procedures

The study employed an exploratory mixed-methods documentary design. Quantitative and qualitative data were extracted from secondary documentary sources using structured data-extraction forms. The quantitative strand generated firm-year financial, climate-risk and climate-strategy variables; the qualitative strand generated coded themes concerning governance, disclosure credibility, implementation constraints and resilience mechanisms.

3.7.4.1 Quantitative Data Collection

Quantitative data extraction process involved the use of AFR to record annual profits, total assets, equity, total liabilities, market capitalisation, natural logarithms of total assets, identifying the industry category based on the raw materials used in the production process. This information was used to compute ROA, ROE, Tobin's Q, leverage and determine firm size based on the natural logarithms of total assets. The AFR were also used to record climate-related indicators relating to emissions, energy use, and sustainability policies which were used to compute the CCR Scores and CCS Scores. The presence of a metric was ascribed a score of 1, and a 0 for no presence. These indicators were used for coding climate change risk scores (CCR Scores) and climate change strategy scores (CCR Scores). Data was cleaned by removing firms which had no values for the entire four-year period under study, firms with outliers were identified and the data was recollected and ratios recalculated to confirm the figures. After checking the data, the final dataset consisted of 52 firm-year observations.

3.7.4.2 Qualitative Data Collection

Data was extracted from AFR, company websites, ZSE website and publications as well as government publications on the climate change practices adopted by manufacturing firms in Zimbabwe. Data were captured on an excel sheet data capturing form, allowing for cross-company comparison on the standard questions set on the data extraction form. The process involved identifying key words such as "climate change", "EMA", "regulatory", "GHG emissions", "renewable energy", "energy", "sustainability", "solar energy", "coal", "pollution", "regenerative Agriculture", "carbon capture", "climate change reporting", "environmental", "El Nino", "drought", "social", "carbon disclosure", "SDGs", "logistics" "raw materials", "partnerships" "supply chain", "collaborations", "community", "circular", "ESG", "risk", "opportunities", "challenges", "stakeholders" and "mitigation" among others.

3.7.5 Variables and Measurement

This study examined the relationship between climate change and firm performance using a panel data model, with climate change risk and strategies as predictors, and financial performance (ROA, ROE, Tobin's Q) as outcomes. Financial variables were calculated from AFRs. A detailed description of the variables is presented in Table 3:1.

Table 3. 1:Variables, Measurement Summary

Construct	Variable code	Measurement	Source	Model role	Interpretive caution
Accounting performance	ROA	Net income divided by total assets.	Annual financial reports	Dependent variable	Accounting return measure; may be sensitive to inflation and accounting measurement.
Accounting performance	ROE	Net income divided by total equity.	Annual financial reports	Dependent variable	May be volatile where the equity base is small or inflation adjusted.
Market performance	TQ	Market value relative to asset/book-value proxy as defined in the dataset.	Market and annual financial data	Dependent variable	Forward-looking valuation proxy: outliers require cautious interpretation.

Climate risk/reporting	CCR	Score based on disclosed physical, transition, regulatory and reputational climate-risk exposure/reporting.	Annual reports, sustainability reports, ZSE and public documents	Independent variable	Disclosure score may capture reporting quality as well as actual risk exposure.
Climate strategy	CCS	Score based on governance capacity, mitigation/adaptation strategy, targets, resource efficiency and implementation signals.	Annual reports, sustainability reports, websites and public documents	Independent and moderating variable	Strategy disclosure is not equivalent to independently verified implementation.
Firm size	lnTA	Natural logarithm of total assets.	Annual financial reports	Control variable	Log transformation reduces skewness and improves comparability across firms, but asset values remain affected by inflation and currency conditions.
Leverage	LEV	Debt-to-equity measure as defined in the dataset.	Annual financial reports	Control variable	Scaling must be consistent before interpreting coefficients.
Industry category	IC	Dummy/category distinguishing agricultural-input-dependent and non-agricultural-input-dependent manufacturing firms.	Firm classification and annual reports	Control variable	Captures broad exposure differences, not all sector heterogeneity.

Author’s own compilation (2025)

The financial performance metrices used were selected because they capture accounting performance and market-based firm valuation. This study’s research methodology draws inspiration from existing literature on climate change, environmental performance, and firm performance, which employed performance metrics such as return ROA, ROE, and Tobin’s Q (Ghose, et al., 2025; Bag, et al., 2023; Cornell & Parker, 2010; Bagh, et al., 2024).

This study operationalises two core climate-related predictors and one composite interpretation layer. The climate change risk/reporting score (CCR) captures the extent to which firms disclose and are exposed to physical, transition, regulatory and reputational climate risks. The climate change strategy score (CCS) captures governance capacity, board oversight, adaptation or mitigation strategy, resource efficiency, targets and implementation signals. References to CCG, climate governance score or ESG score should be read as CCS unless a separate construct is explicitly defined. This study therefore uses CCR and CCS consistently in the regression models, with ROA, ROE and Tobin's Q as dependent performance variables.

Building on prior research on firm performance, this study employed ROA, ROE, and Tobin's Q as response variables (Bhaskaran, et al., 2020; De Lucia, et al., 2020; Khatib et al., 2023; Castilho & Barakat, 2022). ROA is the primary response variable since it is widely used as a financial performance metric that captures a firm's profitability (Purnamasari, 2015) and its efficiency in generating returns from its assets (Peters & Mullen, 2009; (Chabata, 2025) & Miryugin, 2023; Sun, et al., 2020).

ROA is calculated as the ratio of a firm's net income to its total assets' book value, providing valuable insights into a company's resource deployment and earnings generation, irrespective of size or industry. Another financial performance proxy used in the study is ROE. ROE is a financial performance measure that reflects a firm's profitability and revenue-generating capability, based on the employed long-term sources of capital (Naeem , et al., 2022). This metric provides insights into a company's ability to generate a return for its shareholders (Purnamasari, 2015), thereby measuring the financial returns for shareholders' investment. According to Keter, et al., (2023), ROE has a significant influence on the value of a firm as depicted by Tobin's Q.

Tobin's Q is a widely used financial performance measure, which evaluates a firm's economic (Fu, et al., 2016) and market value by comparing its present market value to its book value or replacement value of total assets. This metric considers both market performance and the long-term replacement cost of assets, rendering it a valuable indicator for sustainable investment practices (Naeem , et al., 2022). A firm's market value is its expected future profits and incorporates the risk adjustment of the firm and is determined by its expected future cash flows. Tobin's Q is, therefore, able to reflect more information about a company's financial situation (He, Cheng, Zhang, Guo, & Yu, 2021). Companies that exhibit an elevated Tobin's Q ratio tend to demonstrate an enhanced financial performance over the long term.

This study incorporates firm-level control variables to enhance the robustness of the regression model. Aligning with previous studies on environmental performance and firm performance, this study adopted firm size, leverage, and industry category as firm-specific control variables (Alvarez, 2012; Michalisin & Stinchfield, 2010). The incorporation of these control variables helps to isolate the relationship between climate change and firm performance, thereby reducing potential biases and omitted variable problems. This approach is consistent with prior studies on climate change risk and firm performance that used similar control variables.

3.7.5.1 Justification of Control variables

To ensure comparability and statistical robustness, the study used the Firm Size, Leverage and Industry Category as control variables.

Firm size

Firm size, measured as the natural logarithm of the total assets ln(TA), is an important control variable in studies of firm performance (Cho & Tsang., 2020). Firm size was proxied by natural logarithms of total assets, ln(TA), a measure widely used in accounting and finance literature to reduce skewness in asse values and facilitate comparability across firms of different size. The logarithms transformation mitigates the influence of extreme values and allows for a more linear relationship between firm size and financial performance.

Larger firms often benefit from economies of scale, and greater bargaining power, improved access to financial resources, and enhanced operational efficiencies, all of which may contribute to superior financial performance (Fama & French , 1992). Firm size may also influence a firm’s ability to absorb risks and invest in strategic initiatives, including climate adaptation and environmental innovation. Orlitzky (2001) found that the positive relationship between corporate social performance and financial performance remains significant even after controlling for firm size, suggesting that firm size does not fully explain this association. However, from a RBV perspective, the extent to which environmental innovation translates into financial performance may vary according to a firm’s endowment and scale of operations, with larger firms generally possessing greater capacity to invest in and benefit from environmental initiatives (Andries & Stephan, 2019).

Industry Category (Resource Dependency Dummy)

To account for sectoral differences in performance, a dummy variable for industry category was introduced. Firms were coded as (A) if operations were primarily dependent on agricultural inputs and (B), otherwise. This allows the model to control for exogenous shocks specific to the agricultural sector such as seasonal variations, climate change, and specific commodity price volatility which significantly impact firm performance in an agro-based economy.

Leverage

Financial leverage is included to control for the impact of capital structure on firm performance. In a high-interest and inflationary environment, the degree of debt-to-equity significantly influences a firm's risk profile and profitability (ROA/ROE), making it a necessary control to isolate the effects of the primary independent variables.

Financial leverage, calculated as the debt-to-equity ratio, is crucial for determining suitable financing and investment strategies. Higher leverage can increase financial risk and impact firm performance (Modigliani & Miller, 1958; Evgeny, 2015; Hussan, 2016). The proportion of debt in the capital structure of a firm affects its financial capacity and the determination of its shareholder wealth creation (Hussan, 2016). Maintaining an optimal capital structure is essential for enhancing corporate financial performance. The inclusion of fixed assets and asset tangibility in the determination of Tobin's Q, is based on the fact that assets provide collateral security and provide a firm with the productivity capacity, hence cash flow potential value of a firm is determined by its fixed assets (Daniels , 1933).

3.7.6 Quantitative Data Analysis

This research adopted the multivariate regression model developed by Liu, et al., (2024) and Naseer & Bagh, (2023), to test the impact of climate change on the financial performance of manufacturing companies listed on the ZSE. To ensure accurate results, the study employs a random effects regression model, which accounts for unique differences between firms that might not be directly measured, such as organisational culture, brand reputation and management style.

Quantitative data is analysed using descriptive statistics, and multiple linear regression analysis to test the hypothesis. This analysis is expected to give the following research outcomes: to identify key climate-related factors influencing firm performance, quantification of the impact of each factor on firm performance, and to give insights for policymakers and business leaders to promote climate-friendly practices.

Building on prior studies on climate change and firm performance, this study employed a multivariate regression analysis to investigate the relationship between climate change risk, strategy and firm performance. The study approach is influenced by the works of Castilho & Barakat, (2022) and Secinaro, et al., (2020), who demonstrate the efficacy of multivariate regression analysis in understanding the complex interactions between climate change and corporate financial performance.

By employing a similar approach, this study aimed to provide a comprehensive understanding of the moderation role of climate change governance in mitigating climate risk, hence firm performance. The use of multivariate analysis is particularly well-suited to this research question, as it allows for the simultaneous examination of multiple variables and their interrelationships, providing a more nuanced and accurate representation of the complex dynamics at play.
The quantitative analysis uses random-effects panel regression because the dataset contains repeated observations for each firm and includes time-invariant or slow-moving firm characteristics such as industry category and climate-scoring constructs. The general specification is:

$$FPit = \beta 0 + \beta 1Xit + \beta 2LEVit + \beta 3ICi + \beta 4ln\,(TAit) + ui + \varepsilon it$$

where:

- *FPit* = represents ROA, ROE or Tobin's Q for firm *i* in year *t*,
- β_0 = The constant intercept,
- β_1-β_6= Regression coefficients,

- X = represents CCR Scores, CCS Scores, or CCR×CCS interaction term
- LEV=Firm leverage,
- IC =industry category denoted by dummy (A) or (B),
- ln (TAit) = Natural logarithm of total assets (firm size proxy)
- μ_i = captures unobserved firm-specific heterogeneity
- ε_{it}= the idiosyncratic error term (regression error)

The three estimated models are:

Model 1: $FPit = \beta 0 + \beta 1CCRit + \beta 2LEVit + \beta 3ICit + \beta 4\ln(TAit) + ui + \varepsilon it$

Model 2: $FPit = \beta 0 + \beta 1CCSit + \beta 2LEVit + \beta 3ICit + \beta 4\ln(TAit) + ui + \varepsilon it$

Model 3: $FPit = \beta 0 + \beta 1CCRit + \beta 2CCSit + \beta 3(CCRit \times CCSit) + \beta 4LEVit + \beta 5ICit + \beta 6\ln(TAit) + ui + \varepsilon it$

Regression model 1 for testing hypothesis 1, regression model 2 for testing hypothesis 2, and regression model 3 for testing the moderating effect of climate change strategy on firm performance. Model 3 tests whether climate change strategy strengthens or weakens the relationship between climate change risk reporting and firm performance. Because the sample is small, the results are interpreted as exploratory associations rather than causal estimates.

This model is estimated using the static linear panel regression with Firm-Specific Effects to examine the relationship between climate change and firm performance, while controlling for other relevant factors. The models were estimated using ridge-penalised static linear panel regression, a shrinkage technique employed to address the high degree of multicollinearity present among the explanatory variables. Ridge regression enhances coefficient stability by minimising the sum of squared residuals subject to a regularisation penalty (λ), thereby reducing variance inflation and ensuring reliable estimation despite distortions commonly observed in financial panel data.

A Random-effects (RE) panel-data specification was adopted to control for unobserved, time-invariant firm-level heterogeneity across 13 firms. This approach assumes that the firm-specific random effects (μ) is assumed to be uncorrelated with the explanatory variables and allows for the inclusion and direct estimation of time-invariant regressors, such as industry category. The RE framework also improves estimation efficiency relative to Fixed effects under this assumption.

The analysis is presented in three stages. Model 1 estimates the association between CCR and each performance measure. Model 2 estimates the association between CCS and each performance measure. Model 3 includes CCR, CCS and the interaction term CCR × CCS to test whether the climate strategy score moderates the relationship between climate risk/reporting and firm performance. Because the panel contains only 52 firm-year observations, Model 3 is interpreted as exploratory rather than conclusive. This modelling strategy ensures clearer interpretation of coefficients and more robust inference regarding the differential effects of climate risk exposure and strategic climate responses on firm performance outcomes.

The study was undertaken in an environment characterised by severe hyperinflation and currency volatility, conditions that may have affected the reliability, comparability and interpretation of the financial performance indicators used in the analysis. Furthermore, while the four-year temporal horizon (2021-2024) provides a critical snapshot of corporate resilience, it represents a relatively short panel for capturing long-term structural shifts in governance. The sample of 13 firms also introduces a degree of survivorship bias, as the data reflects only those large-scale entities capable of maintaining consistent financial reporting throughout the economic crisis.

Quantitative data were analysed using R statistical software (version 4.2.2). Descriptive statistics and multivariate regression techniques were applied to examine the relationship between climate change and firm performance. The study used ridge regression, a regularised regression technique that minimises the sum of squared residuals while applying a penalty to large coefficient values. This approach reduces multicollinearity and stabilises coefficient estimates.

3.7.6.1 Model Diagnostic Checking and Fit Analysis

To ensure that statistical integrity of the empirical results and the validity of the subsequent inferences, a comprehensive battery of diagnostic tests was performed on the residuals of the three models: Return on Assets (ROA), Return on Equity (ROE), and Tobin's Q. This stage of the analysis was critical to confirm if the models adhere to the classical linear regression assumptions.

3.7.6.2 Assessment of Multicollinearity and the Ridge Regression Approach

Preliminary diagnostic screening revealed significant multicollinearity among the independent variables. Multicollinearity occurs when predictor variables are highly correlated, leading to unstable coefficient estimates and inflated standard errors (Shrestha, 2020), which can obscure the true relationship between corporate governance and firm performance.

To address this, a ridge regression modelling approach was employed as a formal correction mechanism (Shrestha, 2020). Unlike standard ordinary least squares (OLS), ridge regression introduces a degree of bias (a "penalty" term) to the estimates to substantially reduce their variance (Tutz & Ulbricht, 2008). This trade-off results in a more reliable and robust model, particularly when dealing with complex financial datasets where variables like firm size and leverage often move in tandem. However, ridge coefficients require cautious interpretation, and conventional p-value-based hypothesis decisions should not be overemphasized unless the inferential procedure is explicitly specified.

The data analysis for this study was conducted in three sequential phases to ensure the reliability and validity of the findings.

Phase 1: Diagnostic Screening

Prior to hypothesis testing, the data were subjected to rigorous diagnostic checks to verify the assumptions of the Classical Linear Regression Model (CLRM). This includes (1) normality test: utilising the Kolmogorov-Smirnov and Shapiro-Wilk test to ensure residuals are normally distributed. (2) heteroscedasticity: applying the

Breusch-pagan test to confirm constant variance in the error terms. (3) autocorrelation: using Durbin-Watson and Breusch-Godfrey tests to check for serial correlation. (4) multicollinearity: assessing the Variance Inflation Factor (VIF). Where high correlation was detected between independent variables, a ridge regression approach was adopted to stabilise the coefficient estimates.

Phase 2: Model Estimation

The study estimates three sets of models for each performance proxy: ROA, ROE and Tobin's Q. The first examines CCR, the second examines CCS, and the third includes CCR, CCS and the CCR × CCS interaction term. Ridge regression is used only as a robustness-oriented response to multicollinearity and should not be treated as a substitute for the panel-model logic or as a basis for strong causal inference.

Phase 3: Evaluation of Model Fit

The "goodness-of-fit" and predictive accuracy of each model were evaluated using a suite of performance metrics:

- R-squared (R^2): to determine the proportion of variance explained by the predictors.
- Root Mean Squared Error (RMSE) and Mean Absolute Error (MAE): To quantify the magnitude of prediction errors and assess the model's precision across different performance dimensions.

Given our focus on a population of 13 large-scale manufacturers, we utilised panel data techniques to maximise observations. While fixed effects control for time-invariant unobserved heterogeneity, RE is retained as the main estimator to preserve the analysis of industry-specific (agriculture-input based and non-agriculture-input abased) variation.

To identify the most appropriate estimation for this longitudinal study, the analysis considered both FE and RE panel data models (Baltagi, et al., 2003). The dataset comprised 13 firms observed over the period 2021-2024 within the Zimbabwean context. A RE specification was adopted as it accommodates unobserved firm-specific heterogeneity while allowing estimation of time-invariant variables such as industry classification (Hausman & Taylor, 1981). The RE models captures latent firm characteristics, including organisational structures and managerial practices through a firm-specific random effect assumed to be uncorrelated with the explanatory variables. compared to FE, the RE approach offers greater efficiency in small-N panel settings and avoids the exclusion of time-invariant regressors. Accordingly, the RE model is deemed appropriate for examining the relationship between climate-related variables and firm performance in this study.

3.7.7 Qualitative Data Analysis

Qualitative research adopts a naturalistic approach, seeking to comprehend phenomena within their authentic contexts, without researcher intervention or manipulation (Patton, 2002). This paradigm prioritises an in-depth understanding of real-world settings, preserving the integrity of the phenomenon under investigation.

The study employed the thematic data analysis to analyse the qualitative data. This involved a six-stage process, namely familiarisation with the data sets, generation of data codes, identifying themes, reviewing the themes, defining and naming themes and writing the research findings (Ahmed, et al., 2025). NVivo software was used to analyse the qualitative data responses. Through iterative coding procedures, the data were systematically analysed to uncover latent meanings and themes. Initial coding identified major categories, which were subsequently refined to reveal patterns and interrelationships. By identifying and exploring themes, sub-themes, patterns, and relationships, this analysis provides a rich, contextualised understanding of the data, yielding meaningful insights into the perceptions and experiences of management regarding climate change strategies.

3.7.8 Explanatory Sequential Design

According to Cresswell & Clark, (2018:65-67), there are three primary mixed methods research designs that provide a foundational framework for interdisciplinary inquiry. These designs facilitate the integration of quantitative and qualitative methodologies to yield a more comprehensive understanding of research phenomena. Mixed-methods research employs three key designs (Cresswell & Clark, 2018:65-67):

Convergent, Explanatory sequential, and Exploratory sequential, each with distinct data collection and analysis sequences.

This study adopted the explanatory sequential mixed design (QUAN-QUAL) in which quantitative panel analysis is followed by a documentary multiple-case qualitative phase used to explain and contextualise the quantitative findings (Guest & Fleming, 2015; Creswell & Clark, 2018).

3.7.9 Design Choice

This study adopted a mixed-methods research approach, leveraging the complementary strengths of quantitative and qualitative methods to enhance the rigor and validity of the research design. By integrating both methods, the study seeks to triangulate the findings, increase data reliability, and offset the limitations of single-method approaches. The mixed-methods design combines deductive and inductive thinking, facilitating a more comprehensive understanding of the phenomenon under investigation. The study will employ a consequential explanatory design, commencing with quantitative data collection and analysis, followed by qualitative data extraction to explore complex phenomena and potentially develop explanatory theories. This integrated approach aligns with the principles of mixed-methods research, as advocated by Cresswell & Clark, (2018:65-67), to yield richer insights and more robust findings.

This study investigated climate change risk exposure and climate change strategies among Zimbabwean manufacturing firms, examining their impact on firm performance. The research objectives are to assess climate change awareness, analyse mitigation strategies, explore adaptation challenges, and evaluate government policy effectiveness. A mixed-methods design integrates deductive and inductive approaches, combining quantitative analysis of mitigation strategies with qualitative exploration of challenges. The mixed-methods study was adopted because: climate strategy effects evolve over time, firm heterogeneity must be controlled, Zimbabwe presents institutional complexity requiring contextual explanation, purely crosssectional designs would overstate causal claims, and purely qualitative designs would lack statistical generalisability.

The Quan-qual consequential explanatory design facilitates a comprehensive understanding of climate change management practices. The integrated analysis sheds light on pathways to enhance firm performance, informing policy decisions.

3.8 RELIABILITY AND VALIDITY

Regression analysis is crucial in empirical research, and validity is essential for most applications (Frahm, 2023). Research findings gain credibility by ensuring reliability and validity, minimising errors and bias to yield accurate answers to the research question (Saunders al., 2016:149). To ensure integrity of the findings, the study employed a standardised Data Extraction Form (DEF) to systematically capture financial and qualitative data from the annual financial reports of the 13 sampled firms. Reliability was achieved through the implementation of this uniform protocol, which was pilot tested on subset of reports to refine the scoring categories for corporate governance (CCR, and CCS) and ensure inter-temporal consistency across the 2021-2024 panel. This standardised approach minimised researcher bias and ensured that the same evaluative criteria were applied to each firm regardless of the reporting year. Validity was maintained by directly aligning the extraction fields with the specific research objectives and questions, ensuring that the instrument accurately captures the intended constructs of performance and governance. Furthermore, by prioritising relative ratios and non-monetary proxies such as the employee-based firm size scale, the instrument's validity was preserved against the distortions of the Zimbabwean hyperinflationary environmental, ensuring a precise and objective representation of firm scale and operational success.

3.8.1 Results of the Pilot Test

To ensure the validity and reliability of the research instruments, a preliminary pilot study was conducted using a sample of two listed manufacturing firms that were distinct and separate from the 13 firms used in the primary analysis. this separation was maintained to prevent data contamination and ensure the independence of the results. The pilot study served as a “dry run” for the DEF allowing the researcher to assess content validity and refine the measurement scales in accordance with established methodological standards (Cresswell, 2009:150).

Through this preliminary analysis, coding procedures were finalised and measurement scales were tested for suitability within the specific context of Zimbabwean financial reporting. The pilot phase also provided critical hands-on training in instrument administration, ensuring high inter-temporal consistency and minimising variability during the subsequent collection of the main dataset (Cresswell, 2009:158). Ultimately, the reconciliation of the sample is as follows, while 15 manufacturing firms were initially screened, two were dedicated exclusively to the pilot testing of the instruments, leaving a robust and finalised sample of 13 firms for the multivariate regression and performance analysis. This rigorous approach confirmed both data availability and the statistical analysability of the variables, thereby ensuring the overall robustness of the research design.

3.9 ETHICAL CONSIDERATIONS

This study adhered to rigorous ethical standards, ensuring confidentiality and acknowledging all data sources. The study made use of secondary data; hence, no personal harm was expected to anyone since there were no research participants. However, the researcher ensured that data quality and accuracy were observed. The researcher verified the credibility and reliability of the secondary data sources and guarded against potential biases in the secondary data.

The researcher aimed not to misconstrue other people’s work as being his and acknowledged all sources of material used in this study. All data collected was treated confidentially and was not made available to third parties. This research adhered to the college’s ethical requirements and conformed to the highest standards of academic integrity. To facilitate efficient and cost-effective data analysis, this study collaborated with a statistician, leveraging their expertise to ensure accurate and reliable results.

3.10 LIMITATIONS OF THE STUDY

As is inherent with any research endeavour, this study was not immune to challenges and limitations (Okesina, 2022), that could impact the validity, reliability and generalizability of its findings. The quantitative panel comprises 52 firm-year observations from 13 firms. Although the balanced panel improves the available information relative to a single-year cross-section, the sample remains small for multivariate inference. The results may therefore be sensitive to outliers, scaling choices, variable coding and the inclusion of controls. The analysis accordingly avoids strong causal language and interprets coefficients as evidence of association. The qualitative evidence is used to strengthen interpretation, but it cannot by itself eliminate the statistical limitations of the quantitative data.

3.11 CHAPTER SUMMARY

This chapter outlined the research design and methodology, detailing the paradigm, strategies, and methods used to investigate the climate change-firm performance relationship. Key aspects included the time horizon, pilot study, ethical considerations, and limitations, ensuring methodological rigor and transparency. The following chapter focuses on data presentation and analysis. The following chapter presents the findings of the study, derived from the analysis of quantitative and qualitative documentary evidence.

CHAPTER 4: QUANTITATIVE DATA ANALYSIS, AND DISCUSSION OF FINDINGS

4.1 INTRODUCTION

This chapter presents the quantitative results for the relationship between climate change risk reporting (CCR), climate change strategy (CCS), and firm financial performance among Zimbabwean listed manufacturing firms. The analysis uses a balanced panel of 13 firms observed from 2021 to 2024, producing 52 firm-year observations for the baseline models and 39 observations for the one-year lagged models. Firm performance is analysed using ROA, ROE and Tobin's Q. The chapter is structured by first clarifying the data and variables, then presenting descriptive statistics, correlation analysis, diagnostic tests, model-selection evidence, random-effects panel estimations, one-year lagged models, robustness checks, hypothesis decisions, and a literature-linked theoretical discussion.

The chapter is deliberately cautious in interpretation. The dataset is a census of listed manufacturing firms available for the study, but it remains a small, short panel. Therefore, the results are interpreted as context-specific empirical evidence rather than universal causal proof. This is consistent with the thesis rationale that the climate change-firm performance relationship is contested, context-dependent, and shaped by climate exposure, governance capability, firm resources, and regulatory conditions.

4.2 FINAL SAMPLE RECONCILIATION BY INDUSTRY CATEGORY

To ensure transparency in the sampling process, this section provides a reconciliation of all firms considered at the stage of sample construction. The sampling proceeded in a three-stage process: pilot testing, initial sample identification, and final panel selection. First, two firms (one in each category) were used in a pilot study to refine the climate-risk (CCR) and climate-strategy (CCS) scoring instrument. These firms were excluded from the final dataset. Second, 17 listed manufacturing firms were initially identified based on sector classification and availability of annual reports. Of these, four firms were excluded because they lacked complete financial and climate-related disclosures for the full 2021-2024 period. Third, the final panel comprised 13 firms, each observed over four years, yielding 52 firm-year observations used in the quantitative analysis. The reconciliation is summarized in Table 4.1.

Table 4. 1:Final Sample Reconciliation

Sample selection stage	Industry Category A	Industry Category B	Total firms	Firm-year observations
Pilot firms used for instrument testing	1	1	2	Not included
Initially identified main-sample firms	10	9	19	—
Firms excluded due to incomplete 2021–2024 data	2	2	4	Not included
Final balanced panel sample used in analysis	**7**	**6**	**13**	**52**

Source: Author's own's compilation, (2025)

The reconciliation in Table 4.1 shows how the sample was reduced from the initially identified main sample to the final balanced panel used for quantitative analysis. The initial main-sample frame comprised 19 manufacturing firms (10 in Industry Category A and 9 in Industry Category B). Pilot firms were used only for instrument testing and were excluded from the final regression analysis. Firms with incomplete data for the 2021–2024 period were also excluded. The final balanced panel comprised 13 firms observed over four financial years, producing 52 firm-year observations.

4.3 CHAPTER AND ANALYTICAL LOGIC

The quantitative analysis proceeded through eight stages. First, descriptive statistics were used to evaluate the distribution and scale of the variables. Second, Pearson correlation analysis was used to assess linear associations among variables. Third, Spearman rank correlation was used as a robustness check because CCR and CCS are ordinal disclosure-based scores. Fourth, the regression models were subjected to normality, heteroscedasticity, autocorrelation, and multicollinearity diagnostics. Fifth, fixed-effects and random-effects suitability was assessed using a restricted Hausman test. Sixth, random-effects panel models with firm-clustered robust standard errors were estimated. Seventh, one-year lagged models were estimated to examine whether CCR and CCS in year t are associated with performance in year t+1. Eighth, mean-centred interaction modelling, year-dummy sensitivity analysis, winsorisation, and marginal-effects interpretation were used to strengthen the moderation analysis.

The empirical strategy recognises a central feature of the data: CCR, CCS and industry category are time-invariant within firms in the supplied dataset. This means that fixed-effects estimation cannot directly estimate their coefficients because fixed effects rely on within-firm variation. Random effects are therefore more feasible for the main analysis, while the Hausman test is interpreted with the stated limitation that it applies only to common time-varying variables.

4.3.1 Variables and Model Specification

Table 4. 2:Variables used in the quantitative analysis

Variable	Role	Operationalisation
ROA	Dependent variable	Return on assets; accounting-based operational efficiency.
ROE	Dependent variable	Return on equity; shareholder profitability.
Tobin's Q	Dependent variable	Market-based firm valuation.
CCR Score	Independent variable	Climate change risk reporting score.
CCS Score	Independent variable / moderator	Climate change strategy score.
CCR x CCS	Interaction term	Moderation term testing whether CCS changes the CCR-performance relationship.
Leverage	Control variable	Debt-related capital structure measure.
Industry category	Control variable	Dummy variable distinguishing agriculture-dependent and non-agriculture-dependent manufacturing firms.
lnTA	Control variable	Natural logarithm of total asset value, used as the firm-size control.

Source: Author's own compilation, (2025)

Three models were estimated. Model 1 examined the direct association between CCR and firm performance. Model 2 examined the direct association between CCS and firm performance. Model 3 examined whether CCS moderates the relationship between CCR and firm performance through the CCR x CCS interaction. The interaction model was estimated using mean-centered CCR and CCS to reduce artificial multicollinearity between the interaction term and its component variables.

4.4 DESCRIPTIVE STATISTICS

Table 4. 3:Descriptive statistics for the baseline sample

Variable	N	Mean	Std. Dev.	Minimum	Median	Maximum
CCR Score	52	2.692	1.056	1.000	3.000	5.000
CCS Score	52	4.154	1.485	2.000	4.000	6.000
ROA	52	0.109	0.126	-0.197	0.099	0.497
ROE	52	0.181	0.218	-0.290	0.163	0.786
Tobin's Q	52	1.597	1.658	0.022	1.231	6.813
Total asset value	52	139,276,923	207,755,084	19,600,000	40,900,000	792,000,000
lnTA	52	17.998	1.262	16.791	17.527	20.490
Leverage	52	0.147	0.125	0.008	0.132	0.611
Industry category	52	0.538	0.503	0.000	1.000	1.000

Note. Computed from the supplied 52 firm-year observations. lnTA is the natural logarithm of total asset value.

Source: Author's own compilation, (2025)

The descriptive statistics show moderate variation in CCR and wider variation in CCS. The mean CCR Score is 2.692, while the mean CCS Score is 4.154. This indicates that, within the supplied dataset, climate strategy scores are generally higher than climate risk reporting scores. The higher CCS mean suggests that firms may disclose more about strategic responses than about risk exposure. This is consistent with legitimacy theory, which suggests that firms may present strategic and governance narratives to maintain social approval and investor confidence, particularly in a setting where listed firms face ESG disclosure expectations.

The performance measures show substantial dispersion. ROA has a mean of 0.109, while ROE has a higher mean of 0.181 and greater variation. This is expected because ROE is more sensitive to capital structure and equity-base differences. Tobin's Q has a mean of 1.597 and a wide range from 0.022 to 6.813, indicating considerable differences in market valuation across firms. Total asset value is strongly skewed: the mean is substantially higher than the median because a few large firms dominate the sample. This justifies using lnTA rather than raw total assets. From a finance perspective, this transformation is necessary because untransformed total assets would distort the regression scale and risk giving excessive influence to large firms.

4.4.1 Pearson Correlation

Table 4. 4:Pearson correlation matrix

Variable	CCR	CCS	ROA	ROE	Tobin's Q	lnTA	Leverage	Industry
CCR	1.000	0.340**	0.049	0.063	0.163	0.564***	0.328**	0.601***
CCS	0.340**	1.000	0.155	0.168	0.506***	0.776***	0.025	0.321**
ROA	0.049	0.155	1.000	0.887***	0.130	0.077	-0.100	0.138
ROE	0.063	0.168	0.887***	1.000	0.248*	0.096	-0.110	0.238*
Tobin's Q	0.163	0.506***	0.130	0.248*	1.000	0.651***	-0.141	0.265*
lnTA	0.564***	0.776***	0.077	0.096	0.651***	1.000	-0.113	0.614***
Leverage	0.328**	0.025	-0.100	-0.110	-0.141	-0.113	1.000	-0.197
Industry	0.601***	0.321**	0.138	0.238*	0.265*	0.614***	-0.197	1.000

*Note. *** p < 0.01; ** p < 0.05; * p < 0.10.*

Source: Author's own compilation, (2025)

The Pearson correlations show that CCS is positively and significantly associated with Tobin's Q ($r = 0.506$, $p < 0.01$), while CCR has weak and statistically insignificant correlations with ROA, ROE and Tobin's Q. This preliminary evidence implies that climate strategy is more closely associated with market valuation than climate risk reporting. However, the strong correlation between CCS and lnTA ($r = 0.776$, $p < 0.01$) indicates that larger firms tend to have stronger climate strategy scores. This creates an important interpretation issue: the positive bivariate association between CCS and Tobin's Q may partly reflect firm size, visibility, governance capacity and resource availability rather than a pure strategy effect.

ROA and ROE are strongly correlated ($r = 0.887$, $p < 0.01$), which is expected because both are accounting-based profitability indicators. This does not create a regression problem because ROA and ROE are estimated as separate dependent variables. Industry category is positively correlated with CCR and lnTA, indicating that agriculture-input dependent manufacturing firms tend to have higher climate risk scores and larger asset bases in the supplied data. This is substantively plausible because agriculture-input dependent manufacturing sector is exposed to climate-sensitive raw materials, water availability and energy constraints.

4.5 DIAGNOSTIC TESTING OF REGRESSION ASSUMPTIONS

Before interpreting the panel regression results, diagnostic tests were conducted to assess whether the models were statistically defensible. The purpose of diagnostic testing is not to prove that assumptions are perfectly satisfied, but to identify whether there is evidence of serious violation. The diagnostic tests included Kolmogorov-

Smirnov and Shapiro-Wilk normality tests, the Breusch-Pagan heteroscedasticity test, Durbin-Watson and Breusch-Godfrey autocorrelation tests, and VIF diagnostics for multicollinearity.

Table 4. 5:Diagnostic-test summary

DV	K-S stat	K-S p	S-W stat	S-W p	BP LM	BP p	DW	BG LM	BG p	Max VIF
ROA	0.133	0.292	0.928	0.004	7.615	0.179	1.410	4.068	0.044	4.743
ROE	0.110	0.518	0.950	0.030	7.060	0.216	1.347	4.949	0.026	4.743
Tobin's Q	0.083	0.833	0.981	0.586	4.230	0.517	0.922	14.665	<0.001	4.743

Note. Diagnostics are based on the baseline pooled residual specification used to assess residual behaviour. K-S = Kolmogorov-Smirnov; S-W = Shapiro-Wilk; BP = Breusch-Pagan; BG = Breusch-Godfrey.

Source: Author's own compilation, (2025)

The Kolmogorov-Smirnov test does not reject normality in any of the three models. However, the Shapiro-Wilk test rejects normality for ROA and ROE but not for Tobin's Q. Since the sample is small, the Shapiro-Wilk test is treated as the more sensitive normality diagnostic. This means that residual normality is more defensible for Tobin's Q than for ROA and ROE. The implication is not that the ROA and ROE models are invalid, but that their inferential results require caution.

The Breusch-Pagan p-values are above 0.05 for all three models, indicating no statistically significant evidence of heteroscedasticity. This is favourable because it suggests that error variance is not materially non-constant across observations. In contrast, the autocorrelation diagnostics indicate a major limitation. Durbin-Watson values are below 2 and the Breusch-Godfrey p-values are significant in all three models. This confirms positive serial correlation, especially in Tobin's Q. For this reason, firm-clustered robust standard errors are used in the panel models to improve inference under within-firm dependence.

Table 4. 6:VIF diagnostics

Variable	VIF	Interpretation
CCR Score	2.798	Acceptable
CCS Score	2.955	Acceptable
lnTA	4.743	Highest substantive VIF but below 5
Leverage	1.704	Acceptable
Industry category	2.384	Acceptable

Note. The constant term is excluded from substantive VIF interpretation.

Source: Author's own compilation, (2025)

The VIF results show that multicollinearity is not severe in the direct-effect models. All substantive VIF values are below 5. lnTA has the highest VIF, indicating overlap between firm size, industry and climate scores, but the value remains within an acceptable range for the baseline models. The more serious multicollinearity concern arises only in the raw interaction model, discussed later; this is addressed by mean-centring CCR and CCS.

4.5.1 Model Selection: Fixed Effects, Random Effects and the Hausman Test

Table 4. 7:Restricted Hausman test

DV	FE lnTA	FE LEV	RE lnTA	RE LEV	Chi-square	df	p-value	Decision
ROA	0.031	0.042	0.009	-0.005	0.000*	2	1.000	RE not rejected; restricted test
ROE	-0.345	-0.064	0.007	-0.066	2.536	2	0.281	RE not rejected; restricted test
Tobin's Q	0.516	-1.395	0.844	-1.247	0.069	2	0.966	RE not rejected; restricted test

Note. The Hausman test is restricted to time-varying variables because CCR, CCS and industry category are time-invariant within firms and cannot be directly estimated in a conventional firm fixed-effects model. A negative Hausman statistic was treated as zero, consistent with non-positive definite variance-difference behaviour in small samples.

Source: Author's own compilation, (2025)

The restricted Hausman test does not reject random effects. However, this result must not be overstated. Because CCR, CCS and industry category do not change within firms, fixed effects cannot estimate their direct coefficients. The restricted Hausman comparison therefore assesses only lnTA and leverage. Random effects was retained because it permits estimation of both within-firm and between-firm variation, including the key climate variables.

4.5.2 Random-Effects Panel Results with Firm-Clustered Robust Standard Errors

The random-effects estimations are reported with firm-clustered robust standard errors. This action is justified by the autocorrelation diagnostics, which showed that residuals are correlated across time within firms. Clustered standard errors are therefore more appropriate than unadjusted standard errors for inference. However, because there are only 13 clusters, the results remain exploratory and should not be overstated.

Table 4. 8:Model 1 - CCR and Firm Performance

Variable	ROA	ROE	Tobin's Q
Constant	0.065 (0.463)	0.516 (0.399)	-16.871* (8.891)
CCR Score	-0.008 (0.040)	-0.013 (0.058)	-0.265 (0.401)
Leverage	0.014 (0.166)	-0.021 (0.286)	-1.071 (1.098)
Industry category	0.041 (0.080)	0.129 (0.105)	-0.421 (0.793)
lnTA	0.002 (0.025)	-0.020 (0.021)	1.087* (0.533)
Observations	52	52	52
Firms	13	13	13
rho	0.594	0.495	0.693

*Note. Firm-clustered robust standard errors in parentheses. *** p < 0.01; ** p < 0.05; * p < 0.10.*

Source: Author's own compilation, (2025)

Model 1 shows that CCR does not significantly explain ROA, ROE or Tobin's Q. The CCR coefficients are negative across the three models, but none is statistically significant. This provides no robust evidence that climate change risk reporting directly improves firm performance. The result partially diverges from studies that expect climate risk disclosure to be value-relevant, including Khatib et al. (2023) and Vu and Nguyen (2024), but it is consistent with literature arguing that climate exposure and environmental compliance can impose operational and regulatory burdens. Ghadge et al. (2019), Er-Kara et al. (2021) and Mondal and Bauri (2022) link climate risk to supply-chain disruption, raw-material scarcity and reduced profitability, while Jaffe and Stavins (1995), Millimet and Osang (2003), Aupperle et al. (1985), and Eleftheriadis and Anagnostopoulou (2014) indicate that environmental pressures may generate compliance costs. In the Zimbabwean manufacturing context, CCR may therefore indicate exposure, awareness or disclosure rather than performance-enhancing capability.

Table 4. 9:Model 2 - CCS and Firm Performance

Variable	ROA	ROE	Tobin's Q
Constant	0.479 (0.784)	1.328 (0.819)	-16.290 (12.597)
CCS Score	0.025 (0.031)	0.056 (0.041)	-0.016 (0.281)
Leverage	-0.008 (0.160)	-0.100 (0.226)	-1.299 (1.006)
Industry category	0.050 (0.067)	0.143 (0.086)	-0.675 (0.797)
lnTA	-0.028 (0.050)	-0.080 (0.053)	1.028 (0.780)
Observations	52	52	52
Firms	13	13	13

rho	0.574	0.275	0.705

*Note. Firm-clustered robust standard errors in parentheses. *** p < 0.01; ** p < 0.05; * p < 0.10.*

Source: Author's own compilation, (2025)

Model 2 shows that CCS is positive for ROA and ROE but not statistically significant. This means the direction is consistent with the argument that climate strategy may support accounting performance, but the evidence is not strong enough to claim a direct effect. The finding only weakly agrees with studies that report positive links between climate strategy, sustainability practice and financial performance, including Secinaro et al. (2020), Deepmala and Pandey (2021), Pais Seles et al. (2018), Giang et al. (2021), Mondal and Bauri (2022), Riyad and Antonio (2021), and Lu et al. (2021). It also aligns with Petijean (2019) and Kumar and Firoz (2018), who found no clear relationship. For Tobin's Q, CCS becomes insignificant after firm size is controlled, suggesting that investors may value firm scale and market visibility more strongly than climate strategy alone.

Table 4. 10:Model 3 - Mean-centred Interaction Model

Variable	ROA	ROE	Tobin's Q
Constant	1.369 (0.745)	2.485** (1.015)	-17.777 (15.713)
Centred CCR	-0.037* (0.019)	-0.052* (0.028)	-0.258 (0.456)
Centred CCS	0.047 (0.031)	0.082* (0.041)	-0.022 (0.333)
CCR x CCS	0.055*** (0.012)	0.070*** (0.019)	-0.002 (0.251)
Leverage	0.065 (0.175)	0.061 (0.285)	-1.110 (1.220)
Industry category	0.131* (0.061)	0.253*** (0.078)	-0.428 (0.984)
lnTA	-0.076 (0.041)	-0.138** (0.056)	1.098 (0.897)
Observations	52	52	52
Firms	13	13	13
rho	0.380	0.338	0.741

Note. Firm-clustered robust standard errors in parentheses. CCR and CCS were mean centred before constructing the interaction term.

Source: Author's own compilation, (2025)

Model 3 is the most theoretically important result. The interaction term between centred CCR and centred CCS is positive and statistically significant for ROA and ROE, but not for Tobin's Q. This means that the direct effects of CCR and CCS are weak, but the combination of climate risk exposure and climate strategy matters for accounting performance. The result supports the argument that climate strategy operates as a buffering or risk-mitigation mechanism rather than as an automatic source of financial gain. It is consistent with RBV and NRBV logic because firms with stronger strategic capabilities are better positioned to convert climate risk exposure into resilience and operational response. It also resonates with the Porter Hypothesis, which argues that well-designed environmental responses can stimulate innovation and efficiency (Porter and van der Linde, 1995), but the evidence is partial because the effect appears in ROA and ROE, not in Tobin's Q.

4.5.3 One-year Lagged Analysis

A one-year lag was introduced to improve temporal ordering. CCR, CCS and controls in year t were used to explain ROA, ROE and Tobin's Q in year t+1. This is appropriate because climate risk reporting and climate strategy are unlikely to affect performance immediately. The lagged sample contains 39 observations because 2024 cannot be used to predict 2025 performance in the absence of 2025 data.

Table 4. 11:Descriptive statistics for the one-year lagged sample

Variable	N	Mean	Std. Dev.	Minimum	Median	Maximum
CCR Score	39	2.692	1.061	1.000	3.000	5.000
CCS Score	39	4.154	1.494	2.000	4.000	6.000
ROA(t+1)	39	0.108	0.131	-0.197	0.098	0.497
ROE(t+1)	39	0.187	0.234	-0.290	0.171	0.786
Tobin's Q(t+1)	39	1.641	1.671	0.035	1.162	6.813
lnTA(t)	39	17.989	1.250	16.791	17.565	20.407
Leverage(t)	39	0.156	0.130	0.010	0.140	0.611

Note. The lagged sample uses 2021-2023 predictors to explain 2022-2024 performance.

Source: Author's own compilation, (2025)

Table 4. 12:Lagged Model 1 - CCR(t) and future performance

Variable	ROA(t+1)	ROE(t+1)	Tobin's Q(t+1)
Constant	0.502 (0.345)	0.827* (0.437)	-23.234*** (7.083)
CCR Score(t)	-0.014 (0.043)	-0.006 (0.064)	-0.533 (0.338)
Leverage(t)	0.220 (0.201)	0.246 (0.322)	1.108 (1.027)
Industry category	0.099 (0.063)	0.176* (0.081)	-0.284 (0.786)
lnTA(t)	-0.025 (0.020)	-0.042 (0.024)	1.462*** (0.427)
Observations	39	39	39
Firms	13	13	13
rho	0.688	0.578	0.783

Note. Firm-clustered robust standard errors in parentheses.

Source: Author's own compilation, (2025)

The lagged Model 1 results confirm that CCR does not have a statistically significant direct effect on future ROA, ROE or Tobin's Q. This weakens any claim that climate risk reporting alone improves subsequent financial performance. The result supports a critical distinction between disclosure and capability. From legitimacy theory and institutional theory, firms may disclose climate risks because of regulatory expectations, stakeholder scrutiny or mimetic pressures, but disclosure does not necessarily mean that the firm has implemented operational changes capable of improving profitability.

Table 4. 13:Lagged Model 2 - CCS(t) and future performance

Variable	ROA(t+1)	ROE(t+1)	Tobin's Q(t+1)
Constant	1.398* (0.700)	1.987** (0.876)	-23.887** (8.968)
CCS Score(t)	0.055 (0.033)	0.073* (0.041)	-0.136 (0.216)
Leverage(t)	0.181 (0.165)	0.199 (0.242)	0.796 (0.910)
Industry category	0.121 (0.076)	0.217** (0.094)	-0.873 (0.835)
lnTA(t)	-0.090* (0.047)	-0.125* (0.058)	1.470** (0.547)
Observations	39	39	39
Firms	13	13	13
rho	0.675	0.554	0.813

Note. Firm-clustered robust standard errors in parentheses.

Source: Author's own compilation, (2025)

Lagged Model 2 provides partial evidence for CCS. CCS is positive for future ROA and weakly significant for future ROE, but not significant for future Tobin's Q. This suggests that climate strategy may have delayed benefits for accounting performance, particularly shareholder profitability, but the evidence is still not strong enough to claim a consistent direct effect across all measures. The finding partly agrees with Khatib et al. (2023) and Sharma et al. (2022), who link climate strategy and governance to performance, but the limited statistical strength reflects the small sample, short time frame and Zimbabwean context of energy shortages, regulatory uncertainty and constrained adaptive capacity.

Table 4. 14:Lagged Model 3 - centred moderation model

Variable	ROA(t+1)	ROE(t+1)	Tobin's Q(t+1)
Constant	2.262** (0.964)	3.312** (1.142)	-28.188** (10.896)
Centred CCR(t)	-0.038 (0.037)	-0.042 (0.063)	-0.580 (0.414)
Centred CCS(t)	0.072* (0.036)	0.099** (0.044)	-0.170 (0.260)
CCR x CCS(t)	0.053** (0.020)	0.076** (0.031)	0.043 (0.234)
Leverage(t)	0.226 (0.210)	0.277 (0.358)	1.175 (1.163)
Industry category	0.195** (0.087)	0.315** (0.113)	-0.358 (0.956)
lnTA(t)	-0.129** (0.055)	-0.188** (0.065)	1.657** (0.620)
Observations	39	39	39
Firms	13	13	13
rho	0.641	0.491	0.824

Note. Firm-clustered robust standard errors in parentheses. CCR and CCS were centred before the interaction was constructed.

Source: Author's own compilation, (2025)

Lagged Model 3 provides the strongest evidence in the chapter. The interaction between CCR and CCS is positive and statistically significant for future ROA and future ROE. This means that climate strategy appears to change the way climate risk reporting relates to future accounting performance. Where climate strategy is stronger, climate risk exposure is less damaging and may become more manageable. This supports H_3 for accounting performance. It also aligns with the literature that regards climate strategy as a mechanism for resilience, risk mitigation, supply-chain adaptation and strategic preparedness, including Silwimba and Fadun (2022), Karimi et al. (2021), Massey et al. (2021), Patnaik and Fabrizio (2023), and Hakkarainen et al. (2020).

4.5.4 Robustness Checks

Mean-Centring and Multicollinearity in the Interaction Model

Table 4. 15:VIF comparison for raw and mean-centred interaction models

Variable	Raw interaction VIF	Centred interaction VIF
CCR	27.134	3.515
CCS	12.418	3.076
CCR x CCS	46.190	1.664
Leverage	1.917	1.917
Industry category	3.055	3.055
lnTA	5.374	5.374

Note. Mean-centring substantially reduces artificial multicollinearity in the interaction term.

Source: Author's own compilation, (2025)

The raw interaction model is mathematically weak because the interaction term is highly collinear with CCR and CCS. Before estimating the moderation model, multicollinearity diagnostics were conducted because interaction terms can generate inflated correlations with their component variables. The initial uncentred interaction term, CCR×CCS, produced a VIF of 46.190, indicating severe multicollinearity and coefficient instability. This made the raw interaction specification unsuitable for rigorous statistical interpretation. To address this issue, CCR and CCS were mean centred prior to constructing the interaction term. After centring , the VIF values declined substantially, making the moderation model more statistically defensible while preserving the substantive interpretation of the interaction effect. After mean-centring, the interaction VIF falls to 1.664. This justifies the decision to report the centred interaction model. The substantive interpretation of the interaction is retained, while coefficient instability caused by artificial collinearity is reduced.

4.5.5 Spearman Correlation Robustness Check

Table 4. 16:Spearman rank correlations with future performance

Variable	ROA r	ROA p	ROE r	ROE p	Tobin's Q r	Tobin's Q p
CCR Score	0.146	0.377	0.241	0.139	0.234	0.152
CCS Score	0.160	0.331	0.190	0.246	0.608***	<0.001
CCR x CCS	0.160	0.330	0.090	0.587	0.348**	0.030
Leverage	-0.012	0.941	0.089	0.588	-0.074	0.656
Industry category	0.315*	0.051	0.398**	0.012	0.238	0.145
lnTA	-0.119	0.469	-0.071	0.667	0.435***	0.006

Note. Spearman correlation is used because CCR and CCS are ordinal scores.

Source: Author's own compilation, (2025)

Spearman correlations confirm that CCS is strongly associated with future Tobin's Q at the bivariate level. However, the regression models show that this association weakens once firm size is controlled. This is an important methodological finding: the apparent market-value advantage of climate strategy may be partly a firm-size effect. Larger firms tend to have better-developed climate strategy disclosures and higher market valuation. Therefore, it would be incorrect to claim that CCS independently drives Tobin's Q without controlling for firm size.

4.5.6 Year-Dummy Sensitivity Analysis

Table 4. 17:Lagged Model 3 with year dummies

Variable	ROA(t+1)	ROE(t+1)	Tobin's Q(t+1)
Centred CCR	-0.039 (0.039)	-0.045 (0.064)	-0.563 (0.406)
Centred CCS	0.071* (0.036)	0.094* (0.045)	-0.201 (0.284)
CCR x CCS	0.053** (0.019)	0.075** (0.031)	0.024 (0.238)
Leverage	0.236 (0.219)	0.304 (0.360)	0.961 (0.921)
Industry category	0.194** (0.087)	0.310** (0.115)	-0.450 (0.960)
lnTA	-0.126** (0.055)	-0.177** (0.064)	1.724** (0.673)
2022 dummy	0.056* (0.031)	0.066 (0.059)	0.112 (0.184)
2023 dummy	0.016 (0.029)	0.018 (0.045)	-0.174 (0.249)

Note. Reference year is 2021 predictor year. Standard errors are firm-clustered.

Source: Author's own compilation, (2025)

The year-dummy sensitivity test shows that the positive CCR x CCS interaction remains significant for ROA and ROE after controlling for year-specific shocks. This strengthens the moderation finding because it suggests that the result is not merely driven by a common year effect. This is important in Zimbabwe, where macroeconomic volatility, exchange-rate instability, energy constraints and post-COVID recovery conditions could affect all listed firms simultaneously.

4.5.7 Winsorisation Sensitivity Analysis

Table 4. 18:Winsorised lagged Model 3

Variable	ROA(t+1)	ROE(t+1)	Tobin's Q(t+1)
Centered CCR	-0.023 (0.021)	-0.019 (0.034)	-0.544 (0.392)
Centered CCS	0.071* (0.036)	0.090* (0.042)	-0.148 (0.257)
CCR x CCS	0.048*** (0.014)	0.062*** (0.018)	0.062 (0.218)
Leverage	0.210 (0.173)	0.267 (0.278)	1.482 (1.402)
Industry category	0.171** (0.070)	0.271*** (0.081)	-0.331 (0.929)
lnTA	-0.131* (0.060)	-0.172** (0.066)	1.537** (0.608)

Note. Financial variables were winsorised at the 5th and 95th percentiles to assess outlier influence.

Source: Author's own compilation, (2025)

The winsorised results confirm that the interaction remains positive and significant for ROA and ROE. This indicates that the moderation finding is not driven solely by extreme observations. For Tobin's Q, the interaction remains insignificant, while lnTA remains positive. This reinforces the conclusion that market valuation is more strongly linked to firm size than to the CCR-CCS interaction.

4.5.8 Marginal-Effects Interpretation of the Interaction Term

Table 4. 19:Marginal effect of CCR at different levels of CCS

CCS level	ROA(t+1)	ROE(t+1)	Tobin's Q(t+1)
Low CCS (-1 SD)	-0.117	-0.155	-0.644
Mean CCS	-0.038	-0.042	-0.580
High CCS (+1 SD)	0.042	0.072	-0.516

Note. Values are based on the lagged centered interaction model. They show how the effect of CCR changes at low, mean and high CCS.

Source: Author's own compilation, (2025)

The marginal-effects analysis clarifies the meaning of the interaction term. When CCS is low, the effect of CCR on future accounting performance is negative. At the mean level of CCS, the negative effect is smaller. When CCS is high, the marginal effect becomes positive for ROA and ROE. This provides a substantive interpretation: climate strategy appears to buffer or reverse the adverse accounting-performance implications of climate risk. For Tobin's Q, the marginal effect remains negative, confirming that the moderation result is not supported for market valuation.

4.6 Discussion of Empirical Findings in Relation to Prior Literature

4.6.1 Direct CCR Effect: Weak Evidence and Distinction Between Disclosure and Capability

The first major empirical finding is that CCR does not have a statistically significant direct effect on ROA, ROE or Tobin's Q in either the baseline or one-year lagged models. This finding does not support a simple value-relevance argument that climate risk reporting directly improves firm performance. It partly disagrees with the expectation underlying Khatib et al. (2023) and Vu and Nguyen (2024), which informed the hypothesis that CCR would be significantly associated with firm performance. However, it agrees with the more cautious and cost-based literature showing that climate risk and environmental regulation can impose burdens through supply-chain disruption, compliance costs, raw-material constraints and investor uncertainty. Ghadge et al. (2019), Er-Kara et al. (2021), Mondal and Bauri (2022), Lash and Wellington (2007), and Patnaik and Fabrizio (2023) all support the argument that climate risk can disrupt operations and profitability rather than automatically create value.

This finding is theoretically important. Institutional theory suggests that listed firms may disclose climate risks because they face coercive pressure from regulatory requirements, normative pressure from professional and social expectations, and mimetic pressure to imitate perceived best practice. Legitimacy theory further suggests that disclosure may be used to maintain social approval and protect organisational legitimacy. Therefore, the insignificant CCR effect should not be interpreted as evidence that climate risk is irrelevant. Empirical evidence show that climate risk reporting alone is not sufficient to improve firm performance unless it is supported by strategic capability, governance routines and operational adaptation. This is particularly plausible in Zimbabwe, where manufacturing firms face climate-sensitive supply chains, energy shortages, policy inconsistency and resource constraints.

4.6.2 Direct CCS Effect: Partial Evidence but Not a Standalone Performance Driver

The second major finding is that CCS has a positive but generally weak direct relationship with accounting performance, with only partial lagged support for ROE. This partially agrees with positive empirical studies such as Secinaro et al. (2020), Deepmala and Pandey (2021), Pais Seles et al. (2018), Giang et al. (2021), Mondal and Bauri (2022), Riyad and Antonio (2021), Lu et al. (2021), Khatib et al. (2023), and Sharma et al. (2022), which associate climate strategy, governance and sustainability practices with better financial outcomes. However, the weak significance also supports the inconclusive stream represented by Petijean (2019), Kumar and Firoz (2018), Lewandowski (2017), and Hillmann et al. (2022), where climate-performance relationships are not uniform across contexts.

Theoretically, the CCS result offers partial support for RBV and NRBV. Firms with stronger climate strategies may possess superior organisational routines, governance capability, environmental knowledge and resilience capacity. However, the weak direct effect indicates that these capabilities do not automatically translate into short-term profitability. In a resource-constrained manufacturing environment, climate strategy may require upfront expenditure, energy-efficiency investment, reporting systems, compliance costs and managerial attention before financial benefits emerge. This explains why the direct CCS effect is weaker than the interaction effect. Strategy may matter most when it is deployed against actual climate risk exposure, rather than when it is treated as an isolated disclosure score.

4.6.3 Moderation Effect: The Strongest Empirical Contribution

The strongest and most consistent empirical finding is that the CCR x CCS interaction is positive and statistically significant for ROA and ROE in the baseline centred model, one-year lagged model, year-dummy sensitivity model and winsorised model. This supports H_3 for accounting performance. The finding is conceptually stronger than a simple direct effect claims because it shows that climate strategy changes the effect of climate risk on firm performance. The marginal-effects analysis demonstrates that when CCS is low, CCR is negatively associated with future accounting performance; when CCS is high, the relationship becomes less negative and turns positive for accounting returns. This means that climate strategy operates as a buffering, adaptive or resilience-building mechanism.

This finding agrees with the literature that frames climate strategy as a risk-management capability. Silwimba and Fadun (2022) argue that firms must anticipate, measure and respond to climate risks. Karimi et al. (2021) emphasise scenario planning and preparedness. Patnaik and Fabrizio (2023) link resilience to adaptive supply chains and strategic responsiveness. Hakkarainen et al. (2020), Abere and Saka (2023), and Banjo et al. (2021) connect risk awareness and risk management to manufacturing performance. The moderation result therefore extends the literature by showing that climate strategy does not necessarily improve performance independently, but it improves the firm's ability to manage the financial implications of climate risk.

This is also the most direct support for the integrated theoretical framework. Institutional theory explains why firms face pressure to report and respond to climate change. Legitimacy theory explains why firms disclose climate risks and strategies to maintain acceptance. Stakeholder theory explains why investors, regulators, creditors, customers and communities shape climate-related responses. RBV explains why some firms can convert strategy into performance because they possess internal capabilities. The empirical results suggest that no single theory fully explains the findings. Institutional and legitimacy theory explain disclosure, but RBV explains why strategy moderates risk. Stakeholder theory explains the external pressure that makes climate strategy financially relevant.

4.6.4 Tobin's Q: Market Valuation is More Size-Driven than Climate-Variable Driven

The Tobin's Q results differ from ROA and ROE. Although CCS is positively correlated with Tobin's Q in the Pearson and Spearman analyses, the regression models show that the relationship weakens once lnTA is included. Firm size is the strongest and most consistent predictor of Tobin's Q, especially in the lagged models. This partially agrees with Flammer (2021), who conceptualises Tobin's Q as a forward-looking market measure that may reflect intangible assets, governance quality and strategic positioning. However, the present results suggest that in Zimbabwean listed manufacturing firms, market valuation may be more strongly influenced by firm scale, visibility, liquidity and perceived stability than by climate strategy alone.

This finding qualifies the investor-confidence argument in the literature. Krueger et al. (2020), Cevik and Miryugin (2022), Wang et al. (2024), Liu et al. (2024), and Wang et al. (2025) indicate that climate governance and climate uncertainty increasingly influence firm value and financial markets. The present study does not reject that argument, but it shows that the effect is not cleanly separable from firm size in this small Zimbabwean sample. Larger firms may have better disclosure systems, stronger governance visibility and greater market attention. Therefore, Tobin's Q may be reflecting a combined effect of size, visibility and governance maturity rather than climate strategy alone.

4.6.5 Reconciliation with Porter Hypothesis and Compliance-Cost Literature

The findings occupy a middle position between the Porter Hypothesis and the compliance-cost view. The Porter Hypothesis suggests that well-designed environmental responses can stimulate innovation, efficiency and productivity, ultimately improving performance. The positive CCR x CCS interaction for ROA and ROE partially supports this view because firms with stronger climate strategy appear better able to manage climate risk in ways that protect or improve accounting returns. However, the weak direct effects of CCR and CCS and the insignificant Tobin's Q interaction also support the compliance-cost literature, which argues that environmental initiatives can increase operational costs and weaken short-term profitability. The study therefore does not confirm a purely optimistic sustainability-performance relationship. Instead, it shows a conditional relationship: climate strategy matters when it is aligned with climate risk exposure and operational capability.

4.6.6 Hypothesis Evaluation

Table 4. 20:Hypothesis decisions

Hypothesis	Decision	Justification
H_1: CCR is significantly associated with firm performance	Not supported as a direct effect	CCR is not significant in baseline or lagged direct-effect models.
H_2: CCS is significantly associated with firm performance	Partially and weakly supported	CCS has weak/partial support for lagged ROE, but not consistent direct effects across ROA, ROE and Tobin's Q.
H_3: CCS moderates CCR-performance relationship	Supported for accounting performance only	The centred interaction is positive and significant for ROA and ROE in baseline, lagged, year-dummy and winsorised models, but not for Tobin's Q.

Note. Decisions are based on the full set of baseline, lagged and robustness analyses.

Source: Author's own compilation, (2025)

H_1 is not supported as a direct-effect hypothesis because CCR is not statistically significant across the models. H_2 receives only partial and weak support because CCS shows some positive direction and weak lagged association with ROE, but not consistent significance across the three performance measures. H_3 receives the strongest support, but only for accounting-based performance. The moderation effect is robust for ROA and ROE but not for Tobin's Q. As such this distinction between accounting and market performance is an important contribution of the study.

4.6.7 Integrated Conclusion of the Quantitative Findings

Climate change risk reporting and climate change strategy do not have strong standalone direct effects on firm performance in the supplied dataset. However, climate strategy significantly moderates the relationship between climate risk reporting and accounting performance. This implies that the financial value of climate strategy lies not simply in disclosure or symbolic governance, but in its capacity to help firms manage climate risk exposure. The effect is visible in ROA and ROE, which are accounting-based measures, but not in Tobin's Q, which appears more strongly driven by firm size.

The results are scientifically robust because the analysis incorporates diagnostic testing, model-selection caution, clustered standard errors, one-year lagging, mean-centred interaction modelling, Spearman correlation, year-dummy sensitivity analysis, winsorisation and marginal-effects interpretation. At the same time, the chapter does not overclaim. The small sample, short period, time-invariant CCR and CCS scores, and reliance on secondary data mean that causal claims must remain cautious. The strongest contribution is therefore not a universal causal claim, but a context-specific empirical finding: in Zimbabwean listed manufacturing firms, climate strategy appears to function as a resilience mechanism that strengthens the relationship between climate risk reporting/awareness and future accounting performance.

4.7 CHAPTER SUMMARY

This chapter analysed the quantitative component of the study using descriptive statistics, correlation analysis, diagnostic testing, random-effects panel regression, one-year lagged models and robustness checks. The diagnostic tests showed that heteroscedasticity and severe multicollinearity are not major concerns in the baseline models, but autocorrelation is present; this justified the use of firm-clustered robust standard errors. The direct effects of CCR and CCS were weak. The strongest finding was the positive moderating effect of CCS on the CCR-performance relationship for ROA and ROE. This finding supports the integrated institutional-legitimacy-stakeholder-RBV framework and provides a basis for the qualitative interpretation and triangulation that should follow in the subsequent section or chapter.

CHAPTER 5: PRESENTATION AND ANALYSIS OF QUALITATIVE DATA

5.1 INTRODUCTION

This section of the study delves into the qualitative data analysis, utilising NVivo software to uncover rich insights into the research context. This chapter discusses the findings rather than merely re-presenting descriptive outputs. The qualitative strand uses documentary thematic analysis to interpret how governance capacity, implementation constraints, regulatory pressure, climate exposure, resource dependence and disclosure credibility shape the relationship between climate change and firm performance. NVivo is treated as a coding and data-management aid; interpretation remains the researcher's analytical responsibility. Triangulation is reported using four categories: convergence, where qualitative evidence supports the quantitative pattern; complementarity, where qualitative evidence explains a quantitative result; divergence, where qualitative evidence complicates or contradicts a quantitative result; and silence, where one strand does not provide evidence on an issue raised by the other.

5.2 VISUAL CONCEPTUAL MAPPING OF CLIMATE DISCOURSE IN ZIMBABWEAN MANUFACTURING SECTOR

Qualitative data were managed and coded using NVivo. Word-frequency outputs and visual maps were used only as exploratory aids. The substantive analysis relied on thematic coding of documentary evidence, with attention to governance arrangements, climate-risk disclosures, implementation practices, constraints and performance implications. A word cloud is a visual representation of word count frequencies in the data set and the salient concepts across the corpus (Hai-Jew, 2017; Skeppstedt, et al., 2023). The most frequently occurring terms in the qualitative dataset (total word count=100), highlighting key themes in the relationship between climate change and firm performance in the Zimbabwean manufacturing sector. The font size and boldness represent the frequency and importance of each term (Skeppstedt, et al., 2023).

Figure 5. 1:Key Themes: Climate Discourse in Zimbabwe's Manufacturing Sector

Source: Author's own compilation, (2025)

Figure 5.1 provides high-level visual representation of the salient concepts identified within the firm reports. The dominance of terms like "climate," "change," and "risk" underscores that climate change is no longer a peripheral CSR issue but a core operational concern for the 13 firms studied.

5.2.1 Interplay between Climate Change and Firm Performance

The interplay between climate and firm-level constructs such as performance, costs, strategy, and risk reflect an analytical framing in which climate change is understood as a multidimensional determinant of organisational competitiveness. Existing scholarship emphasises that climate-related disruptions introduce financial and operational uncertainties that can influence supply chain resilience, market positioning, and variability in business (Porter & Reinhardt, 2007; IPCC, 2022). The prominence of risk within the thematic structure suggests that manufacturing firms in Zimbabwe perceive climate change as a material threat to operational continuity and financial stability. Similarly, the emphasis on costs highlights the economic burden associated with climate adaptation and mitigation, including increased operational expenditure and capital investments in resilience measures. This aligns with prior studies conducted in developing economies which states that these factors shape firm-level performance outcomes (Junjun, et al., 2018).

5.2.2 Governance, Policy, and regulatory Framework

The themes governance, policy, and regulatory frameworks represent critical institutional dimensions that mediate a firm's adaptative capacity in the face of climate-related risks. Prior studies argue that firms must effectively mobilise internal resources to comply with environmental regulations and to integrate climate considerations into strategic decision-making (Berrone, et al., 2012). The presence of terms such as government, policies, compliance, and regulation underscore the institutional pressures shaping the climate-performance nexus. Regulatory environments characterised by stringent compliance requirements can act as mechanisms that incentivise sustainable business practices, thereby enhancing organisational resilience and supporting long-term performance (Kolk & Pinkse, 2005).

5.2.3 Strategic Response and Adaptation

The inclusion of themes such as strategies, management, and mitigation reflect the strategic orientation of manufacturing firms in Zimbabwe as they respond to climate-related risks. Literature highlights that proactive climate adaptation, supported by managerial awareness and strategic foresight is essential for sustaining firm performance under conditions of environmental uncertainty (Eisenhardt & Martin, 2000; Linnenluecke, et al., 2013). The thematic patterns suggest that firms may adopt innovative practices such as diversifying raw material sources, strengthening supply chain partnerships, and investing in green technologies. However, these strategic responses often entail significant financial commitments, consistent with evidence that green investments impose short-term cost pressures despite their long-term performance benefits (Ambec & Lanoie, 2008).

5.2.4 Resource and Material Management

The presence of terms such as material, resources, and supply chain highlight the centrality of resource and material management in shaping firm performance amid climate uncertainty. Climate change affects the availability, quality, and cost of raw materials, thereby influencing production efficiency and operational stability (Christopher & Peck, 2004).This underscores the need for climate-resilient supply chain strategies that mitigate exposure to climate-induced disruptions and ensure business continuity. This suggests that developing sustainable supply chain management practices is essential for maintaining competitive advantage in volatile environmental contexts and this aligns with prior studies by (Seuring & Muller, 2008).

5.2.5 Sustainability and Corporate Responsibility (CSR)

The inclusion of sustainability, compliance, and collaborations reflects the integration of environmental, economic, regulatory, and relational considerations within the operational landscape of Zimbabwean manufacturing firms. This thematic configuration aligns with literature suggesting that sustainability-oriented practices enhance organisational legitimacy, strengthen stakeholder relationships, and support long-term performance outcomes (Carroll & Shabana, 2010). The findings emphasise the importance of embedding sustainability within corporate governance structures to enhance against climate-related challenges.

5.2.6 External and Internal Factors

The climate-performance relationship is shaped by a complex interaction between external contextual factors such as supply chain dynamics, regulatory structures, and international norms and internal organisational capabilities, including strategic management, resource availability, and adaptive capacity. This interplay reflects the broader theoretical view that firm performance under climate stress is contingent upon both environmental conditions and firm-specific capabilities (Eisenhardt & Martin, 2000). The themes therefore highlight the multi-layered nature of climate impacts, demonstrating that both external pressures and internal competencies jointly determine organisational outcomes.

5.3 HIERARCHICAL MAPPING OF THEMES

The Sunburst provides a hierarchical visualisation of key themes and sub-themes explored in a study. Visualisation, as defined by Khartabil, (2020) is a graphical representation that aids understanding the insights in datasets, thereby helping to explore arguments and grasp complex problems such as climate change.

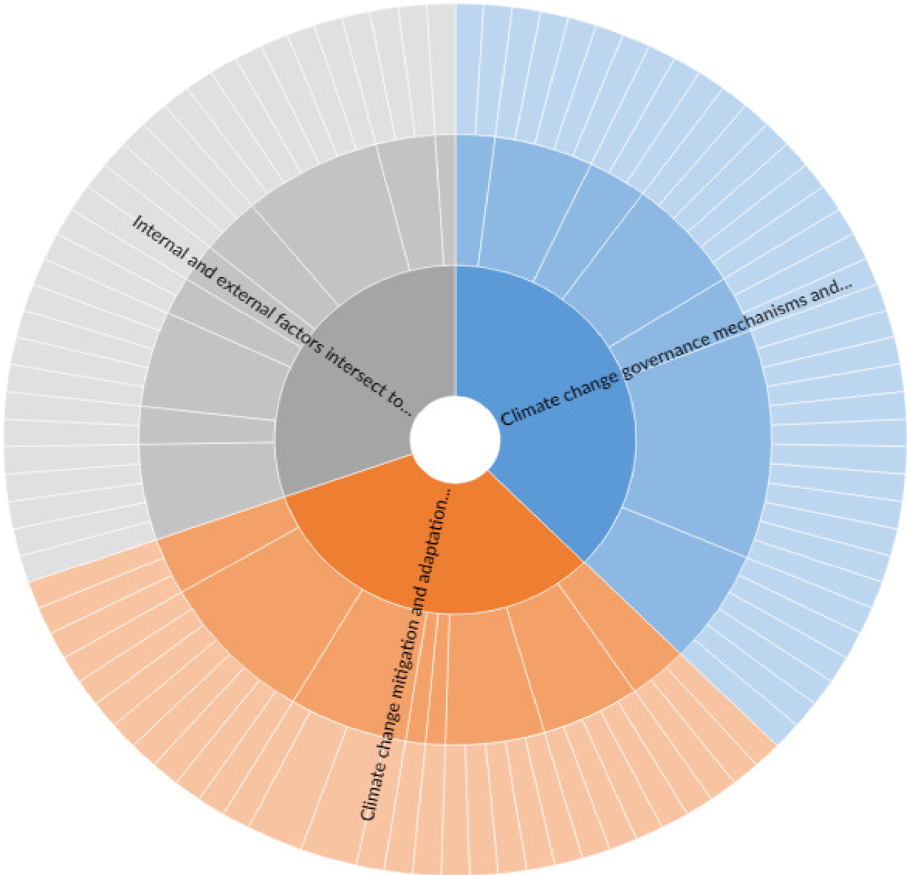

Figure 5. 2: Hierarchical Mapping of Themes

Source: Author's own compilation, (2025)

Figure 5.2 provides a hierarchical visualisation of the core research themes. The diagram is divided into three primary segments that represent the "Climate Action Architecture" of the sampled firms, namely climate change governance mechanisms, climate change mitigation and adaptation, and internal and external intersecting factors. Climate Change Governance Mechanisms: This core segment (Blue) highlights the pivotal role of leadership and the policy structures. It indicates that firms do not view climate change in isolation but as a governance mandate requiring board-level oversight. Climate Change mitigation and Adaptation: The second segment (Orange) reflects the operational "Strategic" response. It identifies proactive measures such as renewable energy adoption and carbon capture as key determinants of adaptive resilience. Internal and External Intersecting Factors: the third segment

(Grey) represents the contextual pressures, including regulatory demands from EMA and market expectations from ZSE.

5.3.1 The Governance-Performance Nexus

The qualitative evidence from the Sunburst and Word Cloud confirms that "Governance" is the engine behind the strategic scores observed in the quantitative phase. While the quantitative results showed a massive boost in Tobin's Q for firms with proactive strategies, the qualitative data explains why: firms are using climate governance to signal institutional leadership (DiMaggio & Powell, 1983). In the Zimbabwean context, this is a response to SI 134 of 2019, which mandates sustainability reporting (Zimbabwe Stock Exchange, 2020). However, the qualitative narrative also highlights "Compliance Costs".

5.3.2 Climate Change Awareness as a Regulatory Derivative

A critical finding from the qualitative data (Figure 4:1) is that "Climate Awareness" is heavily driven by stock market regulatory requirements rather than purely voluntary altruism. This supports the findings by Jeke, et al., (2025) who note that while sustainability reporting is on the rise in Zimbabwe, it is often driven by the need for capital access and listing compliance. The market rewards this "Awareness" because it reduces investor skepticism regarding "greenwashing." However, as Yu, et al., (2020) suggest, if disclosures are perceived as merely "reputational acceptance" rather than substantive value creation, the long-term financial benefits may be capped.

5.3.3 The Energy-Operational Reality

The word cloud's emphasis on "Energy," "Efficiency," and "manufacturing" highlights a unique local factor. For Zimbabwean manufacturers, climate strategy is often an operational necessity (Weinhofer & Busch, 2013) due to national power instability. Proactive firms adopting renewable energy sources (as seen in the Sunburst) are not just mitigating carbon, they are mitigating operational risk which underscores the importance of institutional and policy frameworks in shaping firm responses to climate-related challenges (Kolk & Pinkse, 2005).

5.4 FINDINGS FOR RESEARCH QUESTION 1

How do climate change governance mechanisms mitigate climate-related financial risks?

The resultant themes and sub-themes from question 1 are visually represented in figure 5.3 below.

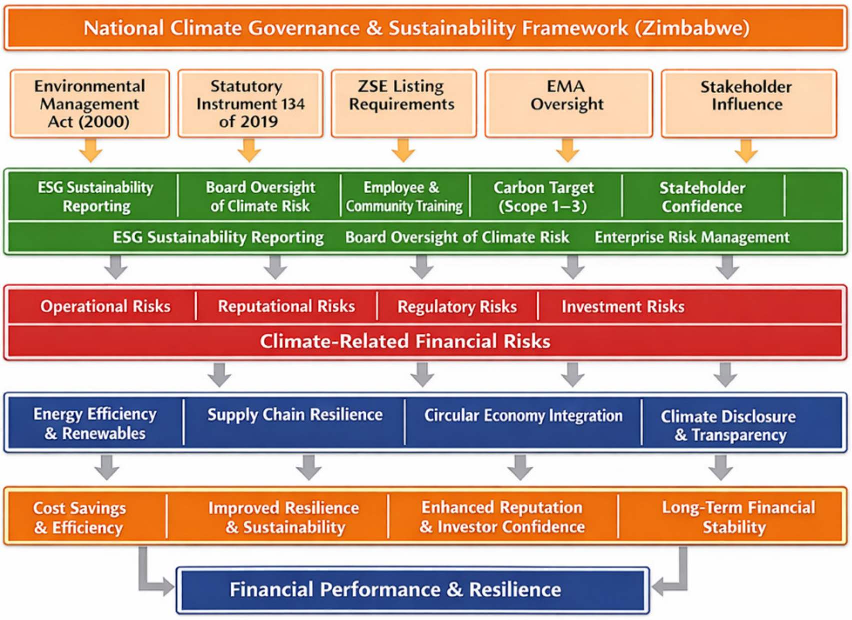

Figure 5. 3:National Climate Governance & Sustainability Framework

Author's own compilation, (2025)

The findings in figure 5.1 demonstrate that climate change governance mechanisms in Zimbabwe operate through a combination of regulatory enforcement, stakeholder expectations, and international reporting norms, all of which shape corporate environmental behaviour. These mechanisms include the Environmental management Act (2002), SI 134 of 2019, ZSE listing requirements, and oversight by EMA. Together, they form a governance architecture that compels firms to disclose environmental performance, integrate climate considerations into operations, and adopt sustainability reporting frameworks.

5.4.1 Regulatory Compliance as a Driver of Climate Governance

The empirical evidence shows that sustainability reporting practices among Zimbabwean manufacturing firms are primarily driven by coercive institutional pressures. Companies explicitly cite government regulations, stakeholder interests, and international best practices as the dominant influences in the ESG reporting. This aligns with institutional theory, which posits that organisations conform to external pressures to maintain legitimacy and secure access to resource (DiMaggio & Powell, 1983). In emerging economies, regulatory frameworks often serve as the primary catalyst for environmental action due to limited voluntary uptake of sustainability practices (Wang, et al., 2025). The Zimbabwean context mirrors this pattern: firms comply with EMA and ZSE requirements to avoid penalties, maintain operational licences, and meet investor expectations. These findings align with prior studies which posit that governance strengthens compliance leading to transparency and accountability (Efunniyi, et al., 2024). This compliance-driven behaviour underscores the importance of strong regulatory institutions in shaping corporate environmental governance (Wang, et al., 2025). These qualitative findings echo earlier scholarly evidence by (Reid & Toffel, 2009) who posited that firms increase their disclosure of climate-change strategies when they face stronger regulatory threats, as compliance pressure pushes them toward greater transparency to avoid sanctions and anticipate future policy shifts.

5.4.2 Climate Change as a material Financial Risk

The qualitative findings reveal that firms recognise climate change as both a material risk and a strategic opportunity. Extreme weather events such as the 2023/24 drought, El Nino patterns, and heatwaves have disrupted raw material availability, increased operational costs, and strained supply chains. These disruptions have direct financial implications, including increased reliance on expensive imported inputs, higher energy costs due to reduced hydroelectricity generation, production downtime caused by power outages, and increased transportation costs due to damaged infrastructure.

These finding align with global evidence that climate-related risks can destabilise supply chains, reduce profitability, and increase operational volatility (IPCC, 2022; Er-Kara, et al., 2021). In emerging markets, where infrastructure is often fragile, climate shocks have amplified financial consequences (Hallegatte, 2019)

5.4.3 Governance Mechanisms as Enablers of Risk Mitigation

Despite these changes, climate governance mechanisms have stimulated adaptative innovation. Firms have invested in solar-powered machinery, biomass energy, cogeneration systems , energy-efficiency technologies, and strengthened supply chain partnerships. One firm even generated surplus electricity for the national grid, demonstrating how climate governance can stimulate revenue Streams. This supports the Porter Hypothesis, which argues that stringent environmental regulations can drive innovation and enhance competitiveness (Porter & Linde, 1995).

Furthermore, board-level oversight of climate risk and integration into ERM frameworks indicate a growing strategic awareness. This aligns with literature emphasing the importance of governance structures in mitigating climate-related financial risks (Ewim, et al., 2023; Eccles & Krzus, 2018).

5.4.4 Limitations and Risks of Greenwashing

The qualitative findings highlight concerns that lack of third-party assurance undermines the credibility of sustainability disclosures. This mirrors global concerns about greenwashing, where firms exaggerate environmental performance to maintain legitimacy (Villena & Dhanorkar, 2020).The findings reveal a pattern of symbolic compliance wherein firms adopt superficial environmental reporting to appease regulators in weak institutional environments, a strategic behaviour that aligns with literature suggesting that institutional development must accompany pressure to transition firms toward substantial compliance (Yang & Kim, 2025).

Overall, climate governance mechanisms mitigate financial risks by compelling firms to adopt resilient operational practices, enhancing transparency and accountability, stimulating innovation through regulatory pressure, strengthening stakeholder confidence, and encouraging integration of climate risk into strategic planning. However, their effectiveness is moderated by policy inconsistency (Mapuranga, et al., 2026), infrastructural constraints, and limited assurance mechanisms.

5.5 RESEARCH QUESTION 2

What climate change mitigation and adaptation strategies enhance firm performance, resilience, and sustainability in Zimbabwean manufacturing sector?

The above overarching research question was divided into secondary questions. These secondary questions provided a structured framework for addressing the primary inquiry. The ensuing framework, encompassing primary themes and sub-themes, is visually depicted in figure 5.4 below.

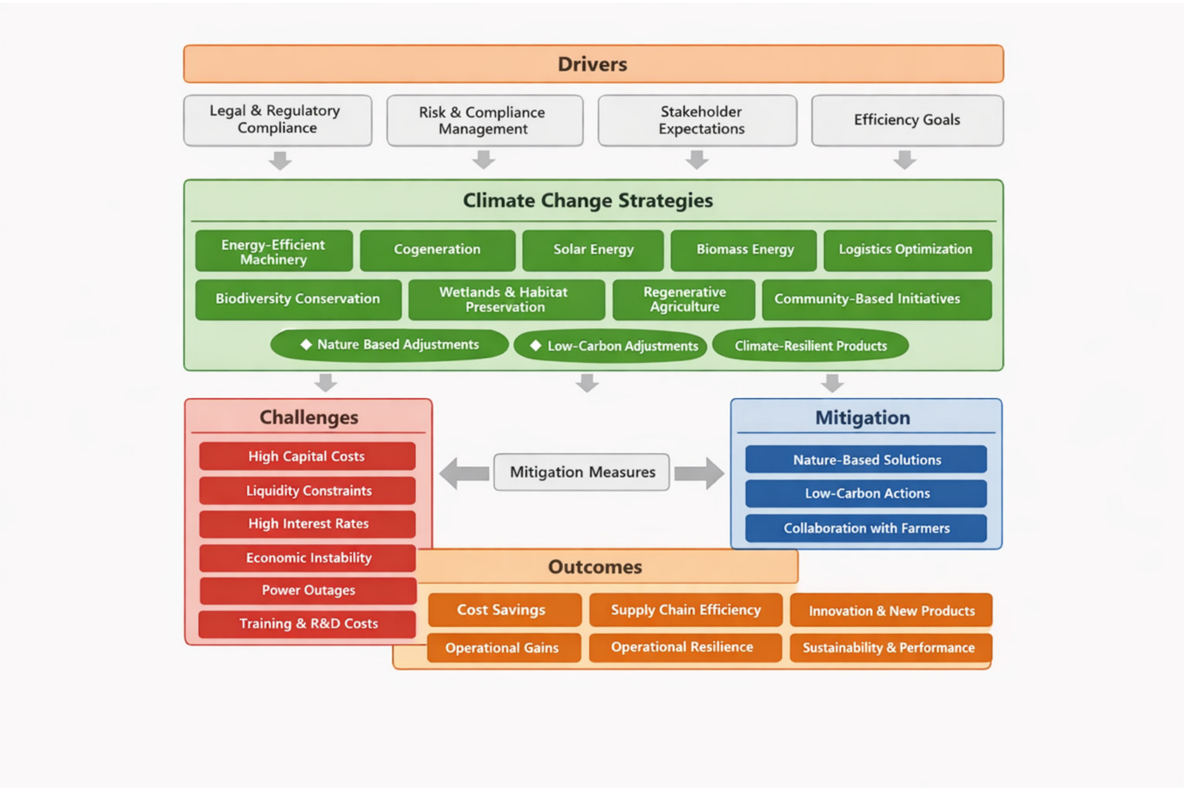

Figure 5. 4:Climate Change Strategy and Firm Performance Framework

Source: Author's own compilation, (2025)

5.5.1 Climate change mitigation and adaptation strategies and their Influence on firm performance, resilience, and sustainability

The second question explores the strategies adopted by Zimbabwean manufacturing firms to mitigate and adapt to climate change, and how these strategies influence firm performance, resilience, and sustainability. These findings reveal a complex landscape in which firms navigate regulatory pressures, operational constraints, and climate-induced disruptions while simultaneously seeking opportunities for innovation, efficiency, and competitive advantage.

5.5.2 Regulatory and Institutional Drivers of climate Mitigation Strategies

The qualitative empirical findings show that the primary driver of climate mitigation strategies among Zimbabwean manufacturing firms is regulatory compliance. Firms are compelled to align with EMA emissions regulations, ZSE sustainability reporting requirements, and the National Determined Contribution (NDC) target of 40 per cent emissions reduction. This compliance-driven behaviour reflects the coercive pillar of institutional theory, which posits that organisations adopt certain practices to conform to legal and regulatory expectations (DiMaggio & Powell, 1983).

Similar patterns are observed in other emerging economies, where regulatory frameworks serve as the main catalyst for environmental action due to limited voluntary uptake (Amran & Haniffa, 2011). In South Africa, mandatory carbon tax legislation has significantly influenced corporate climate strategies (Winkler & Marquard, 2009). In Zimbabwe, firms explicitly acknowledge that compliance with EMA and ZSE requirements is essential to avoid penalties, maintaining operating licenses, and meet investor expectations. This aligns existing literature which states that firm comply with regulatory requirements to avoid penalties (Munteanu , et al., 2020). This underscores the importance of strong regulatory institutions in shaping corporate environmental governance, particularly in contexts where market-based incentives for sustainability remain weak.

5.5.3 Adoption of climate mitigation and adaptation strategies

The qualitative findings reveal that Zimbabwean manufacturing firms have adopted a diverse portfolio of climate mitigation and adaptation strategies. These include energy-efficient machinery and production technologies, solar energy systems (though the uptake is slow due to power storage challenges), biomass energy and cogeneration systems, regenerative agriculture and biodiversity conservation, supply chain collaborations to enhance climate resilience, low-carbon logistics (e.g., light-trailers, electric-powered transport), and nature-based carbon sinking strategies.

These strategies reflect a combination of technological, operational, and ecological approaches to climate resilience. The adoption of energy-efficient machinery and renewable energy sources aligns with global trends in sustainable manufacturing, where firms seek to reduce energy costs, enhance efficiency, and lower carbon footprint (IEA, 2021; Stern, 2007; Zakari, et al., 2022). The use of biomass energy and cogeneration systems is particularly noteworthy, as it demonstrates how firms leverage locally available resources to reduce dependence on fossil fuels. This aligns with literature emphasing the importance of context-specific, resource-efficient solutions in developing economies (Sarkodie & Strezov, 2019).

Regenerative agriculture and biodiversity conservation initiatives reflect a growing recognition of nature-based solutions as cost-effective climate mitigation strategies. These practices enhance carbon sequestration, improve soil health, and strengthen supply chain resilience. These findings are consistent with extant literature on the role of ecosystems in climate adaptation (Seddon, et al., 2020).

5.5.4 Effectiveness of climate Mitigation Strategies

The qualitative empirical evidence indicates that climate mitigation strategies have yielded tangible economic and operational benefits for Zimbabwean manufacturing firms. These include reduced energy costs due to solar and energy-efficient technologies, improved supply chain efficiency through strengthened partnerships with local supplies, enhanced raw material availability via regenerative agriculture, reputational benefits from proactive climate leadership, and new revenue streams, such as surplus electricity generation.

These findings align with the RBV, which posits that firms can achieve competitive advantage by developing unique capabilities and resources (Barney, 1991). In this context, climate mitigation strategies become strategic assets that enhance operational efficiency, reduce costs, and strengthen stakeholder relationships. The adoption of energy-efficient machinery and renewable energy sources has been particularly effective in reducing operational costs. This supports global evidence that energy efficiency is one of the most cost-effective climate mitigation strategies (IEA, 2021; Dolge, et al., 2021). However, these finding contradict the works of Martí-Ballester, (f2017), who concluded that energy efficiency does not result in improved corporate financial performance in the long-term. Martí-Ballester, explains this behaviour as stemming from the substantial research and development costsassociated with implementing energy-efficient systems within the manufacturing sector (Martí-Ballester, 2017).

In addition, firms that engage in regenerative agriculture and biodiversity conservation benefit from more stable and resilient supply chains, consistent with literature on climate-resilient agriculture (Seddon, et al., 2020).However, the effectiveness of these strategies is moderated by financial and infrastructural constraints. High capital costs, inflation, and unreliable power supply limit the adoption of large renewable energy systems. This reflects broader challenges in developing economies, where resource limitations hinder the implementation of transformative climate strategies (Hallegatte, 2019; Pueyo, 2018).

5.5.5 Climate Change as a Catalyst for Innovation and Opportunity

The findings reveal that climate change has paradoxically created strategic opportunities for Zimbabwean manufacturing firms. These include product innovation, such as zero-tillage ploughs, and short-season crop varieties, new business models, including biomass energy generation, enhanced collaboration with farmers, seed companies, and government agencies, and research and development initiatives focused on climate resilience.

These opportunities align with the Porter Hypothesis, which argues that environmental challenges can stimulate innovation and enhance competitiveness (Porter & Linde, 1995). They also reflect the concept of adaptive capacity, which emphasises the ability of firms to adjust to climate risks through innovation, learning, and collaboration (Hoffman, 2007; Tol, 2018).

The research findings show that Zimbabwean firms have leveraged climate change challenges to develop new products and technologies that enhance resilience and create new revenue streams. This demonstrates how climate change can serve as a catalyst for strategic renewal, particularly in resource-constrained environments.

5.5.6 Challenges in Implementing Climate mitigation Strategies

Despite the benefits, firms face significant challenges in implementing climate mitigation strategies. These include high capital costs for energy-efficient machinery and renewable energy systems, liquidity constraints and high interest rates, unreliable power supply and frequent outages, inflationary pressures that increase operational costs, limited access to climate finance, and slow uptake of solar energy due to power storage limitations. These challenges reflect broader structural constraints in Zimbabwe's economic environment. Similar barriers have been documented in other African countries, where financial constraints, weak infrastructure, and policy uncertainty hinder climate action (Maumoh & Onoja, 2024). The absence of carbon capture and storage facilities further highlights the limitations of technological capacity in the region. As a result, firms rely on incremental, low-carbon adjustments rather than transformative change.

5.5.7 Strategies for Overcoming Implementation Challenges

The findings show that firms have adopted several strategies to mitigate these challenges, including nature-based carbon sinking (regenerative agriculture, biodiversity conservation), low-carbon operational adjustments (electric-powered transport, light trailers), collaborative initiatives with farmers and communities, incremental adoption of renewable energy, leveraging indigenous knowledge for climate resilience. These strategies reflect a pragmatic approach to climate mitigation, balancing ambition with resource constraints. They also align with literature emphasising the importance of context-appropriate, low-cost adaptation strategies in developing economies (Sarkodie & Strezov, 2019; Seddon et al., 2020).

Overall, the findings show that climate mitigation and adaptation strategies enhance firm performance, resilience, and sustainability by reducing operational costs, improving supply chain efficiency, fostering innovation and new product development, strengthening stakeholder relationships, enhancing reputational capital and building adaptive capacity. However, the scale and speed of these benefits are moderated by financial, infrastructural, and policy constraints.

5.6 RESEARCH QUESTION 3.

How do internal and external factors intersect to constrain climate change adaptation, influencing firm resilience, sustainability, and financial performance? (Cost v public policy)

Figure 5.5 below analyses the intersections of internal and external factors in constraining climate change adaptation and their subsequent impacts on firm resilience, sustainability, and financial performance.

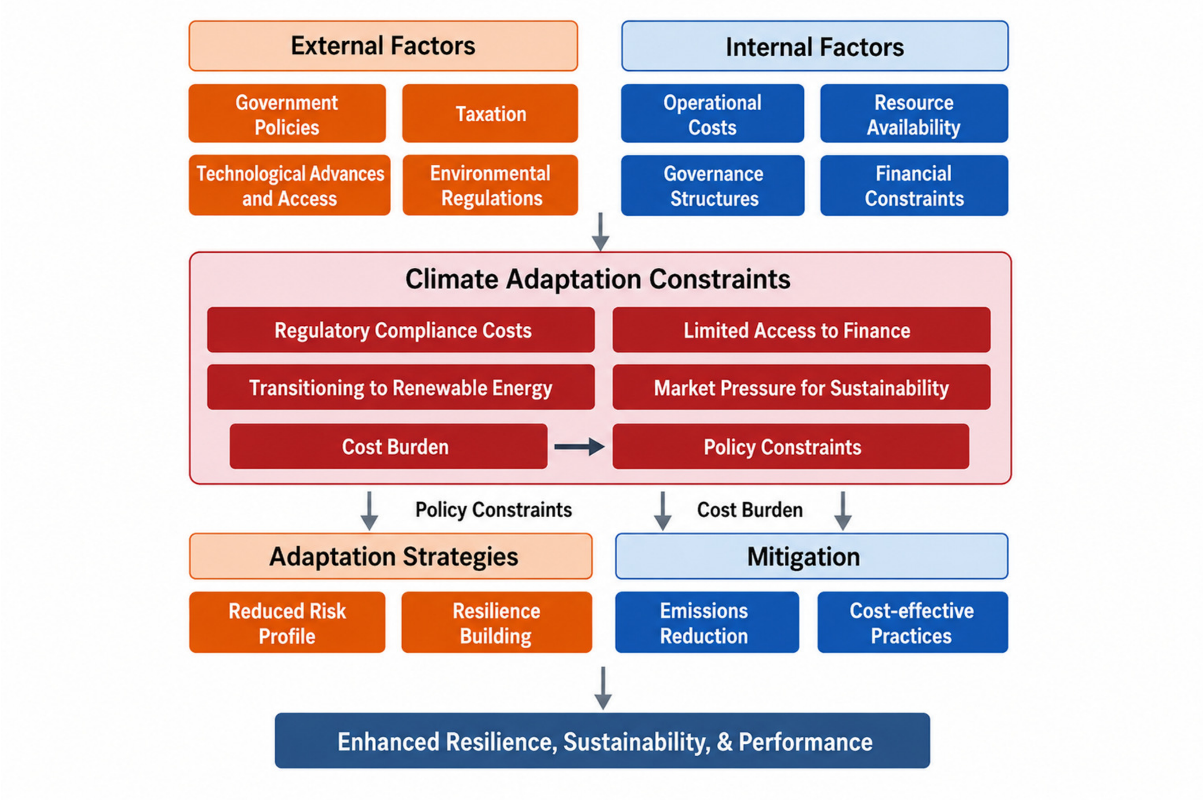

Figure 5. 5:Intersection of internal and external factors constraining climate adaptation

Source: Author's own compilation, (2025)

The third research question examines how internal organisational dynamics, and external institutional pressures interact to shape climate change adaptation in Zimbabwe's manufacturing sector. The findings reveal a complex interplay between regulatory frameworks, industry perceptions, resource constraints, and policy coherence. These interactions significantly influence firms' ability to implement climate-resilient strategies, thereby affecting their long-term sustainability, resilience, and financial performance.

5.6.1 External Institutional Pressures: regulatory Frameworks and policy Mandates

The empirical findings show that Zimbabwe's climate governance landscape is heavily shaped by external institutional pressures, particularly those emanating from the Environmental Management Act (2002), SI 134 of 2019, and national NDC commitments. EMA's colour-coded emissions licensing system (Blue, Green, Yello, red) provides a structured mechanism for monitoring and controlling industrial emissions. Firms are permitted to operate only up to the Green-level emissions standard, compelling them to adopt cleaner production practices.

This regulatory environment reflects the coercive pillar of institutional theory, which posits that organisations conform to legal and regulatory expectations to maintain legitimacy and avoid sanctions (DiMaggio & Powell, 1983). Similar pattens are observed in South Africa, where carbon tax legislation has driven firms to adopt cleaner technologies (Winkler & Marquard, 2009).

In Zimbabwe, compliance with EMA regulations and ZSE sustainability reporting requirements is not optional; it is a prerequisite for continued operation. These findings support literature showing that non-compliance can lead to legitimacy loss and financial penalties (Munteanu , et al., 2020). Firms therefore adopt climate-resilient practices not only to reduce environmental impact but also to maintain regulatory legitimacy. This underscores the certainty of strong regulatory institutions in shaping corporate climate adaptation, particularly in contexts where market-based incentives for sustainability remain weak.

5.6.2 Policy Coherence and Inconsistency: A Double-Edged Sword

While regulatory frameworks provide direction, the findings reveal significant inconsistencies that constrain climate adaptation**.** For example, the government simultaneously promotes renewable energy adoption and invest in fossil-fuel-based power generation, such as the Hwange Thermal power Station. This contradiction undermines the credibility of climate governance and creates uncertainty for firms seeking to invest in long-term renewable energy solutions.

Policy inconsistency is a well-documented barrier to climate change adaptation in developing economies (Mapuranga, et al., 2026; Nyavaya, 2020; Murombo, 2019). When governments send mixed signals, firms face increased investment risk, reduced confidence, and limited access to climate finance. In Zimbabwe, inflation, currency instability, and inconsistent energy policies further exacerbate these challenges, making it difficult for firms to commit to capital-intensive climate technologies. This aligns with literature emphasing the importance of policy coherence in enabling effective climate adaptation (IPCC, 2022; Jordan & Lenschow, 2010). Without consistent and predictable policy frameworks, firms are likely to adopt incremental rather than transformative adaptation strategies.

5.6.3 Internal organisational capabilities and Resource Constraints

The findings reveal that internal organisational factors such as financial resources, technological capacity, managerial awareness, and firm size, play a critical role in shaping climate adaptation. Large firms with greater financial and technological resources are better positioned to adopt comprehensive climate strategies, including renewable energy systems, energy-efficiency machinery, and biodiversity conservation initiatives. These firms also tend to provide more detailed sustainability disclosures and engage more actively with policymakers.

In contrast, smaller firms with limited financial resources often comply only with minimum regulatory requirements. They view environmental regulations as burdensome and costly, reflecting the resource dependency perspective, which argues that firms' strategic choices are constrained by their access to critical resources (Pfeffer & Salancik, 2015). This divergence in adaptive capacity is consistent with global evidence that resource-rich firm are more likely to adopt proactive climate strategies (Kolk & Pinkse, 2005; Busch & Lewandowski, 2017).

These findings also show that firms face significant financial constraints, including high interest rates, liquidity challenges, and inflationary pressures. These constraints limit their ability to invest in renewable energy systems, energy-efficient machinery, and other capital-intensive climate technologies. As a result, firms often rely on low-cost, incremental adaptation strategies, such as nature-based solutions and low-cost operational adjustments. These findings support literature showing manufacturing firms can use ecological stewardship in mitigating carbon emissions (Cantore, et al., 2016), thereby reducing capital investment costs.

5.6.4 Industry Perception and Strategic Responses

The qualitative empirical evidence shows that perceptions of climate policies differ across the industry, with CZI and larger manufacturing firms viewing EMA regulations as both a constraint and a strategic opportunity. While these regulations introduce procedural burdens and raise operational costs, they encourage firms to improve efficiency, strengthen brand reputation, and pursue green transitions. These insights align with Sitompul, et al., (2024), who argues that firms investing in green technologies can differentiate themselves and enhance overall performance.

This dual perception reflects the legitimacy theory, which posits that firms adopt sustainability practices to maintain social acceptance and legitimacy (Suchman, 1995). Larger firms, in particular, leverage climate initiatives to strengthen their legitimacy among stakeholders, including investors, regulators, and communities. Smaller firms, however, view environmental regulations primarily as obstacles. Their limited financial and technological capacity constraints their ability to adopt comprehensive climate strategies, leading to minimal compliance. This divergence underscores the importance of industry-specific and size-specific approaches to climate governance.

5.6.5 Societal Expectations and Stakeholder Influence

The findings reveal that societal expectations play a significant role in shaping corporate climate adaptation. Although there is limited empirical evidence on public responses to pollution incidents, the broader public has embraced circular-economy initiatives due to their income-generating potential. This reflects the growing importance of stakeholder influence in shaping corporate environmental behaviour, consistent with stakeholder theory (Freeman, 1984).

In Zimbabwe, stakeholder expectations are shaped by community needs, environmental awareness, and economic realities. Firms that engage in community-based sustainability initiatives such as regenerative agriculture, water management training, and biodiversity conservation enhance their social licence to operate and strengthen stakeholder relationships. This aligns with literature emphasing the role of stakeholder engagement in building climate resilience (Reid & Toffel, 2009).

5.6.6 Impact on Firm Resilience, Sustainability, and Financial Performance

The intersection of internal and external factors significantly influences firm resilience, sustainability, and financial performance. Firms that align internal capabilities with external expectations through strategic investment, innovation, and stakeholder engagement, achieve greater resilience and long-term sustainability. These firms benefit from cost savings through energy efficiency, improved supply chain resilience, enhanced reputational capital, reduced regulatory risk, and strong stakeholder relationships. These findings reinforce conclusions drawn from prior studies such as the one by Cuddihy, (2000) and Lee & Jung, (2025), however scholars like Díaz-Noriega, et al., (2020); Wills& Keyes, (2017); Hwan & Hee, (2018), and Mahapatra, (1984), argue that regulatory measures implemented by central governments induce market uncertainities, thereby increasing production cost and capital expenditure, henced reduced firm performance.

Conversely, firms that fail to adapt face increased operational costs, regulatory penalties, supply chain disruptions, and reputational damage. These findings converge with the prior studies which state that failure to manage climate transition risk can render corporate assets stranded and undermine their value (Scott, et al., 2017:102-103). This underscores the importance of strategic alignment between internal capabilities and external institutional pressures.

Overall, the findings show that climate adaptation in Zimbabwe’s manufacturing sector is shaped by a dynamic interplay of external institutional pressures, internal organisational capabilities, policy coherence and inconsistency, and industry perceptions and strategic responses. Firms that navigate these intersections effectively achieve greater resilience, sustainability, and financial stability. Conversely, as Scott, et al., (2017:102-103) argues, firms that fail to realign their investment strategies with emerging climate policies risk creating a profound mismatch that trigger the rapid re-pricing of carbon-intensive assets, with repercussions extending beyond direct financial losses to wider declines in productivity and economic growth. However, structural constraints such as financial limitations, policy inconsistency, and infrastructural challenges continue to hinder transformative climate adaptation.

5.7 INTEGRATED SYNTHESIS OF FINDINGS ACROSS THE QUALITATIVE RESEARCH QUESTIONS

The combined findings from the qualitative research questions reveal a deeply interconnected system in which climate governance, mitigation and adaptation strategies, and institutional dynamics collectively shape the resilience, sustainability, and financial performance of Zimbabwean manufacturing firms. This demonstrates that climate change is not an isolated environmental issue but a multidimensional strategic challenge that intersects with governance structures, operational capabilities, regulatory frameworks, and stakeholder expectations.

5.7.1 Governance as the Foundation of Climate Action

Across the qualitative research questions, governance emerges as the foundational mechanism shaping corporate climate behaviour. Regulatory frameworks particularly the Environmental Management Act (2002), SI 134 of 2019, and ZSE listing requirements serve as the primary catalysts for climate action. These instruments compel firms to disclose environmental performance, integrate climate considerations into operations, and adopt sustainability reporting frameworks. These reflect the coercive pillar of institutional theory, which posits that organisations conform to regulatory expectations to maintain legitimacy (Lakhan & Herber, 2022; DiMaggio & Powell, 1983). In Zimbabwe, where voluntary sustainability practices remain limited, regulatory enforcement plays an even more critical role. The findings show that firms adopt climate strategies not only to comply with requirements but also to meet stakeholder expectations and maintain investor confidence. These qualitative findings converge with literature which state that organisations weave narratives of transparency and accountability to harmonise profit and purpose, thereby legitimising their actions in the eyes of stakeholder (Lakhan & Herber, 2022).

5.7.2 Climate Risks as Drivers of Innovation and Adaptation

The findings reveal that climate change manifested through droughts, heatwaves, El-Nino events, and flooding has significant operational and financial implications for manufacturing firms. These risks disrupt supply chains, increase operational costs, and reduce profitability. However, they also stimulate innovation and adaptation. These qualitative findings reinforce existing evidence that climate-related challenges stimulate innovation, enabling firms to pursue cost leadership and develop more sustainable products (Qing, et al., 2023; Porter & Linde, 1995).

Firms have adopted a diverse portfolio of mitigation and adaptation strategies, including energy-efficiency machinery, solar and biomass energy, cogeneration systems, regenerative agriculture, biodiversity conservation, low-carbon logistics, and nature-based carbon sinking. These strategies are consistent with existing evidence showing that operational improvements, energy-cost reductions, strengthened supply-chain resilience, and enhanced innovation capacity are key outcomes of effective sustainability practices (Er-Kara, et al., 2021; Brown , et al., 2013; Zakari, et al., 2022). This aligns with the Porter Hypothesis, which argues that environmental challenges can stimulate innovation and enhance competitiveness (Porter & Linde, 1995).

5.7.3 Internal Capabilities and External Pressures: A Dynamic Interplay

The third research question highlights the dynamic interplay between internal organisational capabilities and external institutional pressures. The findings demonstrate a dynamic interplay between internal organisational capabilities and external institutional pressures. Well-resourced firms with stronger financial capacity, technological capability, and managerial awareness are better positioned to adopt comprehensive climate strategies, leveraging these initiatives to enhance reputation, improve operational efficiency, and support green-energy transitions. However, despite widespread recognition of climate change, many managers lack the technical experience and risk-assessment skills needed to address climate risks effectively given the extreme weather events. This capability gap limits the translation of awareness into meaningful climate-risk management, reinforcing Tol's (2018) argument that awareness alone is insufficient without integration into governance and decision-making structures.

While some firms have developed substantive climate strategies, others rely on minimal or symbolic policies, consistent with Busch & Hoffmann's (2007) view that limited managerial knowledge constraints the identification and quantification of climate impacts. Consequently, many firms default to traditional risk-management approaches that are poorly suited to the long-term and systematic nature of climate risks. Environmental disclosures in AFRs reflect a baseline level of awareness aligned with SI 134 of 2019 and support evidence that sustainability reporting has become central to organisational management (Chang, et al., 2017). Regulatory pressure remains a key driver of climate action, consistent with literature emphasising the influence of stakeholder and government expectations (Reid & Toffel, 2009; Comyns, 2016), while managerial capability gaps and climate uncertainties continue to constrain effective responses.

Smaller firms with limited financial and technical resources tend to comply only with minimum regulatory requirements, perceiving environmental regulations as burdensome and costly. This aligns with the resource-dependency perspectives, which argues that organisational behaviour is shaped by resource availability (Pfeffer & Salancik, 2015). The divergence between well-resourced and resource-constrained firms underscores the central role of resource endowment in shaping climate-change adaptation. External pressures including regulatory mandates, policy frameworks, and stakeholder expectations, further influence corporate climate behaviour, but policy inconsistency, particularly the government's simultaneous support for fossil-fuel power and renewable energy, creates uncertainty that constraints long-term adaptation planning. These findings corroborate (Akpan, et al., 2024), who argues that fossil-fuel dependence poses significant barriers to low-carbon transition.

Overall, strict environmental regulations imposed by EMA act as powerful external driver of climate action, compelling firms to adopt cleaner technologies and modernise operations to meet blue and green emissions thresholds. This supports Porter & Linde,

(1995) and Wu & Tham, (2023), who argue that stringent regulations can stimulate innovation, efficiency, and profitability, while reinforcing legitimacy theory, which suggests firms comply with regulatory expectations to maintain societal acceptance (Suchman, 1995). However, this contrast with (Jaffe & Stavins, 1995), who contend that environmental regulations impose financial burdens that suppress performance and crowd out R&D investment. The findings also challenge Friedman's (1970) profit-maximisation view by showing that environmental practices can generate long-term operational and reputational benefits rather than erote shareholder value.

5.7.4 Climate Governance, Strategy, and Resilience: A Holistic Perspective

Climate governance, mitigation strategies, and institutional dynamics collectively influence firm resilience, sustainability, and financial performance. Firms that align internal capabilities with external expectations through strategic investment, innovation, and stakeholder engagement achieve greater resilience and long-term sustainability. These firms benefit from reduced operational costs, improved supply chain resilience, enhanced reputational capital, stronger stakeholder relationships, and reduced regulatory risk, reflecting broader evidence that effective climate strategies enhance competitiveness and environmental performance (Ren, et al., 2022).

Conversely, firms that fail to adapt face rising operational costs, supply chain disruptions, regulatory sanctions, and reputational damage. This challenge is particularly acute for firms with limited financial and governance capacity, as high R&D costs constrain their ability to innovate, an issue widely noted in developing-country contexts (Nguyen, et al., 2024). Overall, the findings demonstrate that climate governance in Zimbabwe's manufacturing sector functions not merely as compliance tool but as a strategic pathway to resilience, competitiveness, and long-term financial stability, consistent with literature showing that strong governance and adequate financial resources amplify firm's ability to respond effectively to climate-related policies (Ren, et al., 2022; Nguyen, et al., 2024).

5.8 INTEGRATED TRIANGULATION OF QUANTITATIVE AND QUALITATIVE FINDINGS

This section presents the triangulation of the quantitative and qualitative phases of the study. It is structured according to the explanatory sequential logic of the research design: the quantitative results are treated as the initial empirical strand, while the qualitative evidence is used to explain, contextualise, qualify and extend those results. The purpose is therefore not to repeat the statistical findings or the qualitative themes separately, but to integrate both strands into defensible meta-inferences about climate change risk reporting (CCR), climate change strategy (CCS), firm financial performance, and the conditions under which climate-related practices matter for Zimbabwean listed manufacturing firms.

The quantitative phase produced three central results. First, the direct effect of CCR on ROA, ROE and Tobin's Q was statistically weak. Second, the direct effect of CCS was directionally favourable for accounting performance but not consistently significant across the three models. Third, the mean-centred interaction between CCR and CCS provided the strongest statistical evidence, especially for ROA and ROE in the one-year lagged models, indicating that climate strategy may moderate the relationship between climate risk and future accounting performance. The qualitative phase is used here to explain why the direct effects were weak, why the moderation effect is more persuasive, and why Tobin's Q behaved differently from ROA and ROE.

5.8.1 Triangulation of CCR, Climate-Risk Exposure and the Weak Direct Performance Effect

The first area of triangulation concerns the weak direct relationship between CCR and financial performance. Quantitatively, CCR did not exert a statistically robust direct effect on ROA, ROE or Tobin's Q. However, a non-significant coefficient does not imply that climate risk is economically irrelevant. It indicates that, in the supplied short panel of 13 listed manufacturing firms over 2021–2024, the disclosure or scoring of climate change risk did not independently translate into measurable improvements in accounting profitability or market valuation. This finding is particularly important because the literature reviewed in Chapter 1 and Chapter 2 recognises climate change as a material financial and operational risk, with potential effects on supply chains, production costs, investor confidence, asset values and business continuity (Ghadge et al., 2019; Er-Kara et al., 2021; Mondal & Bauri, 2022; IPCC, 2022). The quantitative result therefore does not deny the materiality of climate risk; rather, it suggests that risk reporting alone is insufficient to produce short-term financial benefits.

The qualitative evidence strongly explains this pattern. The qualitative results show that climate change is recognised by firms as a material financial risk, particularly through drought, El Nino effects, heatwaves, energy shortages, raw-material scarcity, supply-chain disruption and increased operational expenditure. These themes converge with prior studies which argue that climate change can destabilise supply chains, increase procurement costs, reduce operational continuity and weaken firm profitability (Ghadge et al., 2019; Er-Kara et al., 2021; Hallegatte, 2019). However, the same qualitative evidence also shows that climate-risk disclosure is strongly shaped by regulatory compliance, ZSE sustainability requirements, EMA expectations, stakeholder pressure and international reporting norms. In other words, CCR appears to function not only as a risk-awareness measure, but also as a compliance and legitimacy mechanism. This explains why the quantitative effect of CCR is weak: a firm may disclose climate risk because it is exposed to risk or because it must comply with institutional expectations, but the disclosure itself does not necessarily mean that the firm has developed the resources, governance systems or operational capacity needed to convert risk awareness into improved performance.

This finding converges strongly with institutional theory. DiMaggio and Powell (1983) argue that organisations respond to coercive, normative and mimetic pressures to maintain legitimacy and secure access to resources. The qualitative evidence shows precisely this pattern: Zimbabwean manufacturing firms disclose climate-related matters partly because regulatory and listing requirements make disclosure necessary. The result also aligns with Reid and Toffel (2009), who argue that stronger regulatory threats encourage firms to disclose more climate-related information. However, the finding diverges from any simplistic interpretation of disclosure theory that assumes transparency automatically improves firm value. The evidence suggests that disclosure is necessary but not sufficient. It is necessary because firms must identify and communicate risk, but insufficient because financial performance depends on the quality of strategic response, not merely the existence of risk reporting.

The qualitative phase also reveals a silent area in the quantitative phase: the credibility of disclosure. The regression model can identify whether CCR scores are statistically associated with performance, but it cannot determine whether the disclosed information reflects substantive climate action or symbolic compliance. The qualitative results highlight concerns about greenwashing and the absence of third-party assurance, which are not captured by the numerical CCR score. This silence is theoretically important. Legitimacy theory predicts that firms may use environmental disclosure to maintain social acceptance and regulatory credibility (Suchman, 1995; Fernando & Lawrence, 2014), but such disclosure may be symbolic where it is not supported by verified implementation (Villena & Dhanorkar, 2020). Therefore, the triangulated conclusion is that CCR is financially meaningful as a risk-identification and legitimacy signal, but it does not independently enhance performance unless accompanied by substantive strategy and governance capability.

5.8.2 Triangulation of CCS, Strategic Capability and the Contested Performance Literature

The second area of triangulation concerns CCS and its relationship with firm performance. Quantitatively, CCS showed a directionally favourable association with accounting-based performance, especially ROA and ROE, but the direct effects were not consistently significant across all models. In the one-year lagged analysis, CCS became more meaningful for ROE, but the evidence remained insufficient to support a broad causal claim that climate strategy directly improves firm performance within one year. This result occupies an important middle ground within the extant literature. It partially agrees with studies that report positive associations between environmental strategy, sustainability practices and financial performance, including Secinaro et al. (2020), Deepmala and Pandey (2021), Pais Seles et al. (2018), Giang et al. (2021), Mondal and Bauri (2022), Riyad and Antonio (2021), and Lu et al. (2021). At the same

time, it also agrees with studies that report weak, mixed or non-significant relationships, such as Petijean (2019) and Kumar and Firoz (2018). The quantitative result is therefore not an anomaly; it fits the broader empirical literature, which remains inconclusive and context-dependent (Lewandowski, 2017; Hillmann et al., 2022).
The qualitative results explain why the CCS-performance relationship is neither clearly positive nor clearly negative. Firms reported adopting energy-efficient machinery, solar energy systems, biomass energy, cogeneration, regenerative agriculture, biodiversity conservation, low-carbon logistics, supply-chain partnerships and nature-based carbon-sinking strategies. These practices are substantive strategic responses rather than mere disclosure. They support the Porter Hypothesis, which argues that well-designed environmental pressure can stimulate innovation and improve competitiveness (Porter & Linde, 1995), and they also align with the resource-based view, which holds that firms can achieve competitive advantage through valuable and difficult-to-imitate capabilities (Barney, 1991). In the Zimbabwean manufacturing context, climate strategy is not only an environmental practice; it is also a response to energy insecurity, water stress, raw-material volatility and production disruption. This explains why the coefficient of CCS is directionally favourable for accounting performance: climate strategies can reduce energy costs, improve process efficiency, stabilise supply chains and strengthen resilience. However, the qualitative evidence also identifies why the quantitative direct effect is not consistently strong.

Firms face high capital costs, liquidity constraints, inflation, high interest rates, unreliable power supply, limited climate finance and storage limitations for solar technologies. These constraints mean that climate strategies may generate long-term resilience benefits but impose short-term financial burdens. This supports the compliance-cost strand of the literature associated with Aupperle et al. (1985), Jaffe and Stavins (1995), Millimet and Osang (2003), and Eleftheriadis and Anagnostopoulou (2014), which argues that environmental initiatives can raise operational costs and reduce short-term profitability. The evidence therefore does not reject the Porter Hypothesis, but it qualifies it. Innovation benefits are possible, but they are conditional on resources, governance maturity and implementation depth.

Similarly, the evidence does not fully support the compliance-cost view, because the qualitative findings show cost savings, operational efficiencies and even new revenue streams from surplus energy generation. CCS has conditional rather than automatic performance value.

This is an area of both convergence and divergence. The quantitative and qualitative strands converge in showing that CCS is more promising than CCR as a performance-relevant construct because strategy is closer to operational action than risk reporting. They also converge with RBV by showing that firms with stronger internal resources are better positioned to benefit from climate strategies. However, the strands diverge in their evidential emphasis. The qualitative evidence presents climate strategies as operationally meaningful, while the quantitative direct-effect models show that these strategies do not yet produce consistently significant financial outcomes across all measures. This suggests that the financial benefits of climate strategy may be delayed, unevenly distributed and dependent on firm size, resource availability and implementation quality. The silence in the quantitative model is also important: the regression captures CCS as a score, but it cannot distinguish between low-cost incremental strategies and capital-intensive transformative strategies. The qualitative findings therefore deepen the quantitative analysis by showing that not all climate strategies are equal. Some strategies reduce costs and improve resilience, while others increase expenditure before benefits materialise.

5.8.3 Triangulation of the CCR-CCS Moderation Effect, Accounting Performance and Market Valuation

The third and most important area of triangulation concerns the moderation effect. Quantitatively, the strongest evidence emerged from Model 3, where the mean-centred interaction between CCR and CCS was positive and statistically significant for ROA and ROE, including in the one-year lagged analysis and robustness checks. This result indicates that CCS moderates the relationship between CCR and accounting performance. The substantive implication is that climate risk by itself may be financially burdensome, but firms with stronger climate strategies are better able to absorb, manage or convert climate-related pressures into more resilient accounting outcomes. This is the central quantitative result that the qualitative phase helps to explain.

The qualitative findings converge strongly with this moderation result. They show that climate risks create operational and financial pressure through energy shortages, drought, raw-material instability, supply-chain disruption and compliance requirements. These findings are consistent with IPCC (2022), Er-Kara et al. (2021), Ghadge et al. (2019), and Hallegatte (2019), who argue that climate shocks can disrupt operations and raise costs. However, the qualitative evidence also shows that firms with stronger governance and strategic capability respond through board-level oversight, ERM integration, renewable energy, biomass and cogeneration systems, supply-chain collaboration, regenerative agriculture, low-carbon logistics and stakeholder partnerships. This directly explains the positive interaction effect. The interaction term is not merely a statistical artefact; it reflects a plausible organisational mechanism. Where climate risk is high but strategy is weak, performance may suffer. Where climate risk is high and strategy is strong, firms are better positioned to protect accounting returns through efficiency, continuity, adaptation and reputational resilience.

The moderation finding is particularly important for theory. It provides stronger support for RBV than the direct-effect models because it shows that strategy matters as a capability under conditions of risk. Barney's (1991) RBV suggests that firms benefit from resources and capabilities that are valuable, rare, difficult to imitate and organisationally embedded. The qualitative evidence shows that larger and better-resourced firms possess stronger financial and technological capacity, greater managerial awareness and more sophisticated governance structures. These capabilities allow them to adopt renewable energy, efficiency technologies and resilient supply-chain arrangements more effectively than smaller firms. Thus, climate strategy operates as a resource-based capability that moderates the risk-performance relationship. Institutional theory also remains relevant because regulatory pressure pushes firms to adopt climate practices, while legitimacy theory explains why firms seek to maintain social approval and investor confidence through sustainability disclosure and climate action. Stakeholder theory further explains why firms respond to regulators, investors, communities, customers and supply-chain partners in shaping adaptation practices.

The main divergence concerns Tobin's Q. Quantitatively, the interaction effect was not significant for Tobin's Q, while firm size was more consistently associated with market valuation. This finding partly diverges from literature that suggests climate governance and sustainability strategy are immediately value-relevant to investors, including arguments linked to Flammer (2021) and Krueger et al. (2020). However, the qualitative results explain why this divergence is plausible in Zimbabwe. In a small emerging capital market, investor valuation may be more strongly influenced by firm size, visibility, liquidity, market dominance and perceived organisational stability than by climate strategy alone. The qualitative evidence shows that larger firms have greater capacity to implement and communicate climate strategies, which means Tobin's Q may reflect firm scale and market confidence rather than climate strategy as an independent driver. This does not invalidate the market-based measure; rather, it suggests that Tobin's Q captures a different financial logic from ROA and ROE. ROA and ROE reflect realised operational and accounting outcomes, where energy efficiency and cost savings can gradually appear. Tobin's Q reflects investor expectations, which may be shaped by broader firm characteristics beyond climate governance.

The silence here is also analytically valuable. The qualitative phase explains governance, energy, supply-chain and resource mechanisms, but it provides less direct evidence on how investors in the ZSE price climate strategy into market valuation. This helps explain why Tobin's Q does not show the same moderation pattern as ROA and ROE. The study can therefore provide a more precise conclusion: the strongest evidence is not that climate strategy immediately increases market value, but that climate strategy strengthens accounting resilience where climate risk is present.

5.8.4 Meta-Inference for the Explanatory Sequential Mixed-Methods Design

The triangulated evidence supports the logic of the explanatory sequential mixed-methods design. The quantitative phase established the main empirical pattern: CCR and CCS showed weak direct effects, the CCR x CCS interaction provided stronger evidence for ROA and ROE, and Tobin's Q was more strongly shaped by firm size. The qualitative phase explained these patterns by showing that CCR is largely driven by compliance and legitimacy pressures, while CCS represents a more substantive but resource-dependent operational capability. Thus, the qualitative findings clarify the mechanisms behind the statistical results rather than merely confirming them.

The integrated findings show convergence, divergence and complementarity. Both strands indicate that climate risk is materially important but does not automatically improve financial performance. Both also show that climate strategy has greater explanatory value than risk reporting alone, particularly where firms possess stronger governance, resources and implementation capacity. Divergence arises because the qualitative evidence shows climate strategies to be operationally meaningful, while the direct quantitative effects remain statistically weak. This is explained by implementation costs, the short time horizon, the small sample and uneven firm capabilities. The Tobin's Q result further suggests that market valuation in Zimbabwe's listed manufacturing sector is more responsive to firm size than to climate strategy disclosure alone.

The silent areas confirm the value of the mixed-methods approach. The quantitative phase could not fully capture greenwashing risk, assurance quality, managerial capability, policy inconsistency, climate-finance constraints or the distinction between symbolic and substantive climate action. The qualitative phase explained these issues by showing that firms operate under coercive regulation, financial constraint and infrastructural instability. Conversely, the qualitative phase could not quantify the magnitude of financial effects, which the quantitative analysis provided. The final meta-inference is therefore that climate strategy is not an unconditional direct driver of financial performance. Rather, it operates as a conditional resilience capability that moderates the financial consequences of climate risk, especially for accounting-based performance.

Table 5. 1:Summary table of convergence, divergence and silence

Empirical focus	Quantitative evidence	Qualitative explanation	Convergence	Divergence	Silent area / added insight	Integrated conclusion
CCR and firm performance	CCR has no statistically robust direct effect on ROA, ROE or Tobin's Q.	Firms recognise climate risk as material, but disclosure is strongly driven by compliance, ZSE/EMA expectations, stakeholder pressure and legitimacy concerns.	Both strands indicate that climate risk is material but not automatically performance-enhancing.	Qualitative evidence shows climate risk is operationally important, while quantitative evidence shows risk reporting alone is not statistically predictive.	Regression cannot distinguish substantive risk management from symbolic disclosure or greenwashing.	CCR is a risk-identification and legitimacy signal, not an independent short-term performance driver.
CCS and direct performance effects	CCS is directionally positive for ROA and ROE but not consistently significant; Tobin's Q effect weakens after controls.	Firms adopt renewable energy, energy efficiency, biomass, cogeneration, regenerative agriculture and supply-chain resilience practices.	Both strands show CCS has more practical performance relevance than CCR.	Qualitative evidence suggests operational benefits, while quantitative evidence shows weak direct statistical effects.	Regression cannot distinguish incremental low-cost actions from transformative capital-intensive strategies.	CCS has conditional value; benefits depend on resource capacity, implementation depth and time horizon.
CCR x CCS moderation	The centred interaction is positive and significant for ROA and ROE, especially in lagged models; not significant for Tobin's Q.	Firms with stronger governance and strategy are better able to manage energy, supply-chain and climate-risk pressures.	Strong convergence: strategy explains how risk exposure can be managed rather than merely disclosed.	Moderation appears in accounting performance but not market valuation.	Qualitative evidence does not directly show how investors price climate strategy into Tobin's Q.	The strongest finding is a conditional resilience effect: CCS buffers the performance consequences of CCR for ROA and ROE.
Firm size and market valuation	lnTA is more consistently associated	Large firms have greater resources,	Both strands show that resources and	Qualitative evidence suggests	Investor pricing mechanisms remain	Market valuation in this context appears

	with Tobin's Q than climate variables.	technology, governance capacity and disclosure sophistication.	capability shape climate response.	climate strategy improves reputation, but quantitative results show market value is more size-driven.	underexplored qualitatively.	to reflect scale and organisational capacity more than climate strategy alone.
Theoretical integration	Direct effects are weak; moderation is stronger.	Institutional pressure drives disclosure; RBV explains capability; legitimacy and stakeholder theories explain disclosure and engagement.	Both strands support a multi-theory explanation.	No single theory fully explains all findings.	Measurement cannot fully capture institutional quality, legitimacy depth or capability differences.	Institutional theory explains why firms act; legitimacy theory explains disclosure; stakeholder theory explains pressure; RBV explains why only capable firms convert climate strategy into performance resilience.

Author's own compilation, (2025)

5.9 CHAPTER SUMMARY

In this explanatory sequential mixed-methods study, the qualitative phase supports and explains the quantitative phase by showing that weak direct effects arise because climate disclosure and strategy operate within a constrained institutional and resource environment. The evidence is strongest for a moderation argument: climate change strategy strengthens the ability of firms to manage climate risk and protect accounting performance, but this effect does not automatically translate into market valuation. This conclusion is consistent with the mixed and contested nature of the extant literature and is more defensible than a simple claim that climate action directly improves firm performance

CHAPTER 6 : RESEARCH CONCLUSIONS AND SUMMARY OF FINDINGS

6.1 INTRODUCTION

This section presents the conclusions of the study after integrating the quantitative panel results, one-year lagged models, diagnostic evidence, robustness checks and qualitative explanatory findings. The conclusions are framed cautiously because the quantitative component was based on a small balanced panel of 13 Zimbabwean listed manufacturing firms observed over four years, producing 52 firm-year observations and 39 lagged observations. The statistical evidence is therefore treated as exploratory but analytically meaningful when interpreted together with the qualitative evidence.

The direct effects of climate change risk reporting (CCR) and climate change strategy (CCS) on firm financial performance are weak and not consistently statistically significant. However, the mean-centred interaction model and the one-year lagged specification provide stronger evidence that CCS moderates the relationship between CCR and accounting-based performance, particularly ROA and ROE. This means that climate strategy does not appear to operate primarily as a direct short-term profitability driver. Rather, it functions as a strategic and governance capability that helps firms manage, buffer or convert climate risk exposure into more resilient accounting outcomes. This interpretation is supported by the qualitative evidence, which shows that climate governance, renewable-energy adoption, energy efficiency, biomass, cogeneration, regenerative agriculture, supply-chain collaboration and board-level oversight are mechanisms through which firms attempt to reduce operational disruption and preserve performance under climate stress.

The conclusion of the study is therefore not that climate change variables deterministically cause firm performance. The study, therefore, concludes that climate risk reporting, climate strategy and governance are associated with firm performance in a complex, conditional and context-dependent way. Climate risk reporting identifies exposure and institutional compliance, but it is insufficient on its own to improve performance. Climate strategy becomes financially meaningful when it is implemented as an operational capability and governance response. This conclusion is consistent with the resource-based view, which treats strategic climate capabilities as firm-specific resources; institutional theory, which explains regulatory and coercive pressures; legitimacy theory, which explains disclosure and reputation-seeking behaviour; and stakeholder theory, which explains investor, regulator, community and supply-chain expectations.

6.2 CONCLUSIONS IN RELATION TO THE RESEARCH QUESTIONS

The five research questions are answered below using the integrated quantitative and qualitative findings. The qualitative phase is used explanatorily, consistent with the explanatory sequential mixed-methods design: it clarifies why the quantitative relationships were weak, conditional or stronger under interaction and lagged specifications.

Research Question 1: What is the relationship between climate change risk reporting (CCR) and the financial performance of listed manufacturing firms in Zimbabwe, measured by ROA, ROE and Tobin's Q?

The quantitative evidence does not support a statistically robust direct relationship between CCR and ROA, ROE or Tobin's Q. In both the baseline random-effects models and the one-year lagged models, CCR did not independently predict firm performance after controlling for leverage, industry category and firm size. This means that climate change risk reporting alone does not explain short-term financial performance in the sampled firms. However, the qualitative evidence prevents a simplistic conclusion that climate risk is financially irrelevant. The documentary themes show that firms experience climate risk through energy insecurity, raw-material shortages, drought and El Nino conditions, water stress, supply-chain disruption, regulatory exposure and cost escalation. Therefore, the study concludes that CCR is a material risk-identification and legitimacy construct, but it is not a sufficient direct predictor of ROA, ROE or Tobin's Q in this short-panel dataset. Climate risk becomes financially meaningful when firms possess the governance and strategic capacity to respond to it.

Research Question 2: What is the relationship between climate change strategy (CCS) and the financial performance of listed manufacturing firms in Zimbabwe?

The direct quantitative relationship between CCS and firm performance is positive in some accounting models but not consistently statistically significant. CCS is therefore not conclusively supported as a standalone short-term driver of ROA, ROE or Tobin's Q. The lagged results indicate some directional support, particularly for future ROE, but the evidence remains modest. The qualitative findings explain why this direct effect is weak: climate strategies often require substantial upfront investment in solar systems, energy-efficient machinery, biomass energy, cogeneration systems, low-carbon logistics and supply-chain resilience. These investments may impose short-term cost pressures before producing measurable financial returns. Therefore, the study concludes that CCS is better understood as a resilience-building and capability-enhancing mechanism than as an immediate profitability variable. This conclusion aligns with the resource-based view and the Porter Hypothesis, but it is qualified by compliance-cost arguments, because resource-constrained firms may struggle to convert strategy into short-term financial gains.

Research Question 3: Does climate change strategy moderate the relationship between climate change risk reporting and firm financial performance?

The findings provide partial support for the moderation argument. The raw interaction model was not defensible because of severe multicollinearity; however, after mean-centring CCR and CCS, the interaction term became statistically meaningful for ROA and ROE. The one-year lagged interaction model also showed positive and significant moderation for accounting-based performance, while the effect remained unsupported for Tobin's Q. The conclusion is that CCS moderates the CCR-performance relationship for accounting performance but not for market valuation. This is the strongest quantitative finding of the study. It means that climate strategy appears to buffer or transform the financial implications of climate risk exposure for ROA and ROE. Qualitative evidence supports this conclusion by showing that firms with stronger governance and operational climate strategies are better positioned to manage energy disruption, supply-chain vulnerability and regulatory pressures. The moderation effect is therefore accepted conditionally: it is supported for accounting performance and unsupported for Tobin's Q.

Research Question 4: How do internal capabilities, governance mechanisms and external regulatory or stakeholder pressures shape climate change adaptation, resilience and sustainability among listed manufacturing firms in Zimbabwe?

The qualitative findings provide the strongest evidence for this question. Internal factors include financial capacity, firm size, managerial awareness, board oversight, enterprise risk management integration, technological capability and data availability. External factors include EMA regulation, ZSE sustainability expectations, SI 134/143 reporting requirements, stakeholder pressure, climate shocks, energy instability, raw-material volatility, inflation and policy inconsistency. The evidence shows that these factors intersect to produce uneven adaptation across firms. Larger and better-resourced firms are more able to invest in renewable energy, energy efficiency and supply-chain resilience, while smaller firms tend to remain closer to minimum compliance. The conclusion is that adaptation is not determined by climate awareness alone; it depends on the interaction between external institutional pressure and internal resource capacity. This conclusion directly supports the integrated theoretical framework combining institutional theory, legitimacy theory, stakeholder theory and the resource-based view.

Research Question 5: What framework can be developed to assess climate change adaptation and mitigation practices among listed manufacturing firms in Zimbabwe?

The study developed a climate change assessment framework and matrix to evaluate climate exposure and reporting, governance capacity, strategic response, operational implementation, financial and resilience outcomes, and disclosure credibility. The framework is not a predictive causal model; it is an assessment, benchmarking and improvement tool for managers, regulators and assurance providers. It is justified by the empirical finding that disclosure alone is insufficient and that performance relevance depends on governance capacity, implementation depth and credibility of reporting.

6.3 CONCLUSIONS IN RELATION TO THE RESEARCH OBJECTIVES

The study had four research objectives. The conclusions below integrate the quantitative and qualitative evidence rather than relying on either phase in isolation.

Objective 1: To critically examine the relationship between climate change risk and firm financial performance.

The study concludes that CCR is not a statistically robust direct predictor of ROA, ROE or Tobin's Q in the sampled listed manufacturing firms. This finding does not mean climate risk has no financial relevance. Rather, it means that the disclosure or reporting of climate risk does not by itself explain financial performance in the short term. The qualitative evidence confirms that climate risk is operationally material through electricity shortages, drought-related input volatility, water constraints, supply-chain disruptions and regulatory exposure. Therefore, Objective 1 is answered as follows: climate change risk is a material governance and operational concern, but its direct financial-performance effect is not statistically conclusive in the short panel. The financial relevance of CCR appears to be conditional on the firm's strategic and governance response.

Objective 2: To examine the moderating effects of climate change governance mechanisms on the relationship between climate-related risks and firm financial performance.

The moderation effect is not uniformly supported across all performance measures, but it is supported for accounting-based performance. The mean-centred and lagged interaction models indicate that CCS positively moderates the relationship between CCR and ROA/ROE, while no statistically reliable moderation effect is observed for Tobin's Q. This means that climate strategy and governance appear to matter most in preserving or improving realised accounting outcomes rather than in immediately influencing market valuation. Qualitative evidence explains this pattern by showing that governance mechanisms, board oversight, compliance systems, energy-efficiency investments and supply-chain partnerships provide practical channels for reducing disruption and improving resilience. Objective 2 is therefore partly supported: climate governance and strategy moderate the CCR-performance relationship for ROA and ROE, but not for Tobin's Q.

Objective 3: To determine how internal and external factors intersect to constrain climate change adaptation, influencing firm resilience, sustainability and financial performance.

The study concludes that climate adaptation is shaped by the interaction between internal capabilities and external pressures. Externally, firms face regulation, policy inconsistency, macroeconomic instability, power shortages, climate shocks, input volatility and stakeholder expectations. Internally, firms differ in access to finance, governance capacity, firm size, technology, managerial awareness and data quality. The qualitative evidence shows that better-resourced firms are more able to translate climate strategy into operational resilience, while smaller or financially constrained firms tend to adopt incremental and lower-cost responses. Objective 3 is therefore strongly supported. Climate adaptation in Zimbabwean manufacturing is constrained by both structural conditions and firm-level capabilities, producing uneven resilience and performance outcomes.

Objective 4: To develop a comprehensive framework for assessing climate change adaptation practices among manufacturing firms in Zimbabwe, emphasising their contribution to resilience and sustainability.

The study developed a climate change assessment framework and matrix that operationalise the relationship between climate exposure, governance capacity, strategy, implementation, financial outcomes and disclosure credibility. The framework is empirically justified because the study shows that climate reporting, climate strategy and performance are linked through conditional mechanisms rather than simple direct effects. The framework therefore provides a structured basis for management self-assessment, regulatory monitoring and assurance evaluation. Objective 4 is achieved.

6.3.1 Conclusions in relation to the hypotheses

The three hypotheses were assessed using the quantitative panel models, lagged models, robustness checks and qualitative explanatory evidence. The conclusions are presented below in a way that distinguishes statistical support from contextual explanation.

Table 6. 1:Summary of Hypotheses Testing Results

Hypothesis	Statement	Decision	Analytical conclusion
H_1	CCR is significantly associated with firm financial performance.	Not supported quantitatively as a direct effect.	CCR was not statistically significant for ROA, ROE or Tobin's Q. Qualitative evidence confirms that climate risk is operationally material, but reporting risk alone does not generate measurable short-term performance effects.
H_2	CCS is significantly associated with firm financial performance.	Weakly/partially supported only in directional and lagged accounting terms; not conclusive as a direct effect.	CCS is directionally favourable in some accounting models and weakly relevant for future ROE, but not consistently significant across all models. The qualitative evidence indicates that strategy creates resilience benefits, but these are delayed, resource-dependent and cost-constrained.
H_3	CCS moderates the relationship between CCR and firm financial performance.	Partially supported.	The centred and lagged interaction models support moderation for ROA and ROE, but not for Tobin's Q. This indicates that climate strategy buffers climate risk effects on accounting performance but is not reflected immediately in market valuation.

Author's own compilation, (2025)

The final hypothesis conclusion is therefore nuanced. H_1 is not supported as a direct quantitative relationship. H_2 is only weakly and directionally supported. H_3 receives the strongest support, but only for accounting-based performance.

This finding shifts the study's core contribution from a direct climate-performance argument to a conditional resilience argument. The evidence indicates that climate strategy is not an unconditional driver of financial performance; rather, it functions as strategic capability that moderates the financial consequences of climate risk. This interpretation is consistent with the resource-based view, which emphasises the role of internal capabilities in converting external pressures into competitive resilience, while also aligning with institutional, legitimacy and stakeholder perspectives, which explain why firms disclose and respond to climate risks in the first place

6.4 INTEGRATED CONCLUSION OF THE STUDY

The study concludes that climate change has become a material strategic, operational and governance issue for listed manufacturing firms in Zimbabwe. However, the relationship between climate change and firm performance is neither linear nor immediate. The direct econometric effects of CCR and CCS are weak, reflecting the small sample, short time horizon, disclosure-based measurement and the delayed nature of climate-strategy pay-offs. The qualitative evidence shows why the direct effects are weak: firms face severe resource constraints, energy insecurity, policy inconsistency, inflationary pressure and uneven implementation capacity. These constraints delay or dilute the financial benefits of climate strategy.

The strongest empirical conclusion is that climate strategy works as a moderating capability. Where firms face climate risks but also possess stronger climate strategies, accounting performance appears more resilient. This is shown by the significant centred interaction effect for ROA and ROE, and it is explained qualitatively by evidence of renewable-energy adoption, energy efficiency, cogeneration, biomass use, regenerative agriculture, supplier collaboration and governance oversight. The moderation effect is not observed for Tobin’s Q, suggesting that the market valuation of Zimbabwean manufacturing firms is more strongly influenced by firm size, visibility, liquidity and structural market factors than by climate strategy alone.

The study therefore contributes a conditional climate-resilience conclusion. Climate risk reporting is necessary for awareness and compliance, but insufficient for performance improvement. Climate strategy is potentially valuable, but only when implemented through credible governance, operational investment and resource mobilisation. Firm performance effects emerge not from disclosure alone, but from the firm’s ability to convert climate awareness into strategic action.

6.5 SUMMARY OF RESEARCH FINDINGS

This section summarises the major findings of the study after integrating the quantitative and qualitative phases. The summary reflects the explanatory sequential design of the research, where the quantitative phase identified patterns and the qualitative phase explained the mechanisms behind those patterns.

The first major finding is that climate change risk reporting is not a statistically significant direct predictor of firm financial performance. The random-effects and lagged models show that CCR does not independently explain ROA, ROE or Tobin's Q. However, qualitative findings show that climate risk is operationally real and financially material through power shortages, water scarcity, raw-material disruption, drought exposure, regulatory compliance and supply-chain instability. Thus, the apparent quantitative weakness of CCR is explained by the fact that reporting risk is not equivalent to managing risk. CCR captures awareness and disclosure, but not necessarily adaptive capacity.

The second major finding is that climate change strategy does not consistently generate immediate direct financial gains. CCS shows directionally favourable results in some accounting models, particularly in relation to future ROE, but the direct effects are not robust across all models. Qualitative evidence explains this pattern by showing that climate strategies require upfront capital expenditure and are constrained by liquidity pressures, inflation, high interest rates, technological limitations and unreliable power supply. Therefore, the benefits of CCS are likely to be delayed and uneven across firms.

The third and strongest quantitative finding is the moderation effect. The mean-centred and lagged interaction models show that CCS positively moderates the relationship between CCR and accounting performance, specifically ROA and ROE. This means that firms exposed to climate-related risks appear better able to protect or improve accounting performance when they also possess stronger climate strategies. Qualitative findings strongly support this result by identifying governance oversight, energy efficiency, renewable energy, biomass, cogeneration, regenerative agriculture and supplier collaboration as practical mechanisms through which firms manage climate-related disruption.

The fourth finding is that Tobin's Q behaves differently from ROA and ROE. The climate variables and their interaction do not significantly explain market valuation after controls are included. Firm size is the more consistent predictor of Tobin's Q. This suggests that investors in the sampled market may respond more strongly to scale, visibility and market position than to climate disclosure or strategy. The qualitative evidence supports this by showing that larger firms have greater resources to implement and disclose climate strategies, which may make climate performance difficult to separate from firm size.

The fifth finding is that internal and external constraints shape the effectiveness of climate adaptation. External pressures include EMA regulation, ZSE reporting expectations, policy inconsistency, macroeconomic volatility, energy deficits, climate shocks and stakeholder expectations. Internal constraints include limited financial resources, technology gaps, managerial capacity, data availability and firm size. These constraints explain why some firms undertake substantive climate action while others remain at symbolic or minimum-compliance levels.

The sixth finding is that the qualitative evidence strengthens the interpretation of the quantitative results. The qualitative phase does not merely repeat the quantitative findings; it explains them. It explains why CCR has weak direct effects, why CCS does not produce immediate profitability gains, why the interaction effect is stronger for accounting performance, and why Tobin's Q is more size-sensitive. This confirms the value of the explanatory sequential mixed-methods design.

Overall, the study concludes that climate change risk and climate strategy influence firm performance through conditional and context-specific mechanisms. The relationship is not automatic. It depends on governance credibility, resource capacity, strategic implementation, regulatory coherence and operational resilience. The evidence is therefore strongest for a conditional resilience argument: climate strategy helps firms manage the financial implications of climate risk, especially in accounting-based performance outcomes, but does not automatically produce immediate market valuation benefits.

Table 6. 2: Integrated summary of conclusions from the latest findings

Theme	Quantitative conclusion	Qualitative explanation	Final integrated conclusion
CCR and performance	No significant direct effect on ROA, ROE or Tobin's Q.	Climate risk is operationally material through energy, supply-chain, water and regulatory channels.	CCR is a risk and legitimacy signal, not a standalone financial-performance driver.
CCS and performance	Weak/direct effects; some directional accounting relevance.	Climate strategies generate resilience benefits but require capital, technology and governance capacity.	CCS is valuable as a long-term capability rather than an immediate profit driver.
CCR x CCS moderation	Positive and significant for ROA and ROE in centred and lagged models; not significant for Tobin's Q.	Strategy helps firms manage energy, supply-chain and operational climate risks.	H_3 is partially supported for accounting performance.
Tobin's Q	Climate variables weak after controls; firm size more influential.	Larger firms have greater disclosure, resources and implementation capacity.	Market valuation is more size- and visibility-driven than climate-strategy driven in this sample.
Internal/external constraints	Not fully captured in the panel model.	Policy inconsistency, capital scarcity, power instability and managerial capacity affect adaptation.	Qualitative evidence explains why quantitative effects are conditional and uneven.
Overall conclusion	Direct effects weak; interaction evidence strongest.	Governance and strategy explain how firms respond to climate risks.	The study supports a conditional climate-resilience argument.

Author's own compilation, (2025)

6.5.1 The Climate Change Assessment Framework

The framework provides the architecture upon which climate change-performance nexus can be assessed. It follows six linked stages: climate exposure and reporting; governance capacity; climate strategy; operational implementation; financial and resilience outcomes; and disclosure credibility with feedback into future governance and strategy. This structure links the study's quantitative variables to the qualitative evidence on implementation and assurance.

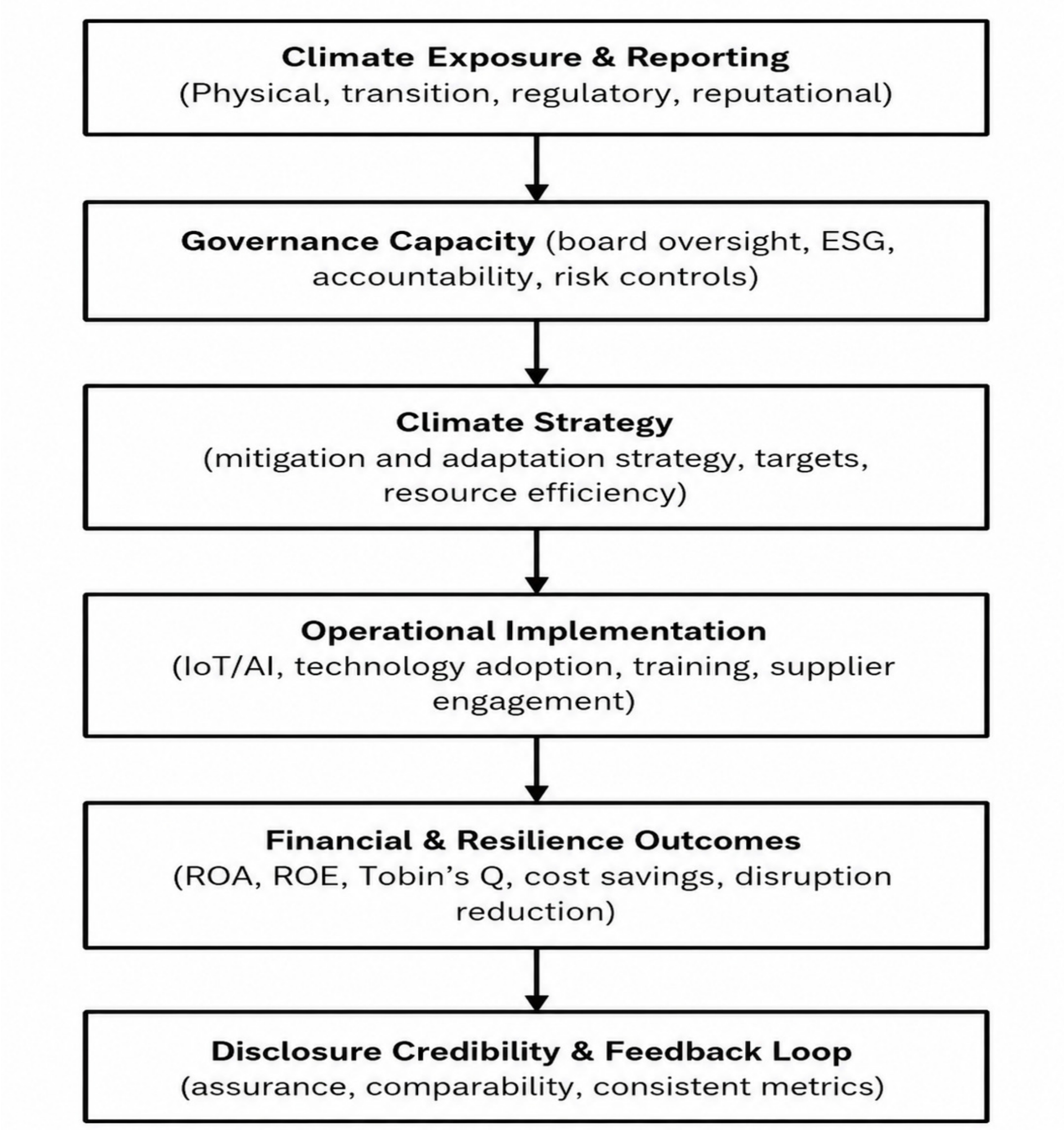

Figure 6. 1: Climate Change Governance, Strategy, and Resilience Assessment Framework

Source: Author's own impression, (2025)

Figure 6:1 above shows the Climate Change Framework developed from the research quantitative and qualitative data. The conceptual framework comprises three pillars- climate change awareness, climate change risk, and climate change governance and strategy-supported by measurable indicators, providing a theoretical foundation for understanding climate change performance.

6.5.2 The Climate Change Assessment Matrix

The Climate Change Assessment Matrix operationalises the conceptual framework. It translates the conceptual framework into scalable and comparable scores, allowing organisations to benchmark performance, track progress, and meet disclosure requirements. Table 6:1 below present the Climate Change Matrix.

Table 6. 3:Climate Change Assessment Matrix

Dimension	Assessment focus	Indicative evidence	Score interpretation
Climate exposure and reporting	Recognition of physical, transition, regulatory and reputational climate risks	Risk disclosures and climate-risk statements	1 = No disclosure 3 = Partial or general disclosure 5 = Detailed, risk-specific disclosure
Governance capacity	Board oversight and climate-risk accountability	Board committees, ESG responsibility and risk controls	1 = No evidence 3 = General ESG oversight 5 = Explicit board-level accountability
Strategic response	Mitigation and adaptation strategy	Energy efficiency, emissions targets and water/resource efficiency	1 = No strategy 3 = Broad initiatives 5 = Measurable strategy with targets
Operational implementation	Conversion of climate strategy into practice	Capital expenditure, technology adoption, training and supplier engagement	1 = Symbolic or narrative evidence 3 = Partial implementation 5 = Measurable operational integration
Financial and resilience outcomes	Effect on profitability, valuation and operational continuity	ROA, ROE, Tobin's Q, cost savings and reduced disruption	1 = No tracking 3 = Limited evidence 5 = Quantified outcome evidence
Disclosure credibility and assurance	Reliability and comparability of climate-related information	Consistent metrics, assurance and standard-aligned reporting	1 = Unverified narrative 3 = Some metrics 5 = Assured, comparable disclosure

Source: Author's own impression, 2025

Table 6.3 above shows the climate change assessment matrix that operationalises the framework, featuring scoring criteria that facilitate benchmarking, comparability, and assurance of climate-related practices. The integration of these two components yields a comprehensive tool that is both theoretically sound and practically applicable, bridging the gap between academic theory and real-world implementation. This study contributes to the advancements of knowledge in sustainability and climate change governance, offering stakeholders a structured approach to evaluate, monitor, and enhance climate change performance.

This framework serves as a basis for evaluating manufacturing companies' performance and can be utilised by management, regulatory authorities, and assurance service providers. The climate change assessment matrix initiative stems from recommendations by Eakpisankit & Pirzada, (2025), who advocates for standardised frameworks addressing both global and jurisdiction-specific expectations. However, Zimbabwe currently lacks a bespoke local Climate Change Assessment Framework and Matrix, tailored to its specific needs and context, making the framework the first initiative in the Zimbabwean context.

The framework is built from the minimum sustainability reporting requirements of the ZSE. It was constructed using predictor variables that determined the relationship between climate change and firm performance and is based on a study based on 13 listed manufacturing companies.

6.6 CONTRIBUTION TO THE BODY OF KNOWLEDGE

This study contributes to the literature on climate change, management accounting, sustainability governance and firm performance by demonstrating that the climate change-firm performance relationship in Zimbabwe's listed manufacturing sector is not a simple direct-effect relationship. The integrated quantitative and qualitative findings show that climate change risk reporting and climate change strategy do not automatically produce statistically significant improvements in ROA, ROE or Tobin's Q. Instead, the strongest empirical insight is that climate change strategy operates as a conditional resilience capability. It shapes how firms absorb, manage and respond to climate risk exposure, particularly in relation to accounting-based performance. The study therefore shifts the interpretation from a direct climate-performance argument to a conditional resilience argument.

6.6.1 Empirical Contribution

The first contribution of the study is empirical. The research provides firm-level evidence from an under-researched Sub-Saharan African context by examining listed manufacturing firms in Zimbabwe over the 2021-2024 period. Much of the existing literature on climate change and firm performance is concentrated in developed economies, large capital markets, carbon-intensive industries or broad ESG settings. This study extends the evidence base by examining the relationship between climate change risk reporting, climate change strategy, leverage, firm size, industry category and three measures of firm performance, namely ROA, ROE and Tobin's Q, in a climate-vulnerable and institutionally constrained economy.

The quantitative evidence shows that climate change risk reporting does not have a statistically robust direct effect on ROA, ROE or Tobin's Q. This contributes to the empirical debate by showing that climate risk reporting should not be assumed to generate immediate financial-performance gains. In this study, CCR functions more as a risk-identification, compliance and legitimacy signal than as an independent short-term performance driver. The qualitative evidence explains this pattern by showing that climate disclosures are shaped by regulatory requirements, ZSE and EMA expectations, stakeholder pressure and legitimacy concerns. Therefore, climate risk reporting is empirically meaningful, but its financial relevance depends on whether disclosure is supported by substantive risk management, governance oversight and implementation capability.

The second empirical contribution is that climate change strategy has greater practical relevance than climate risk reporting, but its direct quantitative effect remains weak and context dependent. CCS is directionally positive for accounting performance in some specifications, particularly ROA and ROE, but the direct effects are not consistently statistically significant. This suggests that climate strategy may not produce immediate accounting profitability within a short time horizon, especially where firms face high implementation costs, limited access to climate finance, energy instability, inflationary pressures and technological constraints. The qualitative findings strengthen this interpretation by showing that firms adopt energy efficiency, renewable energy, biomass energy, cogeneration, regenerative agriculture, biodiversity conservation and supply-chain resilience strategies. These strategies are operationally meaningful, but their benefits are uneven, delayed and resource dependent.

The strongest empirical contribution lies in the moderation evidence. The centred interaction between CCR and CCS is positive and significant for ROA and ROE, especially in lagged models. This indicates that climate strategy conditions the financial consequences of climate risk exposure. Climate risk by itself may reflect exposure to physical, transition, regulatory and operational pressures. However, when climate risk is accompanied by stronger climate strategy, firms appear better able to absorb, manage or reduce the financial consequences of such exposure. This finding provides the central empirical insight of the study: climate strategy does not operate primarily as a direct profitability variable; rather, it functions as a resilience mechanism that helps firms manage climate-related operational and financial stress.

The fourth empirical contribution concerns the distinction between accounting-based and market-based performance. Tobin's Q behaves differently from ROA and ROE. The results indicate that Tobin's Q is more consistently associated with firm size than with CCR, CCS or their interaction. This suggests that market valuation in Zimbabwe's listed manufacturing sector may be shaped more by firm scale, visibility, liquidity, market position and organisational capacity than by climate strategy alone. This finding is important because it shows that accounting-based performance and market-based valuation respond differently to climate-related variables. ROA and ROE appear more sensitive to the operational resilience effects of climate strategy, while Tobin's Q appears more strongly linked to structural firm characteristics.

6.6.2 Theoretical Contribution

The study makes a theoretical contribution by demonstrating that no single theory fully explains the climate change-firm performance relationship in Zimbabwe's manufacturing sector. Instead, the findings require an integrated theoretical explanation drawing on institutional theory, legitimacy theory, stakeholder theory and the resource-based view.

Institutional theory explains why firms disclose climate risks and adopt climate-related strategies in response to regulatory and coercive pressures. The qualitative evidence shows that firms are influenced by environmental regulation, ZSE sustainability expectations, EMA requirements and broader institutional pressure. However, the weak direct quantitative effect of CCR indicates that institutional compliance does not automatically translate into financial performance. This extends institutional theory by showing that compliance may produce visibility, conformity and accountability, but not necessarily short-term profitability.

Legitimacy theory explains why firms disclose climate-related information even when the direct financial benefits are not statistically evident. The findings suggest that climate disclosure helps firms maintain regulatory acceptance, investor confidence, stakeholder approval and social licence to operate. However, the qualitative evidence also raises concerns about symbolic compliance and greenwashing, particularly where disclosures are not supported by assurance, measurable implementation or clear performance indicators. The study therefore distinguishes between disclosure-based legitimacy and implementation-based legitimacy. Disclosure may help firms appear responsive, but substantive legitimacy requires credible governance, measurable strategy and operational evidence.

Stakeholder theory explains why firms respond to pressure from regulators, investors, communities, customers, suppliers and industry bodies. The qualitative findings show that firms' climate responses are shaped by stakeholder expectations, supply-chain relationships, community pressures and investor demands. However, the quantitative findings suggest that stakeholder-facing disclosure and strategy are not automatically reflected in market valuation. This qualifies stakeholder theory by showing that stakeholder pressure may encourage climate action, but financial outcomes depend on whether firms can convert stakeholder engagement into operational efficiency, resilience and credible performance improvement.

The resource-based view provides the strongest explanation for the moderation result. The study shows that climate strategy becomes financially relevant where firms possess the resources, governance systems, technologies, managerial awareness and implementation capacity to convert climate risk exposure into adaptive resilience. Larger and better-resourced firms are more capable of investing in energy alternatives, strengthening supply chains, improving reporting systems and embedding climate strategy into operations. Smaller or resource-constrained firms are more likely to remain at the level of minimum compliance. The study therefore extends RBV by showing that climate strategy operates as a firm-specific capability whose value depends on implementation depth and organisational capacity.

The study's theoretical contribution is therefore integrative. Institutional theory explains why firms are pressured to act; legitimacy theory explains why they disclose; stakeholder theory explains whose expectations shape climate responses; and RBV explains why only capable firms convert climate strategy into resilience and performance. The central theoretical contribution is the conditional resilience argument: climate strategy moderates the financial consequences of climate risk where firms possess sufficient governance and resource capacity.

6.6.3 Practical Contribution

The study makes a practical contribution by showing that climate risk reporting alone is insufficient. Manufacturing firms should not treat disclosure as an end. The findings show that disclosure becomes meaningful only when it is connected to measurable climate strategy, operational implementation, governance oversight and performance monitoring.

For management teams, the study provides a basis for integrating climate risk into enterprise risk management, capital budgeting, supply-chain planning, energy strategy and management accounting systems. Climate strategy should be treated as a resilience investment rather than merely a compliance exercise. Although some strategies may increase costs in the short term, they may reduce production downtime, energy dependence, raw-material vulnerability, regulatory exposure and reputational risk over time.

For regulators, policymakers and assurance providers, the study shows the need to move from disclosure compliance to disclosure credibility. Climate reporting should be supported by measurable indicators, sector-specific guidance and assurance mechanisms. The study's framework and matrix provide a practical tool for assessing whether climate disclosures are supported by governance capacity, strategic response, operational implementation and evidence of resilience outcomes.

6.7 RECOMMENDATIONS

Based on the integrated quantitative and qualitative findings, the study advances recommendations for manufacturing company management teams, policymakers and regulators. These recommendations are grounded in the central conclusion that climate strategy does not operate as an automatic direct driver of financial performance, but as a conditional resilience capability that shapes how firms manage climate-risk exposure. Accordingly, the recommendations focus on strengthening climate governance, improving disclosure credibility, embedding climate risk into management accounting and enterprise risk systems, creating an enabling regulatory and financing environment for substantive climate action.

6.7.1 Recommendations for Manufacturing Company management Teams

Manufacturing company management teams should move beyond symbolic climate disclosure and embed climate risk into corporate strategy, enterprise risk management and performance measurement systems. Boards should assign clear responsibility for climate oversight and ensure that climate risks are included in risk registers, internal controls, capital budgeting and performance dashboards.

Firms should prioritise climate strategies that directly reduce operational vulnerability. These include energy efficiency, renewable-energy options where feasible, water-use efficiency, supplier diversification, climate-resilient procurement, drought contingency planning and supply-chain resilience measures. These actions are especially important because the findings show that climate strategy has greater value when firms face material climate risk.

Management teams should also improve the credibility of climate disclosures by reporting measurable targets, implementation evidence, year-on-year progress and performance outcomes. Where possible, climate-related disclosures should be reviewed through internal audit or third-party assurance to reduce greenwashing risk. Firms should also develop climate-finance-ready projects supported by financial models, risk assessments and measurable outcomes.

6.7.2 Recommendations for Policymakers and Regulators

Policymakers should strengthen national climate-related disclosure guidelines for listed manufacturing firms. These guidelines should be aligned with international good practice but adapted to Zimbabwe's manufacturing context, with specific attention to energy use, water stress, emissions exposure, climate adaptation, governance oversight and measurable performance indicators.

Regulators should move beyond disclosure compliance and promote disclosure credibility. This requires clearer reporting templates, sector-specific metrics and gradual movement toward third-party assurance of climate-related information. Such measures would improve comparability, reduce symbolic reporting and strengthen investor confidence.

Policymakers should also address implementation constraints by supporting climate-resilient manufacturing investment. This may include tax incentives, concessional loans, green finance facilities, import-duty relief for clean technologies and public-private partnerships in renewable energy and industrial resilience. A predictable and coherent policy environment is necessary if firms are to invest confidently in long-term climate adaptation.

6.8 LIMITATIONS OF THE STUDY

The study is limited by its small quantitative sample of 13 listed manufacturing firms observed over four years, producing 52 firm-year observations. Although this reflects the available listed manufacturing population after applying the study criteria, the small panel limits statistical power and requires cautious interpretation of non-significant findings.

The study period, 2021-2024, is also relatively short. Climate strategies may require longer time horizons before their financial effects become visible. The one-year lagged analysis improves temporal ordering, but longer lag structures could not be tested adequately because of the limited time series.

The study also relies on disclosure-based CCR and CCS scores. These scores measure reported climate risk and strategy, not necessarily actual emissions reduction, adaptation effectiveness or operational resilience. Firms with stronger reporting systems may score highly even where implementation is partial, while firms undertaking practical actions may under-report them.

A further limitation is the possibility of symbolic disclosure or greenwashing. Without third-party assurance, it is difficult to determine whether all climate disclosures reflect substantive implementation. This limitation is partly addressed through qualitative triangulation, but it remains an important constraint.

The broader Zimbabwean macroeconomic environment also presents a limitation. Inflation, currency instability, power shortages and policy uncertainty may affect ROA, ROE and Tobin's Q independently of climate variables. Finally, the findings are limited to listed manufacturing firms and should not be generalised automatically to unlisted firms, other sectors or other countries.

6.9 AREAS FOR FUTURE STUDY

Future research should extend the study period to capture longer-term climate-performance effects and allow two-year or three-year lag structures. A longer panel would improve statistical power and provide stronger evidence on whether climate strategy generates delayed financial benefits.

Future studies should include unlisted manufacturing firms to determine whether listed firms differ from non-listed firms in climate disclosure, governance capacity and strategic implementation.

Future research should use item-level climate disclosure and strategy data. This would allow more rigorous reliability testing of CCR and CCS constructs and help distinguish symbolic disclosure from substantive implementation.

Future studies should incorporate direct environmental performance measures, such as emissions intensity, energy intensity, renewable-energy share, water use, waste reduction, climate-related capital expenditure and verified adaptation investment.
Further research should also examine the relationship between climate strategy and cost of capital. This would help determine whether investors and lenders price climate governance, disclosure credibility and adaptation capacity into financing decisions.
Finally, future studies should examine the role of assurance and climate finance in strengthening climate strategy implementation. These areas are important because the current study identified disclosure credibility and financial constraints as key barriers to effective climate action.

6.10 CHAPTER CONCLUSION

This chapter synthesised the conclusions, contributions, recommendations, limitations and future research directions arising from the study. The integrated evidence shows that climate change is a material governance, operational and financial concern for Zimbabwean listed manufacturing firms. However, the relationship between climate change and firm performance is complex, conditional and context dependent. The quantitative findings show weak direct effects for CCR and CCS, but stronger evidence where climate strategy interacts with climate risk to explain ROA and ROE. The qualitative findings explain this pattern by showing that climate risk reporting is shaped by regulatory compliance and legitimacy pressures, while climate strategy reflects operational responses to energy insecurity, raw-material vulnerability, supply-chain disruption, policy pressure and resource constraints.

The core conclusion is that climate strategy does not automatically improve firm performance. Rather, it shapes whether climate risk exposure becomes financially damaging or manageable. Where firms have stronger governance systems, strategic capability and implementation resources, climate risk can be better absorbed and managed. Where such capabilities are weak, climate risk is more likely to translate into operational disruption and financial pressure.

The study contributes empirically by providing evidence from Zimbabwe's listed manufacturing sector, theoretically by integrating institutional theory, legitimacy theory, stakeholder theory and RBV, and practically by offering guidance for management, policymakers, regulators and assurance providers. Overall, the chapter concludes that climate governance, risk reporting and strategy should be embedded within management accounting, enterprise risk management and resilience planning systems rather than treated as symbolic disclosure practices.

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Appendix A: Quantitative Data Extraction Forms

Quantitative Data Extraction Form [Excel Sheet]

INDEPENDENT VARIABLES	CODES	Indicator Variables
Climate Change Awareness	CA1	Firm provides traning to employess on climate change related issues
CCA	CA2	Firm publishes carbon emissions report in its Annual Financial Statements (AFS)
	CA3	Firm publishes its water usage and management report in the AFS
	CA4	Firm publishes its energy consumption report in the AFS
	CA5	Firm publishes its waste management report in the AFS
Climate Change Risk	CR1	Firm exposed to raw material vulnerability due to extreme weather events
CCR	CR2	Firm operations are vulnerable to clean water scarcity
	CR3	Firm's operations are heavily dependent on fossil energy sources
	CR4	Firm operations have a high enevironmental impact
	CR5	Firm operating in carbon emission regulatory environment
Climate Change Governance	CG1	Firm has implemented carbon capture and storage facilities
CCG	CG2	Firm has implemented energy efficient - cogenetion technology
	CG3	Firm has adopted renewable energy sources in its branches
	CG4	Firm has achieved reduced carbon emission targets
	CG5	Firm publishes comprehensive climate change risks & opporunities reports
	CG6	Firm has a comprehensive climate change mitigation strategy report
DEPENDENT VARIABLES	ROA	Return on Assets
	ROE	Return on Equity
	Tobin's Q	Tobin's Q
CONTROL VARIABLES	LEV	Leverage
	FS	Firm Size
	IT	Indstry Type

CLIMATE CHANGE STRATEGY INDICATORS

Climate Change strategy Factors	CO2 Capture & Storage/Removal	Energy Efficiency	Renewable Energy Adoption	Climate Risk Mgt (CO2 Target)	Climate Disclosure	Comprehensive Climate strategy	Total CCS Score
Company Name	0/1	0/1	0/1	0/1	0/1	0/1	1 to 6
	1						
	0						
Climate Change Strategy Score :	1	limited Awareness					
	2	Basic Understanding					
	3	Developing strategy					
	4	Advanced Strategy					
	6	Leadership and innovation					

	Climate Change Awareness Factors					
	CC employee tarining	C2O emission report	H2O usage report	Energy Consumption Report	Waste management Report	Total Score
Company Name	**0/1**	**0/1**	**0/1**	**0/1**	**0/1**	**1 to 5**

Climate Change Risk Metrics	**Raw material Vulnerability**	**Clean Water Depencency**	**Fossil Energy Exposure**	**Environmmental impact**	**Regulatory Environment**	**Total Risk Score**
Company Name	**0/1**	**0/1**	**0/1**	**0/1**	**0/1**	**1 to 5**
Notes :						
Presence of climate risk factor :		**1**				
Absence ofclimate risk factor :		0				
Agriculture-bases Inputs: climate events affects availability of raw materials						
companies with a high water usage are prone to increased climate-related risks						
Energy sources and usage: Companies relyingbheavily on fossil fuels are morevulnerable to climate-related regulations, price volatility or supply chain disruptions						
Product climate sensitivity: products with a high carbon footprint may face decreasing demand						
Geographical local: exposing the business to climate related events						

Appendix B: Qualitative Data Extraction Form

Climate change and firm performance: Evidence from listed manufacturing companies in Zimbabwe

Qualitative Data Extraction Form

BY
Bonyongwe Moses

UNIVERSITY OF SOUTH AFRICA

Question 1: How do climate change governance mechanisms mitigate climate-related financial risks, and what lessons can be drawn from industry best practices?

1.What topics are covered in the entity's sustainability report, and what factors shape the entity's approach to sustainability reporting?

2.Is there recognition of climate-related risks and opportunities in the entity's sustainability report?

3.Has the entity raised awareness about climate change risks among its employees and the broader community?

4.What extreme weather events have impacted manufacturing companies in Zimbabwe over the past four years, and what were the effects of these events on those manufacturing companies?

5.Do companies establish any targets related to carbon emissions?

6.Do manufacturing companies integrate climate risk into their overall ERM strategy, and if so, in which specific areas? Annexure D

Thematic Map for Research Question 2: What climate change mitigation and adaptation strategies enhance firm performance, resilience, and sustainability in Zimbabwean manufacturing?

1.What is the company's main driver for adopting climate change mitigation strategies?
2.What strategies have the entities employed to mitigate carbon emissions?
3.Have these strategies been effective?
4.What opportunities have been created by climate change risks?
5.Is there evidence to show that climate change strategies impacted the flow of Capital into the organisation and the cost of capital?
6.What challenges did the organisation face in implementing climate change mitigation strategies?
7.How do companies mitigate these challenges?
8.Did climate change mitigation present businesses with an opportunity in their operations?
Thematic Map for Research Question 3. "How do internal and external factors intersect to constrain climate change adaptation, influencing firm resilience, sustainability, and financial performance? (Cost v public policy)",
1.What are the emissions categories associated with the Environmental Management Agency (EMA)
2.What government climate-related policies have influenced how companies operate?
3.How has compliance with national and international environmental regulations influenced the company's operational practices and costs?
4.What are the customer responses to companies implementing climate change policies?
5.In what ways do government policies incentivise manufacturing firms to integrate climate change resilience strategies into their operations?
6.How do industry's view and respond to government and international policies on climate change within their business operations?
7.How have climate change policies influenced changes in industry operations?

Appendix C : Ethical Clearance certificate

College of Accounting Sciences_RERC

NHREC Registration # : (if applicable)
Ref #: 5460
Name: Mr Moses bonyongwe
Student #: 43219357
Staff #:

Date: 07/03/2025

Dear: Mr Moses bonyongwe

Decision: Ethics Approval from 9 October 2024 to 8 October 2027

Researcher: Mr Moses Bonyongwe

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Supervisor: Dr Timothy Aluko ealukot@unisa.ac.za

Co-Supervisor:

Co-Researcher(s):

Email address:

Climate change and firm performance: Evidence from listed manufacturing companies in Zimbabwe

Qualification: PhD management accounting

Thank you for the application for research ethics clearance by the College of Accounting Sciences_RERC for the above mentioned research study Ethics approval is granted for three years.

The **negligible risk application** was **reviewed** by College of Accounting Sciences_RERC on 9 October 2024 in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the College of Accounting Sciences_RERC .
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.

Appendix D: Authority to Submit

UNISA | university of south africa

0902 MDLINK

BONYONGWE M MR
18 J NKOMO ROAD
BRAESIDE
HARARE
ZIMBABWE

STUDENT NUMBER : 4321-935-7

ENQUIRIES NAME : ZINHLE PRUDENCE DLADLA
ENQUIRIES TEL :

DATE : 2025-09-12

Dear Student

With reference to previous correspondence, I have pleasure in informing you that your supervisor has consented to your submitting the research component for examination with the following approved title:

Climate change and firm performance: Evidence from listed manufacturing companies in Zimbabwe

Please note that if you submit with a different title than the approved title the examination process will be delayed with at least 3 weeks, as the new title will first have to be approved.

Please make sure that the copy you submit is the final copy and not a draft. The final copy may not contain comments or editorial marks.

For purposes of examination, please submit the electronic copy of your research component in .pdf format as well as word format to the following link: https://mylifeunisaac.sharepoint.com/sites/StudentSubmissions. Please note that you will have to wait for access on the above link before submitting, and that access is not immediate, it will only take place during office hours.

Please visit the link https://sway.office.com/Gq1gqO2rqAbtzC1o for guidelines on the submission process.

Regarding submission dates the following rules apply:

. If submission takes place after 15 June, the successful student might only graduate in Autumn of the following year.
. If submission takes place after 15 November, the successful student might only graduate in Spring of the following year.
. If submission takes place after the end of February, the successful student will graduate in Spring, and will have to re-register and pay the full tuition fees.
. Please note that if you are not registered for the current academic year, you will have to re register before you may submit.

Please note that, after the examination has been completed and after any corrections that the examiners might request have been affected, a student must, before the degree can be awarded, submit the corrected copy in electronic format to his/her supervisor for uploading to the Unisa Institutional Repository.

Yours faithfully,

Prof MM Sepota
Acting Registrar

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